STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO

23 April 1985

COMMISSION HEARING

IN THE MATTER OF:

The hearing called by the Oil Conservation Commission on its own motion to define the vertical and areal extent of aquifers potentially vulnerable to contamination by the surface disposition of water produced in conjunction with the production of oil and gas in McKinley, Rio Arriba, Sandoval and San Juan Counties, New Mexico. CASE 8224

BEFORE: Richard L. Stamets, Chairman
Commissioner Ed Kelley

TRANSCRIPT OF HEARING

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(Thereafter at the hour of 8:30 o'clock a.m. on the 23rd day of April, 1985, the hearing was reconvened at which time the following proceedings were had, to-wit:)

MR. STAMETS: The hearing will please come to order.

Mr. Kellahin, do you have any further witnesses?

MR. KELLAHIN: Yes, Mr. Chairman, at this time we'll call Mr. Al Kendrick.

Mr. Chairman, Mr. Kendrick's exhibits are marked One through Thirteen. The original marked set has been placed before you. Copies have circulated to all counsel, I believe.

I have got two sets left is anyone cares to share those.

A. R. KENDRICK,

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Mr. Kendrick, for the record would you please state your name and occupation?

A A. R. Kendrick, petroleum consultant.

Q Mr. Kendrick, would you describe for the record your educational background in the field of oil and gas engineering?

A Graduated from Texas Tech with a Bachelor of Science in petroleum engineering with a geology minor.

Q In what year was that, sir?

A 1951.

Q Subsequent to graduation in 1951 would you describe for us what has been your work experience in the field of oil and gas petroleum engineering?

A After graduation and until July the 1st of 1955 I worked as a mudlogging engineer for a consulting firm out of Ft. Worth.

July the 1st, 1955, I went to work for the State of New Mexico in the Oil Conservation Division Office in Aztec as the District Engineer.

Q I'm sorry, what was that date again?

A July 1, 1955.

Q Thank you. What period of time were you the District Supervisor for the Oil Conservation Division in Aztec, commencing in '55?

A I was not supervisor in 1955; was the engineer in 1955.

I was promoted to Supervisor in 1975 and retired at the end of January, 1980.

Q Would you describe for the record briefly

what your duties were at the Oil Conservation Division Office in Aztec?

A To help to supervise the development of the rules and regulations and to see that the operating companies abided by those rules and regulations.

Q Subsequent to retiring from the Oil Conservation Division, Mr. Kendrick, have you continued to be employed in some capacity in the oil and gas industry in the San Juan Basin?

A Yes, sir. I've been consulting for a number of companies in the San Juan Basin.

Q You're appearing today on behalf of what company or what organization, Mr. Kendrick?

A Four Corners Gas Producers Association. It's a composition of more than sixty of the smaller producing individuals or companies in the San Juan Basin.

Q With regards to your employment by that association, Mr. Kendrick, have you made a study of certain of the issues with regards to the disposal of produced water into unlined surface pits in the vulnerable area of the San Juan Basin?

A Yes, sir.

MR. KELLAHIN: Mr. Chairman, we tender at this time Mr. Al Kendrick as an expert petroleum engineer.

MR. STAMETS: He is considered qualified.

Q Mr. Kendrick, I'd like to direct your attention first of all to the issue that has been discussed here on various occasions during the course of this hearing about the potential for the Manana Mary Wheeler Gas Well in the Flora Vista area of the San Juan Basin to be a potential source of hydrocarbon contamination to the groundwater in that area.

With regards to that issue, sir, have you made a study of the facts as you have found them for this well?

A Yes, sir.

Q Let me direct your attention to what is marked as your Exhibit Number One, sir, and have you identify that for us.

A Exhibit Number One is a portion of the USGS Quadrangle for Flora Vista, New Mexico. The scale is about two inches per mile. The squares on there represent sections and from left to right I have identified the following points by color code.

Identified toward the left is a black dot in the southeast quarter of Section 29.

Q That's on the far left bottom corner of the plat, is a black dot?

A Yes, sir.

Q All right, sir, and that represents what?

A That represents the B.M.N.S. Wyper No. 1 well.

Q All right, sir, what type of well is that?

A That was a Farmington oil well.

Q All right, sir, and then as we move from left to right on the plat?

A The green dot represents the J. Glenn Turner Osborn No. 1 Well in the southwest quarter of Section 22.

Q And what kind of well are we looking at there?

A The Osborn No. 1 Well was the discovery well in the Flora Vista Meseaverde Pool.

It's a Mesaverde gas well.

Q And as we continue from left to right on the plat we see an area that's identified by a blue shaded area and --

A The last --

Q -- a blue well dot.

A That blue area represents the area where the Flora Vista Water Users Association have their water wells.

Q All right, sir, and what is the blue dot?

A The dark blue dot represents one of the water wells that casing is capped in that area.

Q All right, sir, and the red dot?

A The red dot represents the Manana Gas Company Mary Wheeler No. 1-E Well --

Q Okay.

A -- in the southwest quarter of Section 23.

Q And then finally the yellow dot.

A The yellow dot represents the Monsanto Chemical Company NWP Unit Well No. 1.

Q And what kind of well is that?

A That was a Dakota-Mesaverde dual completed gas well, which has now been plugged.

MR. STAMETS: Mr. Kellahin, I'm not sure that I've got the yellow dot on mine. What's the location?

A Southwest quarter of Section 23.

MR. KELLAHIN: Yes, sir.

MR. STAMETS: We should have a total of five colored wells on there?

A Yes, sir.

Q What's the purpose of this exhibit, Mr. Kendrick?

A This is to show the concentration of the area and I wish to make some remarks about each of these items in my testimony.

Q All right. Let's turn to Exhibit Number Two, if you please, and have you identify and describe that exhibit.

A Exhibit Number Two is a portion of Plate I from the USGS Professional Paper 676 by James E. Fassett

and Jim S. Hinds. That paper is entitled "Geology and Fuel Resources of the Fruitland Formation and Kirtland Shale of the San Juan Basin, New Mexico and Colorado."

The squares on this plat represent townships. Township 30 North, Range 12 West, which is the area of interest in my testimony, is located between Farmington and Aztec.

The Ojo Alamo outcrop shown on this map is designated by the symbol Toa and is shown as a cross hatched or diagonally striped pattern in the southwest portion of Township 30 North, Range 12 West.

The bluff, or steeply dipping formation on the south side of the Animas River in the northeast quarter of Section 27 and the northwest quarter of Section 26, shown on Exhibit One, is a bluff and that is the Ojo Alamo sandstone bluff on the south edge of the San Juan River.

Water from this Ojo Alamo formation is identified in the publications as containing sulfates to the south and west of Farmington.

The Ojo Alamo outcrops on the west and south and east edges of the San Juan Basin. It does not outcrop on the north edge of the Basin, so that the low points in the Ojo Alamo outcrop are along the Animas and San Juan River Valleys. Any percolation into the Ojo Alamo formation can only flush that portion that's higher than the outcrops in those valleys because there is no outlet to the north. The further north we go, the worse the water quality

in the Ojo Alamo formation.

Q For purposes of identifying the Manana Mary Wheeler Well in relation to the Flora Vista water wells in this area, what significance is the information contained on Exhibit Number Two and what opinion do you draw from this information?

A The Ojo Alamo outcrops and possibly exists underneath the vallley fill where the Mary Wheeler No. 1-E Well is drilled.

Q What is the significance to an operator such as Manana in terms of drilling a well such as the Manana gas well through this Farmington sandstone deposit?

A The Farmington Sandstone would be in the Kirtland Shale immediately below the Ojo Alamo and penetration into the Kirtland Shale would subject the driller's drilling into the Farmington Sandstone in this proximity.

The Farmington Sandstones are lenses or sand bars in a deltaic type deposit and possibly contain oil, gas, water, or any combination or nothing.

So any penetration below the Ojo Alamo formation might subject the driller of encountering the Farmington Sandstone.

Q All right, sir, let's turn to Exhibit Number Three, Mr. Kendrick, and have you identify and describe this exhibit.

A Exhibit Number Three is a history of the Wyper Farmington Oil Pool as presented in the Four Corners

Geological Society publication, Oil and Gas Fields of the Four Corners Area - Volume III.

This oil well was identified on Exhibit One with the black dot in the southwest quarter -- excuse me, southeast quarter of Section 29.

This oil well was not a prolific producer, however, it was located about one mile south and three miles west of the Flora Vista Water Users Association's water wells.

Q This is the well that's identified on Exhibit Number One as the black dot.

A Yes, sir.

Q All right, sir.

A The significance of the outcrop map shown on Exhibit Two and of this history is to show that the Farmington Sandstone does exist in this proximity.

Q All right, sir, let's go to Exhibit Number Four.

A Exhibit Number Four is the tabulation of information I know from my own knowledge from having been associated with the J. Glenn Turner Osborn No. 1 being drilled in 1961. It's identified by the green dot in the southwest quarter of Section 22. It's about one mile west of the Flora Vista Water Users' wells.

While the drilling contractor was out of the hole to change bits, this well experienced a blowout during the drilling operations. The total depth of the well

at that time was into the Mesaverde formation and thus the Flora Vista Mesaverde Gas Pool was discovered.

After the blowout was under control I visited with the gentleman named McCoy, who lived in the northeast quarter of Section 28.

Q When was this, Mr. Kendrick?

A In 1961.

Q And at that point why would you visit that site? What was your employment?

A I was with the Oil Conservation Division and was investigating some reports of gas blowouts in the area during the time that the well had blown out.

Q With regards to this well and the report of a blowout, what did your investigation show you?

A When I talked with Mr. McCoy he told me that the cold weather had caused the frost crust on the earth and the gas that broke through to the surface would raise up bubbles of the sod to elevations that he depicted to be 1-1/2 to 2 feet above the normal level of the swampy area where his pasture was, and this frozen sod would rupture and the gas would vent to the atmosphere.

So that gas did break to the surface from this gas blowout and could possibly have contaminated several water sands or, excuse me, gravel, river gravels or sandbars in the river valley and left some entrapped gas that could possibly have lead to gas being present at the Flora Vista water wells.

Q Did you visit the site of the McCoy Ranch and see indications of gas breaking through the surface?

A I did not see the indications of gas breaking through the surface because the crisis had ended at the time that I was there.

Q Did you make an investigation to determine the extent at which the gas migrated in the shallow soil areas beyond this immediate vicinity?

A No, sir. The crisis had ended and the valley did not become ignited that night so I didn't pursue it further.

Q You said the crisis was ended. How was the difficulty remedied or how was accident prevented at this well?

A The blowout was brought under control and the source of the gas ceased and therefore the blowout in the area had ceased.

Q What conclusion do you draw, Mr. Kendrick, from the information that you have compiled in terms of this incident at the Osborn Well?

A That this is a possible source for natural gas that might have occurred at the Flora Vista water well.

Q All right, sir. Let's direct your attention now to Exhibit Number Five.

A Exhibit Number Five is a four-page exhibit. It relates to the Monsanto Chemical Company NWP Unit

Well No. 1, located in the southwest quarter of Section 23 and identified by the orange dot on Exhibit One.

Q This information consists of correspondence between you and what operator or individuals?

A I corresponded with Mr. J. T. Reagan of the Monsanto Chemical Company in 1961 directing him to cause a pit to be lined for the disposal of 50 to 100 barrels of produced water per day, because this well was adjacent to the Animas River and this was the only way to protect the quality of water in the Animas River, was to require that that pit be lined.

Q We're looking now for Exhibit Number Five at the well dot on Exhibit One that's identified with a yellow dot?

A Yes.

Q While you were involved with the Oil Conservation Division in Aztec, Mr. Kendrick, would you describe for us what was the practice and policy of the District with regards to potential groundwater contamnation by oil and gas operations?

A Our policy at that time and prior to that time was to attempt to protect the water from any contamination from any source created by the oil industry.

Q What is the significance for this hearing of the information contained on Exhibit Number Five and the correspondence between you on behalf of the Division and Monsanto Chemical Company?

A The first two pages of this letter exchange is to show we were interested in protecting the quality of the water in the river by requiring a lined pit to contain the produced salt water.

Q Why had you reached the conclusion that it was necessary to protect the groundwater from the produced water from this well?

A By an oral conversation with Mr. Reagan that the water had the quality of about 80,000 parts per million total solids.

Q All right, sir, and what action was taken with regards to this well?

A This well produced for several more years. Then in about 1976 there is the last two pages of this exhibit shows that an exchange of information between me and the operator of the well.

Charles Gholson, who is the field man for the District advised me that the well was producing in surges through an opening in the wellhead, which meant that the well had been temporarily abandoned but the well flowing gas in surges indicated the possibility of water in the wellbore.

So I wrote the operator and asked them to either repair the well or plug it.

The last page of the report is the subsequent report of plugging, so they did abandon the well and plug it to prevent casing failure or further contamination,

if any existed.

Q In terms of the relationship of this Monsanto well to the Flora Vista water wells, is there any significance to draw from the relationship?

A The Monsanto Well was upstream about some 1700 feet from the -- from the Manana Gas Mary Wheeler No. 1-E Well. If there were a casing failure in the Monsanto Chemical Well to cause it to fail to produce or to cease to produce, a casing leak in this well could have charged the river sands or provided a source of contamination for the -- Flora Vista water well.

Q All right, sir, let me direct your attention to Exhibit Number Six, Mr. Kendrick, and have you identify this exhibit.

A Exhibit Number Six is a memorandum I recently picked up in Frank Chavez' office.

This memorandum was issued February the 13th, 1961, and it's entitled "Stream Contamination."

This memorandum was issued within a month of the blowout of the Osborn Well but it did not mention blowouts. It mentioned produced oil, excuse me, this mentions drilling fluids and cautioned the operating company to see that the drilling contractors confine their drilling fluids to prevent water contamination.

At about the same time this memorandum was issued our office was in the policy of having our summer help to cruise the river valley areas to insure that all the

tanks had firewalls around them to contain any spills and keep the spills from reaching the irrigation canals or the rivers.

Q Let me direct your attention now, Mr. Kendrick, to your Exhibit Number Seven.

A Exhibit Number Seven is an enlargement of the southwest quarter of Section 23, as shown on Exhibit One. I drew this by hand and tried to scale this up to give a little more clarification of the area in the Flora Vista Water Users water well area to let us look at that situation a little closer.

Q All right, sir, would you orient us to the plat attached to Exhibit Number Seven and again identify for us what is indicated by each of the color coded dots?

A The color code is the same as on Exhibit One.

The yellow in the northeast quarter of this plat is the Monsanto Well.

The red dot is the Mary Wheeler Well.

The light blue dots reflect the Flora Vista Water Users' water wells.

And the dark blue dot reflects the capped well at Flora Vista.

Q Have you made an investigation and study of the circumstances surrounding the drilling of the Mary Wheeler Well?

A Yes, sir.

Q Would you turn now to Exhibit Number Eight?

A Exhibit Number Eight relates to the Mary Wheeler No. 1-E Well. It's located 892 feet from the south line and 624 feet from the west line of Section 23.

It was spud January the 28th, 1980.

I have attached letters from Mr. Curtis J. Little and Mr. Ed Hartman that indicate that natural gas was present during the drilling of this well before surface casing was set at 225 feet.

This indicates to me that natural gas was present in the river valley fill before the gas well was spud. In my opinion the alluvium was charged before the gas well was spud.

I might quote from Mr. Little's letter, a quote he has from his daily drilling report, which said, show of gas outside casing. Stopped when cement circulated. Pressure tested 500 pounds okay.

Q With regards to your investigation of the circumstances surrounding the Flora Vista water wells and the Manana gas well, have you made an attempt to determine the relative location of the various Flora Vista water wells to the Manana gas well.

A Yes, sir.

Q Let's turn your attention now, sir, to the Exhibit Number Nine and to the plat that's attached to Exhibit Number Nine.

A The plat is not attached to Exhibit Number Nine but in most cases it was submitted with the packet of --

Q First of all, start with --

A -- information.

Q -- the plat and identify it so that we know what you're looking at when you start discussing it.

If you'll start, sir, in the upper right-hand corner where it says "Mary Wheeler 1-E", that is the location of the Manana Mary Wheeler Gas Well?

A That is the approximate location of the gas well.

Q All right, sir, and the pit is what pit?

A Represents the green fiberglass pit in the fenced area at the separators on the Mary Wheeler 1-E location.

Q And as we move to the south and west would you identify for us a line above which is written the numbers 112, and as we move to the southwest begin to identify for us what the significance is of the dots?

A The black line that runs from the south corner of the pit to the southwest was started on the southwesternmost end.

I was curious about the footages between some of the wells and drove down through there and the roadway drives past the black dot in the center of the page with a "W" under it and some slash marks through the dot. That's

the abandoned water well of the Flora Vista Water Well Users Group, or excuse me, the contaminated well.

The roadway proceeds rather straight to the southwest and I went on down to where I thought I was even with the black dot in the lower lefthand corner with a "W" under it. That is a producing water well for the Flora Vista Water Users Association.

It was producing on March the 27th when we had a field inspection up there. It was producing last week when I was there.

I assumed I had turned a right angle corner from that road and I measured a distance shown as 48 feet below that line. That's the distance from my position at the edge of the road to the water well.

I then measured 49 feet from wellbore to wellbore from the capped well to that water well.

Then I went back to the road --

Q Identify the capped well for us now so we're not lost.

A All right, the capped well is the black dot to the northeast of the producing water well in the lower lefthand corner of the plat. The capped well is the dot with the plus sign through it.

Q That is a capped water well?

A Yes, that is a capped well drilled by the Flora Vista Water Users Association.

I went back to the roadway and with a

steel tape measured along the roadway and at the point each time I thought I was about at right angles to a point of interest I marked the ground and measured between those so that 50 feet from the starting point I thought I was even with the capped water well. I measured 54 feet back to the water well and then 41 feet further on I was even with Mr. Boyer's Monitor Well No. 2, which was about 21 feet from the edge of the roadway.

68 feet further up the roadway, about 23 feet off to the side was Mr. Boyer's Monitor Well No. 1.

Then about 122 feet up to the abandoned well. 27 feet further northeast and then turn back to the northwest about 35 feet to Mr. Boyer's Monitor Well No. 3.

83 feet further I turned to the right 27 feet to Mr. Boyer's Well No. 5 and then about 112 feet more to the pit.

I did not attempt to measure to Mr. Boyer's Well No. 4 because it was out through some vegetation and I could not determine its exact location.

When I plotted these from these numbers and drew the line from the water well in the lower lefthand corner to the water well that has been contaminated, that is the red line along there.

Q I want to make sure I know which one is the water well that has evidence of contamination.

A It's the one in the center of the page with the "W" and the slashed line from top to bottom through

the well.

Q All right, sir, have you examined the surface at that location where the contaminated water well is?

A Yes, sir. The contaminated water well has a concrete slab poured around it. After they abandoned the well they did not put a cap on the well or cover it. It's standing with the casing open.

Q Can you see the casing?

A Yes, sir, the casing protrudes about six inches above the concrete.

Q Have you made a visual inspection of the casing?

A Yes, sir. I was quite surprised last week when I looked in the hole to estimate the depth to the water, when I noticed there is a hole in the side of that casing about four feet down that's at least four feet -- excuse me, at least four inches in diameter in the southwest wall of that casing.

I was kind of surprised to find a perforation that shallow in a water well when the water level was so much lower than that.

Q And could you make an approximation of the water level in that well?

A The depth to water in the well was between four and five feet.

Q Based upon your study of this informa-

tion, Mr. Kendrick, can you give us the sequence or the chronology in which these various wells were drilled?

A I talked to Richard Thurston of the Flora Vista Water Users Association and I talked to Frank Chavez about this capped well.

Mr. Thurston told me that that was the first well that the Flora Vista Water Users Association Group drilled in that area.

Q Which one, the contaminated --

A No, sir, the --

Q -- water well?

A -- capped well down in the lower lefthand corner with the plus sign through it.

Q All right, that's the first one drilled. What's the next one drilled?

A I'm not sure what the sequence of their other wells were.

Q All right.

A But this well was drilled to a depth of 23 feet and abandoned because they had drilled into gooey clay and stinking water, according to Mr. Thurston.

MS. PRUETT: Excuse me. Mr. Chairman, I'm going to have to make a hearsay objection to that. Mr. Thurston isn't here and we can't cross examine him as to what exactly was found or why they capped that.

It seems to me the witness is not entirely of what the dates of sequences are and not (not

understood).

MR. KELLAHIN: I make my same response to that objection as I did yesterday, Mr. Chairman.

MR. STAMETS: I think we'll allow the witness to continue to answer these questions. If the answer becomes critical we could always ask for a sworn statement from Mr. Thurston.

In any event, we'll take the evidence for what it's worth.

Q The information that you have derived from Mr. Thurston is the capped water well was the first one --

A Yes, sir.

Q -- drilled?

A Yes, sir.

Q And that well was not placed on production because it was contaminated?

A They elected not to use it because they drilled into gooey clay and stinking water.

Q All right. What is the next well drilled?

A I'm not sure of the sequence of other water wells drilled by the Flora Vista Water Users Association.

But prior to the time the Manana gas well was spud there were three Flora Vista water wells, three wells had been drilled before the gas well had been spud.

Q Mr. Kendrick, if the capped water well, the first one drilled, encounters gooey clay and stinking water, and if that well is drilled prior to the Manana Mary Wheeler gas well, can you draw any conclusions from that sequence of events?

A I can draw the conclusion that the Mary Wheeler definitely did not contaminate the well that was -- that the water users people elected not to use, the one they welded the cap on.

Q Upon what basis do you reach that opinion?

A It was drilled before the other well was drilled and they abandoned it before the other well was drilled.

Q Let me direct your attention, Mr. Kendrick, to what your opinion is with regards to the reasonable probability that the use of the unlined surface pits by the Manana Mary Wheeler Well would be the most likely source of contamination of the Flora Vista wells, based upon what you've studied and learned.

A The first report that I heard orally of the contamination of one of the Flora Vista Water Users Association's wells was that it had natural gas in it.

Then I learned that it was contaminated by the pit, and as I remember from all my training in the petroleum business, gas is lighter than air and air is lighter than water, and if you pour gas and water in a pit,

the gas is going to go up. It's not going to burrow back into the ground and get itself pressurized enough to go into the water.

So I don't believe that the contamination of the water well was done by the pit at the Mary Wheeler Well.

Q Let me turn your attention now, Mr. Kendrick, to Exhibit Number Ten and from the perspective of you as a consultant for the Four Corners Gas Producers Association, can you describe for us what would be the impact upon your membership of an order issued by the Commission that would ban the use of unlined surface pits for produced water and other ancillary unlined pits in the vulnerable area of San Juan Basin?

A The major companies can absorb some extra cost in the operations of some of their wells by spreading the cost of the average of the wells over some of the wells that won't cover.

Small operators cannot do that, especially those who only own a few wells.

The cost of lining and maintaining pits will reduce the ultimate recovery of natural gas from the San Juan Basin by causing early abandonment from the low volume wells.

The ratio of gas and water produced from a well does not reflect on the amount of gas left in the reservoir. The early abandonment of a well can leave a sub-

stantial amount of gas in the ground because we don't know how much gas is left just because a wellbore is producing water.

The highest cost of lining the pits may not be to the producers. It may be to the ultimate consumer who will lose that amount of gas that's left in the ground and it will not be economical to drill for the gas in the future again.

Q Have you had an opportunity yet, Mr. Kendrick, to complete a compilation of the total number of wells that might be impacted that are operated by members of your association in the vulnerable area should the Division ban the use of unlined surface pits?

A No, sir.

Q I'd like to skip over Exhibits Eleven and Twelve at this moment and go to Exhibit Number Thirteen, which is the schematic of the pit site.

Were you present in the earlier hearing in this case, Mr. Kendrick, when Mr. Boyer showed a schematic of pits in relation to oil and gas wells?

A Yes, sir.

Q I show you what is marked as Exhibit Number Thirteen and ask you to identify that exhibit.

A This exhibit is a location plat prepared by the Tenneco Oil Exploration and Production, identified as a typical gas well installation, San Juan Basin, New Mexico.

MR. TAYLOR: Excuse me, Mr.

Chairman, I don't have a copy of that exhibit.

MR. KELLAHIN: Neither do I.

A Let's put it on the --

Q Mr. Kendrick, how many years experience have you had in the oil and gas industry in the San Juan Basin?

A About thirty years.

Q And you have seen Mr. Boyer's drawing of wellbore arrangment and the pit arrangements that he presented earlier?

A Yes, sir.

Q You've had an opportunity to review Exhibit Number Thirteen?

A Yes, sir.

Q Would you describe for us which one more closely typifies the typical gas well in the San Juan Basin in the vulnerable area?

A This Exhibit Number Thirteen would more likely typify a well in the San Juan Basin that produces gas and liquids.

Q In reviewing Mr. Boyer's schematic of the wellbore -- of the well site and the pit arrangements, would you describe for us what he's done in that exhibit?

A Mr. Boyer's exhibit?

Q Yes, sir, in terms of the numbers of pits and their arrangements?

A The exhibit presented by Mr. Boyer de-

tailed every possible pit that one would encounter on a location; not necessarily required on that location but a type of pit for each type that would be designed for a location and including some of the pipeline pits.

Q In your years of experience, Mr. Kendrick, how often would you encounter a well site that had a configuration as shown on Mr. Boyer's schematic?

A I think that this would probably typify more than half the wells --

Q Excuse me, I didn't make myself clear. I asked you in terms of Mr. Boyer's schematic for the pit arrangements for that exhibit how often would you encounter a well site that had that kind of -- that volume of pits and that arrangement of pits?

A I've never seen a well that had that many pits.

Q In terms of Exhibit Number Thirteen would you describe for us what is the well arrangement and the kinds of wells that that would be typical of?

A This would be typical for most Dakota wells, most Mesaverde wells, some other wells, in that the wellhead is shown to the upper left. It shows the flow line to a separator, the separator pit to the north, or top part of the page, electric line to a tank, a pit beside the tank for the water draw, the gas line from the separator to the dehydrator, discharge line from the dehydrator to the water pit, a gas line from the dehydrator to the meter run.

A lot of the locations have the tanks so located so that the tank can be drained into the same pit where the separator discharges, but this configuration would probably match most of the wells, that is more than half of the wells that produce gas and liquids in the San Juan Basin.

Q Exhibit Number Thirteen identifies the separator pit as a separator pit. During the course of the hearing we've talked about a produced water pit. Which of the pits indicated on Exhibit Number Thirteen would be the produced water pit?

A The separator pit.

Q Were you present at the earlier hearing when there was testimony about the Duncan Oil Field and the fact that the oil well, the Duncan Well 6-11, had a separator that was buried in the ground?

A Yes, sir.

Q How often do you see a separator at an oil well buried below the ground?

A Very, very seldom.

Q Would that be a typical utilization of the separator and the oil well in the vulnerable area?

A No, sir.

Q With regards to the arrangement of the pits at the typical gas well installation, Mr. Kendrick, is it -- is it reasonably possible or is it accepted standard practice to attempt to arrange the pits so that you use one

pit at a site as opposed to the three you've depicted here?

A No, sir. Traditionally the separator and dehydrator are separated by a sufficient distance that utilization of one pit would not be economical.

Q What is the purpose of having the multiple pits as opposed to having a single pit?

A Because the separators and dehydrators quite often contain fireboxes, it is not adviseable to group that equipment around the pit so that one might be discharging gas in the same -- in a direction towards another unit which contained a firebox, and creating a hazard so that the units have been separated sufficiently far apart in an attempt to prevent any fires on locations.

Q Let me direct your attention now, sir, back to Exhibit Number Eleven and to the issue that we have been addressing here at the hearing, and that is whether or not we should continue the use of the unlined pits for volumes of produced water of 5 barrels a day or less.

Do you have any opinions with regards to how to write such an order or the factors that ought to go in such an order, based upon your years of experience not only with the Oil Conservation Division but as a consulting petroleum engineer?

A Yes, sir. I would like to make some points that I think might be utilized in an order requiring the lining of pits.

The first item that I would recommend is

to line pits on an individual basis; not line all pits, but to line pits that need to be lined.

Require lining for pits for wells that produce an excess of 5 barrels per day or more of water.

Allow exceptions when the operator or the owner of the pit demonstrates that the water being discharged into that pit is below 10,000 parts per million total solids.

Require lined pits for wells that produce water less than 5 barrels per day that have a total dissolved solids content equivalent to 5 barrels at 10,000 parts per million, or more.

This would eliminate a lot of paper work of granting exceptions to a required lining order. It would put the burden of proof on the operator of the well, not on the regulatory agencies. It would tend to give some simplicity to the rules in that the regulatory agency of the state could be with the same, similar rule with the Federal government and thereby simplify the regulations for pits and not cause the operators the concern of trying to determine which set of rules which pit has to qualify under.

And if there is ever a question about the volume or quantity or quality of water produced into a pit, ask for a test and witness the test there.

Q One of the issues discussed yesterday afternoon was the possibility of setting up a pit registration mechanism that included having the operators submit various

items of information to the Division.

You've had an opportunity to think about that question. Do you care to make any response about the possibility of a pit registration system?

A One of the remarks we got early on in the organization of the Water Study Committees and the research we've been doing in the committee meetings was that the regulatory agency for the state does not have sufficient personnel or funding to go into a big program to regulate the pits.

When we start a pit registration situation we immediately require people to process the applications and thereby causing a load on the staff of the Oil Conservation Division.

The costs of obtaining samples for all the water produced at the quality that was asked for yesterday would be in the range of several hundred or a thousand dollars per sample to be run.

If we go into a pit registration process and we have a pit on the north side of the location and elect to move it to the south side, it's quite possible we'd have to go through the same expense just to move a pit to the other side of the location because of the required location and water analysis problems.

I think that the cost to the regulatory agency and to the producers would be more than is warranted.

Q Did you participate on behalf of your as-

sociation as a member of the short term Water Study Committee?

A Yes, sir.

Q Based upon your study and knowledge of the San Juan Basin, Mr. Kendrick, have you received information to convince you as an expert that there is a documented case in the San Juan Basin of groundwater contamination by the utilization of unlined surface pits for the disposal of produced water?

A No, sir.

Q What conclusions do you reach based upon yoru study, Mr. Kendrick?

A We have no evidence to date that any water well has been contaminated in the San Juan Basin by the improper disposal of produced water after more than forty or fifty years of production of oil and gas in the San Juan Basin.

There has been some conjecture about the contamination at Flora Vista but I don't think that the people that made that charge considered the facts.

I've shown some examples of what I think are more realistic reasons for the Flora Vista water wells to have been contaminated but as a general rule water produced -- or as the water production of a well increases the gas production decreases and the requirement of lining the pits will hasten the date of abandonment, thereby leaving gas in the ground.

The produced water in the San Juan Basin historically has been of a whole lot better quality than the water produced in the southeast part of New Mexico, where there has been some crisis because of the high total dissolved solids.

In the San Juan Basin that is not the -- the water is not nearly of the poor quality that there is in the southeast and I don't think the restraints in the San Juan Basin should be based on the quality of water produced in the southeastern part of New Mexico.

Q Do you have an opinion, Mr. Kendrick, as to what ought to be done about the practice of allowing produced water to be disposed of in unlined surface pits at rates of 5 barrels a day or less?

A Yes, sir.

Q And what is that opinion?

A I think that the disposal of water in unlined pits should be continued until such time as someone can show to us that a problem has been generated.

Q Are your comments and conclusions set forth on your Exhibit Number Twelve?

A Yes, sir.

MR. KELLAHIN: At this time, Mr. Chairman, we move the introduction of Exhibits One through Thirteen.

MR. STAMETS: Without objection the exhibits will be admitted.

Are there questions of this witness?

Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q Mr. Kendrick, you've been employed as a consultant in the San Juan Basin since your retirement at the Oil Conservation Division.

Were you employed by Manana Gas at the time the Mary Wheeler Well was drilled?

A Yes, sir.

Q Was a fiberglass pit installed there installed to prevent water pollution?

A Yes, sir.

Q Apparently it's worked according to Mr. Hicks' testimony.

A I beg your pardon?

Q According to Mr. Hicks' testimony previously would you say that this pit has functioned and prevented pollution from the produced water from the Mary Wheeler No. 1?

A I don't think I heard that part of Mr. Hicks' testimony that the pit prevented it.

Q Do you think that the pit has prevented pollution, the fiberglass pit?

A I'm not sure that the fiberglass pit prevented pollution because I don't know the quality of water

produced by the well so I don't know whether there was pollution without the pit.

Q You've been personally on the site of the Mary Wheeler No. 1, have you not, sir?

A Yes, sir.

Q Is there any petroleum products in that fiberglass pit?

A Yes, sir.

Q Are there any other fiberglass pits on the Mary Wheeler property?

A Yes, sir.

Q Would you describe them, what they are?

A There is an abandoned pit sitting just to the downstream side of the fenced compound around the liquids tank that is an abandoned pit that was used in the same position as where the present fiberglass lined pit is installed.

Q Is there also a fiberglass pit or tank at the tank drain at that location?

A I'm not sure.

Q Are there any other fiberglass pits to your knowledge and belief on any other well in the vulnerable area?

A I don't recall having seen one. I don't -- I don't personally know of another fiberglass lined pit in the San Juan Basin.

I've heard that they've been installed

but I have not seen another fiberglass lined pit.

Q Well, if I could stimulate your recollection, in the Cedar Hill area where Amoco has production on the McCoy Well, do recall if fiberglass pits have been installed there along the river?

A I have not seen them. I don't know of them.

Q Mr. Kendrick, has any pit, produced water pit, to your knowledge every introduced any petroleum products as in benzene or even crude oil from the pit into the ground, such as in the El Paso Lindsay "A" No. 1 Well along the San Juan River or from any pit in the Cedar Hill area?

A I don't know of -- about any benzene contamination. I have no equipment to test it. I have no experience with that.

There was some liquids in a sandbar next to an irrigation canal in the proximity of the Lindsay or Archuleta Well along the San Juan River but I don't know that it came from the pit or whether it came from a tank.

Q What was the distance those products traveled from either the pit or the tank to that sandbar?

A If it traveled from the tank, it was sitting on the sandbar. The distance would have been two or three feet vertical and maybe as much as 50 feet laterally underneath in the gravel bar.

Q And from the pit?

A There was no pit as far as I know under

that tank.

Q At that time did you direct the operator to take action to prevent the introduction of any more products from either the pit or the tank at that site?

A The tank had already been removed from the site so that was not necessary.

We did ask the operator of the nearby wells and the pipeline operator, or pipeline company representatives to excavate a canal alongside of the water canal and burn the petroleum product out of the sandbar.

Q Did you ever conduct an investigation in the Cedar Hill area where oil traveled from an unlined pit thorugh the ground and was coming into the Animas River?

A No, sir.

Q Mr. Kendrick, I notice on your Exhibit Thirteen you don't show a blowdown pit and you said that represents about half the wells, Basin Dakota and Blanco Mesaverde wells in the San Juan Basin.

About how many of those Blanco Mesaverde and Basin Dakota wells have blowdown pits?

A I don't recall very many having blowdown pits. Amoco's wells normally have blowdown pits but a lot of El Paso's wells and a lot of other operators do not maintain a blowdown pit.

Q I notice also there's an absence of a drip pot beneath the meter run. Do you have some type of figure as to how many meter runs have drip pots?

A The information I have from the pipeline companies is that if you install a separator, you being an operator, if the operator installs a separator they do not install a drip.

If the operator does not install a separator, then they in self protection install a drip.

Q So therefore those Pictured Cliffs locations that Mr. Hicks mentioned that do not have separators would have a drip pot, is that correct?

A For the most part, yes.

Q Mr. Kendrick, in your examination of produced water pits, what percentage of them had oil products flowing on them or not?

A In the Blanco Mesaverde Pool I would say that most of the wells south and west of the axis of the basin would have some amount from a trace to a full cover on top of the water in the pit.

For those north and east of the axis of the San Juan Basin, I would not expect any liquid petroleum on the pit.

For the Basin Dakota Pool it varies with each location so that possibly half of the wells to three-quarters of the wells would have some amount of petroleum on the pit, from a little to a lot.

Q Mr. Kendrick, in listening to the previous testimony and from your own study you came to the conclusion that a casing leak in the Monsanto Well could have

been a possible source of contamination at the Flora Vista site.

Would you conclude that perhaps there was little degradation of petroleum products during -- in the distance from the Monsanto Well to the Flora Vista Well?

A If the well produced into a sandbar and overwhelmed the bacteria and was trapped into a buried sandbar, it's possible that there would have been little degradation for that 1700 feet of lateral movement.

Q Mr. Kendrick, was there ever any gas present in any of the water wells that were drilled, to your recollection, in your talks with Mr. Thurston?

A I did not inquire of him if natural gas was present.

Q In the analyses you've seen of the water produced at that site, do they show any natural gas?

A I never saw natural gas at the water wells at Flora Vista. I was told that natural gas was a contaminant when we started this study.

Q If there was not any natural gas would you conclude that perhaps the gas was a little bit deeper than the depths of these water wells?

A I would not have any basis to make that determination.

According to the information I've learned about the Manana Gas, Incorporated's Mary Wheeler No. 1-E, gas was encountered somewhere between the surface and 225

feet of depth. That's all I know of it.

Q Mr. Kendrick, you talked about the economics of installing fiberglass lined pits, and yet Manana Gas, which is a small operator, elected to install two, and even replaced one when it turned out it was leaking.

Were those economics calculated on the basis of that one well before those pits were installed?

A Yes, sir.

Q In your qualifications you said that you helped to derive and administer regulations of the Oil Conservation Division and you recommended a 5 barrel per day limit for lining.

Is this 5 barrels per day of actual production the average for a year production or a month, how would you derive this figure of 5 barrels a day?

A I think it ought to be based on an average monthly, total volume produced during an average month.

Q If there was a restriction to 5 barrels per day without lining, then that would restrict the production of a well which might have a higher allowable, what considerations would the operator have to take into account?

A I don't understand the restrictions on the allowable.

Q Well, if the operator wished to have an unlined pit but exceeded 5 barrels of water per day, would he have to consider the economics for the increase of gas

allowable under allowable conditions versus the cost of the pit before he made a decision whether or not to install a lined pit?

A Yes, sir, I think it would be the operator's responsibility to make that decision.

Q At the close of your testimony you said the Division ought to show that there's been a problem, or a problem's been generated before they should issue an order that was so far reaching.

In your experience with oil and gas, helping to write regulations and administering them, what type of prevention measures should the Oil Conservation Division take to prevent problems from being generated?

A I can't -- I can't equate to your question, Mr. Chavez. If I were to equate to it, I would relate something to the effect that we know that 50,000 people die in car wrecks each year so we shouldn't drive.

Q Are there any -- have you ever at the -- have you ever helped to write any regulations that will prevent problems from occurring rather than wait until problems have occurred?

A I assume that over the years I sat in the conference with some. I don't know that I penned the exact words to that effect. I probably sat in conference on this memorandum that I showed as the exhibit dealing with produced water.

MR. CHAVEZ: That's all the

questions I have.

MR. STAMETS: Are there other questions of this witness?

Mr. Taylor.

CROSS EXAMINATION

BY MR. TAYLOR:

Q Mr. Kendrick, these first few questions I think are in relation to some of your exhibits you have.

To your knowledge were any samples taken from the first 23-foot well that you spoke of? I guess that was the water well near the Flora Vista wells, I think?

A I don't know whether any samples were taken or what was done. I went to Mr. Chavez and asked him about the capped water well at Flora Vista and asked him if he had learned of it. He told me that he had talked to Mr. Thurstonson and had gained some information.

I called Mr. Thurstonson and got the same information relayed to me that Mr. Chavez had relayed to me, plus he told me that it was the first well that they had drilled.

So I don't know whether they took any samples or what their drilling problem was, but it was drilled by the water group, not by an oil or gas company.

Q What was the gentleman's name that was the head of the Flora Vista, Thurston?

A Richard Thurstonson.

Q In your conversations with Mr. Thurston-son, did he mention any contamination next to the gas well that was discovered by his backhoe operator when he was digging the new water well?

A No, sir.

Q And the events have occurred subsequent to the drilling of the contaminated well and the Mary Wheeler Well that have caused contamination.

A Yes, sir.

Q What kind of an event could that be?

A If the Ojo Alamo formation is exposed below the water well in the valley and any gas well on either side of the river had experienced a casing failure and contaminated the Ojo Alamo formation, it could have traveled to the river valley and existed at that point from some point not necessarily close to the gas -- to the water well.

Q Don't these theories of contamination that rely on a well not nearby the Flora Vista Well essentially fly in the face of the theories of degradation, which are essentially that no contamination will occur because those contaminants and other things will be degraded trying to move to this well?

A Well, the organics would be degraded unless they overwhelm the bacteria and the other forces but in a period of time they seem to take control again.

Q Could the gooey clay and stinking water that you referred to, I guess, in the drilling the first

Flora Vista well be due to decompensation -- decomposition of swamp organic products in the area?

A Yes, sir.

Q In the blowout that occurred in 1961, or if the blowout that occurred in 1961, had the gas migrated into the water sands, and you speculate that the Flora Vista contamination was due to this blowout, in this example, too, wouldn't you say that biodegradation did not play an important part in breaking down those materials that showed up in the well?

A Not necessarily because the biodegradation depends on oxygen being present and if the influx of petroleum products into that sandbar utilized all of the oxygen in that sandbar, then that gas can stay there like it does in the gas reservoir for thousands and thousands and thousands of years.

Remember, the gas that we're producing has been underground for many thousands of years so that biodegradation does not devour every bit of organic material that's below the surface.

Q What evidence do you have that natural gas is or has been present in the Flora Vista wells, or in the well that was contaminated, let's say?

A The only information I got was from a remark made at the time we started the water study and they told me that natural gas was in the Flora Vista water well and this was part of the problem that generated the call to

make the study in the area.

Q You, yourself, haven't made any analysis or seen any analysis of Flora Vista wells showing natural gas in those wells.

A The water analysis of the well would not show that because when you pour the water into the vial the gas is going to the atmosphere, so the gas is not going to be showing in the water analysis.

Q There couldn't be any that would be in solution with the water?

A It would be such a trace amount that when it reaches the room atmosphere it's going to -- or atmospheric temperature and pressure it's going to by its own state of being gaseous will go into the gaseous stage and escape out of the water.

Q Are you aware of any investigation conducted around the Kanob wells or the El Paso dehydrator in particular, was there any digging done around those areas to investigate potential contamination in the pits?

A I inquired of the El Paso Natural Company. I was told that they did excavate around their dehydrator pit but they found no contamination.

Q Do you have any analytical data to support your theories on contamination of this Flora Vista well other than speculation? When you say it could be this, it could be that, do you have any proof that it was any one of these things or are you just saying it could be any number

of things other than the Manana Well?

A I have no proof of the source but I'm showing that the speculation that the pits caused it is not the only possible source of contamination.

Q So you're just adding some speculation or hypotheticals of what could have happened.

A I'm offering what I think are more reasonable solutions to the contamination instead of speculating on the pit.

Q When you discuss water quality with regards to the TDS, do you feel there should be any concern over water quality with respect to aromatic hydrocarbons?

A No, sir, I think the testimony yesterday showed that the aromatic hydrocarbons would have disappeared and apparently it did not create any problem over a sustained distance.

Q So as far as you're concerned, benzene in the water is no problem.

A That's correct.

Q You mentioned that cases of contamination should be shown before a ruling on pits is made.

Are you advocating a body count methodology with respect to water supplies, protecting fresh water supplies, where we have to have so many cases of contamination or so people that show up sick before there's any action taken?

Q Would you describe body count, please?

A Well, that's what I just did; so many cases of pollution or contamination in wells have to show up or so many people get sick from drinking the water before any action is taken?

Q I don't think that we need to have people to die. I think all we have to have is evidence that contamination is there and we would make an investigation and determine the source as best we can, but because of one point of contamination in the San Juan Basin, we can't compare that to one automobile wreck and ban automobiles.

Q But could we put seat belts in automobiles, what could we do comparable to that in oil and gas wells?

A Seat belts in automobiles does not stop the automobiles from wrecking.

Q No, it doesn't, but doesn't that -- doesn't it cut losses if there are wrecks?

A I'm not sure that it does.

Q Okay, that's all the questions I have.

MR. STAMETS: Are there other questions?

Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q Mr. Kendrick, Mr. Hicks and your testimony pretty well indicate that produced water from the fiberglass pit, not positively, but probably would not cause

the pollution in the water well, is that your understanding?

A I don't know how you relate to Mr. Hicks' testimony but my testimony is that if there was natural gas before the Manana Well was drilled in that same sandbar, 125 to 150 feet away from this contaminated well.

Q You say it's the same sandbar as the water.

A In the valley fill.

Q However, even the evidence that Mr. Thurstonson presented showed that there was a clay lens at 23 feet and the other wells are a bit shallower than that, aren't they?

A I don't know how deep the other wells are.

Q So you don't know whether the other water wells -- well, you don't really know that much it then, about the other water wells, included the contaminated one.

A That's true.

Q Mr. Kendrick, were there any unlined pits at the Mary Wheeler 1-E location?

A When?

Q After the well was first put on production and before the pollution was found?

A Yes, sir.

Q Which pits was that?

A The one at the tank.

Q Wasn't there also a dehydrator pit on

that location?

A Yes, sir.

Q Was that lined?

A I never saw a lining in it so I assume that it was not.

Q Mr. Kendrick, along with products from the well itself that it could introduce in produced water, aren't there other products put into the flow, such as glycols in the dehydrator unit that mix with produced water?

A I assume that some glycol might have been discharged in the pit. I don't know that it was.

Q Would you describe glycol as an aromatic, a volatile, or oil, or how would you describe glycol?

A I think glycol is an alcohol that's a petroleum derivative.

Q Is it an oily substance?

A I think so.

Q Have you ever seen any glycol in a hydrator pit?

A Not to identify it as glycol, I have not.

Q Without personally identifying it, have you been told what was in a pit was glycol with some other condition that had migrated?

A No, sir. I never discussed the contents of a pit at a dehydrator pit with any of the pipeline operating people.

Q During your employment with Manana, did

the production separator ever malfunction and put oil into the hydrator such that it dumped oil into the unlined dehydrator pit?

A I do not know.

Q Do you think it would be possible that the oil and grease that was played into the sample from the Flora Vista water well could have been crude oil or glycol?

A I think it might be possible, yes, sir.

Q To the best of your knowledge does the glycol contain aromatics such as benzene and toluene?

A I do not know.

Q That's all the questions I have.

MR. STAMETS: Ms. Pruett?

CROSS EXAMINATION

BY MS. PRUETT:

Q You stated, I believe, in your testimony that the Farmington sandstone layer contained oil, gas, water, or nothing. Is that correct?

A Or any combination of the three.

Q Right, any combination. But it could be nothing.

A That's true.

Q And you stated that the blowout could have contaminated the sands and gravel in the river valley which could have contaminated the Flora Vista Well.

A Yes.

Q It also may not have.

A That's true.

Q Do you have any explanation for why this well which experienced a blowout which is a mile to the west of the contaminated well would have contaminated just that one well, not any of the others in the area?

A Mother Nature is a rather fickle little lady and does various things.

Q You also stated that the crisis at this blowout ended when the blowout itself was brought under control. Isn't water contamination of the Flora Vista Well a continuing crisis?

A I don't know.

Q Did you read about that contamination at the Flora Vista Well in the papers?

A I read some conjecture about them, yes.

Q Did you ever go forward to either EID or OCD to share with them the information that you had and these possible explanations for the contamination?

A No, but neither did I hide from them. My record with the State of New Mexico is public; has been for thirty years and I've never backed down from anybody asking me a question. No one ever came to me and asked for any information.

Q You testified that you learned that the Flora Vista wells -- well was contaminated with natural gas. Could you tell me who told you that or how you learned that

information?

A No, that was more than a year ago and someone said that there's natural gas in the well water at Flora Vista and we have a water problem so we're going to start studying the water.

Q I think you said that you later learned. Where did you get that information?

A I'm not sure whether the Oil Commission Office in Aztec told me that the suspicion was about the water pit or what the source of information is, but there it seems to me that I read some of that in the newspaper, that three was conjecture that the produced water in the water pit at the Manana well was the cause of the pollution.

Q But all of these things that you've learned were, of course, suspicions or conjectures.

A I have not seen any evidence, have not heard any evidence presented at this hearing, or in any of our committee meetings to show that there has been any water well in the San Juan Basin contaminated by any produced water from a pit.

Q Have you heard any evidence at this hearing or any place else pinning the definite cause of the pollution at the Flora Vista water well?

A No.

Q And your explanations contain an element of conjecture also, don't they?

A Yes. They are other possible sources of

contamination.

Q Now if the alluvium was charged prior to the spudding of the Mary Wheeler Gas Well how do you explain the fact that the Flora Vista Users found odor-free wells in the alluvium at other locations?

A If you'll refer to the plat on my Exhibit Nine, the one that's got the black line and the red line on it, applying some arithmetic to the numbers. The numbers in red I did not testify to but the numbers 281, 222, and 285 are distances.

281 represents the distance from the left end of the black line to the confluence of the red and black lines in feet.

285 feet would then be the hypotenuse of a triangle from the black line and the red line and across the left end of those down there so that the distance from the quote contaminated well in the center of the page to the producing water well in the lower lefthand corner is about 285 feet, but the measured distance with a steel tape between the water well in the lefthand corner and the capped well is 49 feet. I measured that with one piece of tape so that there;s not any conjecture on my part. That is the distance between the centers of those wells, and one is contaminated and one is not. I can't explain why. Like I say, Mother Nature does some queer things.

Q Do you have any explanation for the fact that after years of getting good water from this well all of

a sudden the Flora Vista Water Users discovered bad water in that well if the alluvium from the Mary Wheeler gas well had been charged years and years and years before?

A Well, I've -- I've never heard any evidence that they got fresh water out of that well at any time. There has been no evidence presented to show that that well ever produced good, fresh water.

Q If some evidence were presented to you hypothetically, how would you explain that?

A I'd probably explain it hypothetically, but --

Q Then go ahead.

A But the -- there has been no evidence showing that that well ever produced clean, fresh water.

Q Again I'll ask you, if you had evidence that showed that it did at one time produce clean, fresh water, how would you explain where it's suddenly going bad?

MR. STAMETS: Mr. Kendrick, before you answer that question, let's make sure that you and Ms. Pruett are talking about the same well.

I believe Ms. Pruett is talking about the well at the confluence of the red and black lines. Is that the one you're talking about?

MS. PRUETT: I'm speaking about the Flora Vista contaminated water well and --

MR. STAMETS: Okay, you're talking about --

MS. PRUETT: -- frankly, I'll have to admit I can't tell which one it is on this map.

MR. STAMETS: All right. There are two wells which could be contaminated. There's the initial well, which is -- has been referred to as the capped well.

MS. PRUETT: The one that went down and they -- I'm not speaking of that well.

MR. STAMETS: You're talking about the well which Mr. Kendrick has shown at the confluence of the red and black lines.

MS. PRUETT: Right, number 27.

MR. STAMETS: Okay.

A The 27 on there is the distance but with --

MS. PRUETT: Okay.

A -- the "W" in the middle of the page.

Q Right.

A But if someone showed me that that well at one time produced clean, fresh water and then started producing contaminated water, I have no way to identify which of the possible sources of contamination would be responsible.

Q Would that be consistent, however, with the contamination from the alluvium?

A It's possible.

Q In your Exhibit Eight you indicate that a

show of gas was found when surface casing was set on that well at the depth of 225 feet, and that the gas was sealed off after the pipe was cemented.

But isn't it true that the Flora Vista water wells are considerably shallower than 225 feet?

A I don't know how deep they are.

Q You don't know if they're 225 or 25?

A That's true.

Q You mentioned in Exhibit Five that the Monsanto unlined earthen pit that received produced water with a total dissolved solids of approximately 80,000 parts per million.

How far is this pit from the Flora Vista Water Users contaminated well, that well that you show at the confluence of the red and black lines?

A First let me make the statement that I did not testify that they produced water into an unlined pit of 80,000 parts per million.

Q I'm sorry.

A They asked me how to dispose of it and I told them to line the pit, but the wellbore itself is approximately 1700 feet, I think, from the Mary Wheeler Well and so that would make it some 1900 feet from the quote contaminated well.

Q But the Flora Vista well was not polluted with TDS, was it?

A I don't know.

Q Again, if the earthen -- if the Monsanto pit was the source of contamination at this Flora Vista well, why did it only contaminate one well and why would it produce a sudden contamination in the well?

A I did not present any testimony showing that the pit at the Monsanto well contaminated anything. I showed that I asked that the pit be lined to prevent contamination of the river.

Q Was it lined?

A I don't know, but if you'll look, you'll find my letter directing that it be lined if they disposed it.

Q About --

A The testimony I had about the Monsanto well was that it was a possibility of casing failure which might have contaminated the sandbars, but not the pit.

Q Okay. So again if there were a casing failure I would ask you how you could -- why only one well would be contaminated and not the rest of them.

A We have a well here 49 feet from one that's apparently contaminated and one that's not contaminated and they're only 49 feet apart.

A well that's 2000 feet away might contaminate one and not another.

Q I have a question about your proposed witnessed production test and analysis.

Produced water, the quantity of produced

water and its volume can fluctuate seasonly and over greater periods of time, can't it?

A Yes, it can fluctuate daily.

Q When would you suggest that this witnessed production test be conducted so that it would be a representative measure of the produced water for any given time?

A At the convenience of the Oil Conservation Division witness.

Q Would you recommend a weekly average, a yearly average?

A We take a test for 24 hours and determine how much oil a well produces in a day and the oil volume varies from day to day. We take one test and assign an allowable to that well based on that test.

Q Okay, is that the kind of one day test that you were suggesting in your exhibit?

A I think that would be satisfactory, yes.

MS. PRUETT: I have no more questions.

CROSS EXAMINATION

BY MR. STAMETS:

Q Mr. Kendrick.

A Yes, sir.

Q Yesterday we heard from Mr. Hicks that in all likelihood the potential threat of contamination is

greater from liquid hydrocarbons than produced water in this area and such liquid hydrocarbons can get out in pits as results of upsets.

If none of these pits in the vulnerable area are lined, how can the Commission be sure that hydrocarbons are not going to get into the -- onto the soil and into the fresh water?

A Mr. Stamets, the -- no regulation that is passed by this state can insure that. There is just no way unless we leave all the oil in the ground.

Q Would not the lined pit at the tank battery provide additional insurance, though, against upset causing hydrocarbons to get into the fresh water?

A It might if the pit were empty at the time the upset came. If the pit was approximately full at the time the upset came it would just run the pit over.

So the -- setting the pits would be some measure of insurance, but it would not be a preventative.

Q Your proposal to measuring produced water would be to do that once a year?

A Well, if we --

Q Or a month?

A If we start out with a production of a well and measured the amount of water there and determined it was less than 5 barrels, if for any reason someone suspected that it was producing more than 5 barrels per day, if it were an offset or a landowner, someone with an interest

in the production of that well or a regulatory agency representative asked for a test, then we would ask that the Oil Conservation Division people witness the test.

Q In general what does the water production do in the San Juan Basin, does it increase or decrease over the life of the well?

A From well to well it changes. Some wells produce more initially and tapers off, and some start with no water production and get a little bit of production, but the San Juan Basin does not have a water drive situation, that is bottom water coming up under the gas, so that we don't have a great increase in the amount of water production in the type reservoirs that we have in the San Juan Basin.

MR. STAMETS: Any other questions of this witness?

Mr. Kellahin.

MR. KELLAHIN: Thank you, sir.

REDIRECT EXAMINATION

BY MR. KELLAHIN:

Q In response to some questions by Mr. Stamets, Mr. Kendrick, this hearing is set up to discuss whether or not we should line pits for produced water.

Mr. Stamets has raised another question for you to consider and asked whether or not we need to line unlined pits to take care of product spills, upsets at the

separator, that would dump product into the pit, or are there in place now adequate regulations and rules of the Oil Conservation Division that will take care of spills and upsets? Do you have an opinion on that?

A I think the rule that prohibits the storage of oil in open pits is as effective as a new rule which says the same thing.

Q Based upon your years of experience in the San Juan Basin, Mr. Kendrick, what is the custom and practice of the pumpers for the various operators to go out and visit the well sites? Do they do it daily, biweekly, what is the frequency?

A The frequency depends on the individual well in question.

Some wells need to be visited about once a month just to see that it's still there.

Some wells need to be visited daily to look at the producing problems.

Q Based upon your knowledge and experience in the industry, Mr. Kendrick, do you believe that the oil field operations, as well as the Oil Commission rules and regulations now, are adequate to provide a contingency plan to take care of spills and upsets, that will allow the pumper to remove those things from the unlined pit, as opposed to taking the step of having all those pits lined to protect against upsets?

A Yes, sir. I think that the normal opera-

tional procedures would continue to solve the problem as it has in the past.

Q Thank you, sir, nothing further.

MR. STAMETS: Ms. Pruett.

RECROSS EXAMINATION

BY MS. PRUETT:

Q Would you tell us what those normal operational procedures are for fielding upsets and leaks?

A It depends on the company. It depends on the well.

Q Why don't you just choose one or the other? I -- I don't know.

A Well, as a general rule, if a problem develops, we solve it, at the most expeditious manner.

Q How do you do that? Do you dig up all the dirt in the pit to pick up any soil that may be contaminated with petroleum products, or do you try and put something in there that can neutralize the problem, or what method do you use?

A We pump it, salvage the oil out of a pit but we do not make a policy of digging up the dirt and taking it from one location to another location to lay it back down on the ground. There's no place to put oily sand except back on the ground.

So why move it from one location to another and spend a bunch of unnecessary money and create a --

Q The same problem that you had at first.

A -- the same somewhere else and just spoil two pieces of ground where one has suffered some damage.

Q Now those wells or those sites which are only visited once a month, they could experience a significant accident over that month and you wouldn't -- the operator would not have the opportunity to immediately deal with it, would they?

A Those wells that would be visited once a month would not be wells that produced liquids. Those wells that produce liquids have to be visited more often to insure that an upset or a spill has not occurred.

Q Are all the wells that produce liquids visited daily?

A No.

Q Even if a problem were discovered as much as twelve hours later, would all the produced liquids still be in that pit or wouldn't there be a certain amount of hydrocarbons that could already have entered the soil?

A There would be some hydrocarbons in the soil immediately. The soil is not impervious to hydrocarbons for the most part.

Q So the operator could not recapture all of the released hydrocarbons. They could recover a portion and we don't know -- that portion would depend on each particular case.

A That's true.

Q Okay, thank you.

MR. STAMETS: Mr. Pearce, did you have a question?

CROSS EXAMINATION

BY MR. ELMER:

Q Would you please turn to Exhibit Number Twelve?

A Yes, sir.

Q Now you made certain economic assumptions on Exhibit Number Twelve. I refer to your paragraph one, two, three, four, where you stated the general rule of water production of a well increases, the gas production and the cash flow decreases, being perhaps a burden upon the operator, and yet in response to another question you just stated that the gas versus water ratio varies from well to well.

So which statement is correct?

A Both, but in this instance identified on Exhibit Twelve, when a well starts producing water, when the water starts into the tubing string, then it forces a restriction on the gas flow and thereby causes a reduction in the gas volume.

Q Yes. But your reply to, I believe, Ms. Pruett's previous question was in terms of when you measure the water flow, you said, you indicated that it was on an individual basis and it varied from well to well.

This statement indicates that towards to

the end of the life of a well, that you have an increase in the production of water.

So if -- if your previous statement is such that the gas/water ratio varies from time to time, your economic assumption is not necessarily true in conclusion No. 12.

A As the well depletes, the pressure in the reservoir depletes; therefore, there is less pressure to unload the water.

If a well is gargling water this is a restriction on its ability to produce. The water alone will cause abandonment earlier than if the well produced just dry gas.

If we add the cost of a pit on the fact that the finances are already impaired by the liquid in the wellbore causing producing problems, the well will be abandoned earlier.

Q But when does this occur in terms of the cycle of the well? Again I'm trying to reconcile the two statements as to the -- when you measure the water flow.

You indicated, sir, in previous testimony with respect to the measurement of water that from well to well it varied.

A It does.

Q All right, so you can't necessarily state that the -- close to the end of the life of a well that the water will cause any loss of production.

A That's true. All wells do not make water.

Q To my mind, sir, you still haven't reconciled the two statements between Exhibit Number Twelve and your previous response.

A Well, let me explain it this way. Some wells make a great amount of water; some wells make no water.

Those wells that do make water, the gas production is impaired by the water in the wellbore.

If the well does not make water, then there will be no water production problems.

Q But that could be at the very beginning of the cycle with economic oil.

A That's true, from --

Q And not at the end.

A -- the beginning to the end.

Q From the beginning to the end.

A Yes, sir.

Q Thank you.

MR. STAMETS: Mr. Pearce.

MR. PEARCE: Very briefly, if I may, sir.

CROSS EXAMINATION

BY MR. PEARCE:

Q Mr. Kendrick, were you in attendance at the hearing yesterday?

A Most of the day; not all the day.

Q Were you in attendance when Dr. Miller testified about the occurrence of major spills of thousands of gallons of gasoline which in his experience were the types of events which overwhelmed micro-organism activity relating to biodegradation?

A Yes, sir.

Q Would you tell me, sir, your opinion of the average content of the separator? If the entire contents of a separator dumped, what volume of liquid are we talking about?

A A small separator the total volume of the contents would range in the area of about a half a barrel.

In a large separator this might get to ten barrels.

Q In a well which produces, let's say, five barrels or less per day of water, what size separator tank would you expect to find?

A One that would hold about twenty or thirty gallons.

Q Mr. Kendrick, during your time working for the Oil Conservation Division and Commission, were you aware of a rule which required that spills and leaks and

leaks be reported?

A Yes, sir.

Q And were those events routinely reported?

A Yes, sir, after the enactment of that rule.

Q Do you recall when that rule was enacted?

A Not precisely.

Q Could you give me a rough guess? I don't know.

A I'd say somewhere around 1970.

Q I have before me, sir, a copy of Oil Conservation Division Rule 116, entitled "Notification of Fire Breaks, Leaks, Spills, and Blowouts".

If I may, sir, I'm going to read you the -- a portion of the section of that rule which is entitled "Content of Notification".

That section says in part, "A report shall specify the nature and the quantity of the loss; also the general conditions prevailing in the area, including precipitation, temperature, and soil conditions.

The report shall also detail the measures that have been taken and are being taken to remedy the situation reported."

In your employment with the Oil Conservation Division during the time that rule was in effect, is it your experience that those reports came in pereiodically and reflected the required information?

A Yes, sir.

Q Thank you, sir. No further questions.

MR. STAMETS: Any other questions of this witness?

Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q Mr. Kendrick, you testified as to the economics but you haven't presented any data or calculations on the economics of lined pits.

Because there is some question as to what the final requirements may be, should there be any pits, it's kind of difficult to come up with some estimates, but in your employment with Manana, could you tell us what the economics were for installing the fiberglass pit at the Mary Wheeler 1-E?

A Yes, sir. The pit cost $2300 delivered to the location from Amarillo and the backhoe operator utilized about one day to install the pit.

Q What was the total cost of drilling the well, do you know?

A I don't know. I never saw the AFE on it. I do not know.

Q Do you know what the -- could you give me a good estimate of what a Dakota well would have cost to drill at that time in that area?

A Probably in the range of $250,000.

MR. CHAVEZ: That's all I have.

MR. STAMETS: Any other questions of the witness?

You may be excused.

Mr. Kellahin, do you have any more witnesses?

MR. KELLAHIN: On behalf of my clients I do not, Mr. Chairman.

MR. STAMETS: Any other oil company witnesses?

Let's take about a fifteen minute recess.

(Thereupon a recess was taken.)

MR. STAMETS: The hearing will please come to order.

I'd like to recall Mr. Hicks to the stand for a couple of questions.

MR. KELLAHIN: Point of procedure, Mr. Chairman, we've rested our direct case.

I want to reserve the right to recall witnesses that have previously testified as well as additional rebuttal witnesses in the event there are witnesses from either the Division or the EID or someone else on this issue.

MR. STAMETS: We understand and

that is reserved.

MR. KELLAHIN: In addition, sir, I'd like to make an objection for the record with regards to the potential of the Commission to consider the lining of unlined pits as a contingency plan to solve some difficulty that may or may not occur with regards to spills and upsets.

We believe that an adequate case on that issue can be developed to show that there is not a need to line unlined pits to meet that contingency; however, the call of this case was to determine what to do with produced water and we are not prepared today to discuss contingency issues with regards to other potential sources of contamination other than produced water.

If that is to be a subject of consideration, we'd request that that be docketed as a separate case.

MR. STAMETS: Mr. Elmer has a question or two of Mr. Hicks.

CROSS EXAMINATION

BY MR. ELMER:

Q Mr. Hicks, when you were performing your study did you observed the amount of participation -- precipitation, or measure the amount of precipitation that was going into the pits at the time of the study?

A Rainfall?

Q Yes.

A No, that was not measured.

Q All right. Could that, do you know, if in fact there was rainfall during the course of the study?

A There was rainfall -- I don't -- can't testify as to how much -- on the day before we sampled the Eaton site, and light rain during the day of the McCoy site.

Q To what extent have outside precipitation have skewed your study in terms of the results?

A For those particular cases, the amount was -- results in terms of groudnwater monitoring or --

Q The -- the groundwater; also the values in parts per billion by the pit?

A In terms of the groundwater monitoring the rainfall would not -- the previous rainfall would not skew that at all, in my opinion.

Q Okay.

A In terms of the -- the results that we obtained from the pit samples themselves in all three cases the volume in the pit was considerable as compared to the amount of rain that would have fallen in that previous day, and the results, I believe, are fully accurate.

Q I see. With respect to the study, should a series of studies be done taking into account that there was or was not rain, because over a period of time you do have the impact of rain.

A If you compare the amount of the rain

that would fall into a produced water pit as compared to the amount of produced water, my opinion is that the volume of rain would be insignificant compared to the produced water.

Q But if on a hypothetical situation, if you had a pit, let's say, had some heavy metals, and you didn't have rain but evaporative, would the concentration of the heavy metals increase?

A As you, if you were put -- yes. Yes.

Q Okay. And then if you would have rain and a runoff, would a greater concentration then go into perhaps, you know, through an unlined pit would a greater concentration then flow down into -- into the ground?

A I can't testify to that. All I could say, the metals would be increased in the pit. Whether they would enter groundwater or not --

Q Yes.

A -- I have no data to support or deny that.

Q But if you had a high water table, you indicated, I think, that one pit was very -- that the water table was very high, right?

A The pit was indeed constructed into the water table.

Q Yes. So the potentiality of the heavy metals going right to the water table would be there.

A Well, in fact, yes, and it would be diluted by the groundwater as it passed through the pit.

Q I have no further questions.

MR. STAMETS: Mr. Taylor?

MR. TAYLOR: Mr. Chairman, I have a couple of questions, if I might.

MR. STAMETS: Okay.

RECROSS EXAMINATION

BY MR. TAYLOR:

Q Mr. Hicks, when -- when was the period of your study, were you testing the wells and drilling your monitor wells?

A How about April 11th, 12th, and 13th. I've got my boss checking the calendar.

MR. BUYS: Yes. The first work, if I might, was the 11th, 12th, and 13th of March. That's when the wells were evaluated and the first wells, monitoring wells were put in.

A And then the subsequent week we performed our second set of sampling.

MR. BUYS: Second sampling, yes.

Q So March 11th, 12th, and 13th you started evaluating the wells, the fifty or sixty wells you've talked about and you also drilled your three monitor wells in that period?

A March 11th, 12th, and 13th was the evaluation of twenty-one well sites, the selection of three well

sites, and the construction of monitoring wells and the sampling of, first sampling of pits.

Q And when was the -- I think you just referred to a second sampling. When was that?

A The second sampling was the following week. That date, I believe it was the following Monday or --

MR. BUYS: It was a Monday.

Q Monday, around the 20th or so. You stated yesterday that in your rate of water production, that that you used, that was provided by the companies, so -- or that your -- I guess Tenneco provided to whatever wells you were testing.

So the rate of water production that you used was not necessarily reflected by the actual rate of production at the time?

A Well, actually, that's not the case, as I found out a half hour ago that the data we received -- that we were provided with on the Eaton Well was in fact monitored by a flow counter device which would give an accurate representation of the fluid produced by the separator and dumped into the pit.

Q Is it your understanding that more water would be produced at a certain time of year from a well than an other time of year?

A I have no knowledge of that.

Q So your, what you're saying is that you

you're testing these wells during a period of March 11th, 12th, 13th, and subsequent to that a week later was the only testing that you did and this was not a process of where you tested water for several weeks or a month to determine if contaminants were showing up, but it was essentially a one or two times testing procedure and you didn't find large amounts of the contaminants at that time, although some did show up in the water supply, is that correct?

A It is correct; however, I think it would be interesting to note that wells closer to the pit would obviously be more -- or would be more reflective of recent disposal practices whereas wells further from the pit down gradient would be reflective of past disposal practices due to the velocity of groundwater movement, and therefore by spacing wells out further from the pit you actually do get a time sequence of potential contamination.

So the further wells away would actually be reflective of what has happened in the past. The closer wells would be reflective of what's happening in the recent past and the pit itself would be reflective of what's happening at that instant.

Q So essentially your testimony of a 5 barrel exemption is appropriate, is not based on what you would call large scale testing. It's testing over essentially one period at three limited locations.

A Three limited locations that are reflective of a much larger population and in fact are the worst

case scenario or what we believe to be the worst case scenario of those populations. That's correct.

Q How did you determine that the point from which you were withdrawing water and testing it from the monitor wells was the point at which fluids might migrate if they were in the groundwater level?

A Any leakage from a pit enters the groundwater from -- or enters the top, the uppermost portion of the groundwater water table.

We designed our monitor wells so that the screened intervals would intercept the uppermost portion of this -- of the aquifer.

In many cases the screen -- in all cases the screen was less than six inches below the top of the water table. In some cases the screen was a couple of inches above the top of the water table, and this is the -- the most vulnerable section of that aquifer.

Q But I thought you told me yesterday that you had not made any tests to determine the level of water in this area? How did you do this, from the monitor well, you just --

A There's --

Q -- did this in the monitor wells?

A There's three water level maps which document that we did in fact test the depth to water and in fact surveyed in the elevations so that we would have accurate water level maps so that the depth to water and the --

was fully known.

Additionally, in several of the sites we put down an exploratory well before we even put in our monitor wells to determine what the depth to groundwater would be so that we would be certain with respect to where the top of the groundwater was.

MR. TAYLOR: That's all the questions I have. Thank you.

MR. STAMETS: Mr. Hicks may be excused.

MR. ELMER: May I ask him a question, sir?

MS. PRUETT: Mr. Chairman, I have a question.

MR. KELLAHIN: Mr. Chairman, I --

MR. STAMETS: Mr. Kellahin.

MR. KELLAHIN: I need to know how to play the game, sir.

Are we going ot go round robin until this man's exhausted like he was yesterday, that's fine. I need to get him a drink of water and we'll do this some more.

But I thought we were having questions of this witness from the chairman that would not open this witness up to additional questions.

Having already undertaken that

task with Mr. Taylor, I have prepared a list of a number of questions myself that we need to discuss.

Now I'll play by whatever rules you want to play by but I need to know what the rules are.

MR. STAMETS: I can appreciate your concern, Mr. Kellahin, and I agree with you totally.

We are dealing with very, this morning, very potentially expensive issues and certainly Mr. Hicks' testimony is to the crux of the issue, and much as I would like to hurry the thing along, I believe I will have to allow some questions and certainly that would include any that you would like to ask.

MR. KELLAHIN: Need a drink of water, Randy?

MR. HICKS: I'm fine.

MR. STAMETS: Please be as brief as possible.

MS. PRUETT: Surely.

RECROSS EXAMINATION

BY MS. PRUETT:

Q I think you just testified that you didn't believe there was any rainfall effect in your study and that one of the reasons was because the volume in the pit was considerable when you did your studies.

What volume is that?

A The pit itself is approximately 10 x 10

feet. The depth of water in each one of these pits was a foot in one case, in two cases, and perhaps a foot and a half in another case.

Rainfall of a tenth of an inch or less, I don't know what occurred at the airport on that date, would be insignificant, in my opinion, with respect to the benzene concentrations that we're looking at.

We're talking about 3.5 milligrams per liter. A dilution calculation may be able to be done but it may reduce it to 3.3 or 3.2, but with regards to the result, it wouldn't change, in my opinion.

Q Will your well logs and your field sheets that you're going to provide us reflect the volumes in the pit of each of the 50 to 60 pits that you studied?

A Yes, they do.

Q Does the volume -- do the depths in the pits of one and 1-1/2 foot reflect a representative depth of volume in a pit over the vulnerable area of about 1200 wells?

A No, they don't.

Q Are a number of those pits in the vulnerable area indeed -- to appear dry?

A Yes, they do.

Q You were just discussing your well screens. If there were any kind of an oil film on the water table would your well screen reflect that?

A Yes, they would, because the wells were

totally drawn down during the sampling procedure.

Q Would the well screens reflect any vadose zone spreading?

A The groundwater monitoring wells monitor the saturated zone. In terms of spreading of contamination through the vadose zone, they would reflect it in that the spreading would increase the amount of area that would be -- that would affect groundwater.

If you're saying that Mr. Boyer should redo his calculations with respect to four feet diameter and maybe make it sixteen feet, maybe the vadose zone will spread out that much and we'll have more dilution and also absorption and also volatilization, biodegradation.

The well screens that we put in monitor the saturated zone. They would be affected by vadose zone spreading in that sense.

Q Do you have any written statistical analysis that you could provide us showing that your three wells represent -- a representative sample of the 1200 to 1500 wells in the San Juan vulnerable area?

A A statistical analysis, no.

Q I believe you testified that you did not -- this is my last one -- you did not personally conduct a specific conductance test.

Did anyone else perform any?

A The -- I'm not certain but I believe that some of the -- we have conductance values from the second

set of sampling but I honestly don't know. If they exist, you'll see them.

Q Would you check and make those available to us?

A Yes.

MR. STAMETS: Mr. Kellahin, did you have some additional questions?

MR. KELLAHIN: If the Commission please.

REDIRECT EXAMINATION

BY MR. KELLAHIN:

Q Mr. Hicks, do you have a calculator?

Sir, I'd like you to go through with me a calculation with some assumptions I'm about to give you so we can put a number on the rainfall that might impact a typical pit in the vulnerable area.

I want you to tell us what is going to be the volume of water that will be added by rainfall to the pit in relation to the total volume of produced water that that pit would be subject to.

Let's start with the total produced water at the Eaton site. Your prior testimony was we have four gallons a day.

MR. BUYS: Barrels.

Q I'm sorry, four barrels a day. Would you multiply that by 365 and give me what that number is?

A I'd ask somebody in the audience to follow along on a piece of paper to insure that the calculations are done correctly and the units are cancelled accordingly.

Four barrels times 42, we're dealing with 168 gallons per day.

Q We can do it in barrels.

A Thank you.

Q Four times 365, I can almost do that one.

A Okay. 1460 barrels per year.

Q All right. Let's go back and figure out what the impact would be to the pit of the rainfall. If we have a pit that is 15 feet by 15 feet and we put into that pit gross rainfall without -- without evaporation taken into consideration, in one year given an average rainfall of eight inches, which is .66 feet per year.

Is the calculation 15 times 15 times .66?

A Yeah, we'd have 14 -- I'm sorry -- 148.5 cubic feet of fluid.

Q All right, let's trans -- let's convert the 148.5 cubic feet of fluid into gallons and then into barrels.

A I believe the conversion factor from feet to gallons is 7.48. We come up with 1,110 gallons. Now if we divide by 42 we'll determine the barrels, and we come up with 26 barrels.

Q A year.

A A year of rainfall.

Q In your opinion is that a volume of rainfall impacted into the unlined pit that will change in any way the conclusions you've reached based upon your study of the groundwater at these three sites?

A I don't believe so. It's a small volume compared to the volume produced.

Q My second and last area to discuss with you is one I think Mr. Taylor was addressing and I believe the point he was making is whether or not the study you did in the ground monitoring at those three sites in March and April of this year is a one-time look at the groundwater and that if we came back today or next month or next year and did the same thing we might see something different.

A I would find that very hard to believe because the values -- we looked at a site that had been in existence for twenty years. We looked at two sites that have been in existence for four years, and all three sites consistently came up with the same results.

I talked briefly about the spacing of wells and how that would in fact be a history of the potential contamination. I don't believe if we came in and monitored for six months or a year or two years that we would see any difference than what we saw during our sampling.

Q In regards to Ms. Pruett's question about the reliability of the study in terms of its statistically being accurate, can you provide us subsequent to the hearing

with the verification by Dr. Wall, the statistician, that the method of random sampling is one that is statistically accurate and reliable?

A Yes, sir.

MR. STAMETS: The witness may be excused.

MR. TAYLOR: Mr. Chairman, I'd just like to bring up at this time in relation to Dr. Hicks that we are --

MR. HICKS: Am I excused?

MR. TAYLOR: -- requesting his field notes and chemical analysis data sheets and the technicians from the Oil Conservation Division have requested that they be allowed to review these before we make any final submittals in this case.

I would request that you set up some time schedule for us to do that.

MR. STAMETS: Will you make those notes available to the Division staff (not understood)?

MR. HICKS: I ask for a week plus or minus a few days for preparation of those -- those notes into an order that would be understandable with the correlation of photographs and everything else so it would fall into one package.

MR. TAYLOR: And we would request that chemical analysis be supplied to us in total from

both labs.

MR. STAMETS: Okay. Before the hearing concludes today we will figure some sort of time frame for any counsel's late submittals.

MR. KELLAHIN: Mr. Chairman, might I suggest becaue we do seem to have a number of clean-up matters to trade information, that it might be helpful if counsel meet subsequent to the hearing and submit to the Commission a procedure or method of cooperation by which we will not only trade our information but we will obtain information from the Oil Commission and others.

I think it might be easier to let us do that outside of the hearing process, submit it to you for approval, and go about it in that fashion.

MR. STAMETS: That sounds good. About how much time do you think would be appropriate?

MR. KELLAHIN: I think within ten days of the conclusion of the hearing we could trade the actual documents. I think the preparation of the list could be done within a few days after the hearing, depending upon what the persons' schedules are and the various lawyers.

MR. STAMETS: Are you talking about sometime the week of May the 6th?

MR. KELLAHIN: Yes, sir, that would be possible.

MR. STAMETS: Do you think everybody needs to be there at one time, Mr. Kellahin?

MR. KELLAHIN: Perhaps not. I think Ms. Pruett comes from Albuquerque. Either we can do this on the telephone or we can arrange a convenient time to get together.

MR. STAMETS: Let's try and have it done on or before the 7th of May.

Mr. Taylor, you wanted Mr. Boyer back?

MR. TAYLOR: Yes, Mr. Chairman. I've got a few questions I want to ask him.

DAVID BOYER,

being recalled as a witness and being previously sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. TAYLOR:

Q May I remind you that you have already been sworn and are still under oath?

Mr. Boyer, could you state for us the status of OCD investigation into the Flora Vista water well site situation?

A Yes, Mr. Taylor. I wish -- I'm not sure of the exact dates but subsequent to the February 20th hearing and subsequent to the -- and again I don't have the exact dates, but the OCD in cooperation with the EID went out and began a more thorough investigation of the Flora

Vista situation. The -- what we did was we went out and installed five monitoring wells out in that area and also took samples of the wells and the -- the existing wells and the water prior to installing the wells.

The status is such that we have no definitive conclusions yet because the wells need to be developed before they are ready for sampling and there also needs to be some additional work done around the wells themselves.

So at this time we are not making any definitive conclusions regarding the site and I consider it work in progress.

Q Okay. In your simple dilution model that you presented to us I believe in the February hearing, the value -- you used a value of 14 parts per million concentration of benzene. I believe that was in the pit. Do you believe that --

MR. KELLAHIN: I'm sorry, Mr. Taylor, I couldn't hear you. Could you tell me what that number was again?

Q 14 part per million, I believe.

A Well, the number I used in the February hearing was a compilation of the information I had at that time. I used 14 parts per million. We've had some testimony over the past few days about numbers in the pits and numbers in the -- whether or not that number is a good one.

We have also -- we have seen that we have produced water from some pits and dehydrators at rates that

exceed 14 per million, parts per million benzene. We've certainly had a -- when you have a discharge from a dehydrator of as little as 2 gallons per day, a lot of that is somewhat, may be distillate which is higher than 14, much higher than 14 milligrams per liter.

Mr. Baca previously stated that -- that solutions of benzene in solution with water would have less of a capacity to flash off than if it was just pure benzene, so I think that number of 14 parts per million is -- is a good one. We sampled stuff coming from the separator and we certainly have higher numbers than that, so I'll stick with 14.

Q You just stated that this number of 14 parts per million was a compilation of data. Could you just briefly tell us what that was from? Was that from various -- is that an average?

A Well, that was the average I had at the time that I took all the samples and then in the February -- in the February values --

Q From tests of --

A Of produced water. Well, it was including the pits, right, and it had everything at that time.

Q Do you feel that Mr. Hicks values of benzene concentrations are too conservative and if so, why?

A In the pits, you mean, the numbers that he put in the pits in his exhibit.

Let me get those numbers. The numbers --

he used an average, or he showed an average of one of the pits of 3.83 and he had some lower numbers on -- on the others. I think that the numbers in the pits may be -- may be too conservative. Part of that is based on what I said before, is that we have higher numbers of benzene coming out and in some cases it goes directly into the ground, especially if there is a little oil involved. In other words, any distillate and water, very little oil, will infiltrate quite quickly and not reflected by water standing in the pits.

When there is water standing in the pits it is influenced by rainfall and we just went through a calculation where Mr. Hicks showed that, or attempted to show that rainfall, that volume of rainfall or the concentrations, the final concentrations due to input from rainfall were very low, or had very little effect on the situation.

On the contrary, I think that on any given day when you're having a rainfall event and have a small amount of water in the pit, it could be quite -- have quite an impact.

For example, if you had four to five inches of snow fall on a pit or if you convert that to rainfall, a half an inch of rain, and you get -- include the runoff from any -- from the sides of the pit going in, and you add that to six or eight inches of -- of standing produced water, I think that can lower the -- the benzene concentration in the -- or lower the concentration of pollut-

ants in the pit.

For example, in Table I of Mr. Hicks' exhibit, I think that was Exhibit Number One, I believe, that he prepared, he showed that there is one pit that had a concentration of 10.2 milligrams per liter, and that was -- I believe that to be more representative when you have standing fluids out there, more representative than the average of 3.58.

So I'm going to stick with the 14.

Q Do you agree with Mr. Hicks' analysis that his study of three monitor wells in essentially a one time situation is enough to show that a 5 barrel exemption is adequate to protect groundwater supply?

A Well, I think that the study shows that, again, for the dates that he sampled and the locations he sampled, those were the results he got. I think that there is a wide variety of conditions in the San Juan Basin, in the alluvial areas of the San Juan Basin, as I testified to earlier, with a wide range of different hydraulic conductivities and aquifer conditions.

I also wonder about the measurement of the gradient and the reversability of the gradient due to seasonal variations from the river and other -- other things.

So I would say that more than three would be necessary.

Q I now show you exhibit -- what's been

marked as Division's Exhibit Number Eighteen, and would ask you to explain that for us.

A Yes. I have copies available for the Commission and also for persons in the audience.

I'll put a title on this. This is an aquifer simulation using the random walk model.

At the April the 3rd hearing I was asked by Mr. Kellahin down there whether or not an aquifer model would provide a more realistic view of what may be happening in the aquifer, more realistic than the simple dilution, and when I made the simple dilution calculations I was using just that, simple dilution to show that there may be a problem from -- from these discharges.

In any event, since April 3rd I went and used an aquifer simulation model and I'd like to discuss it real briefly here.

This is called the Random Walk Solute Transport Model. It takes the simple mixing model that I showed at the February 20th hearing and adds the effects of convection and dispersion and some of the chemical actions, such as retardation that were talked about by Mr. Schultz on April the 3rd.

This particular model has been developed by Thomas Prickett and others and is documented in the Illinois Water Survey Bulletin No. 65. It's a standard model used by hydrologists to simulate solute transport or transport of contamination and pollutants in aquifers.

This particular, these particular simulations were used -- were run on an IBM PC. Mr. Prickett offers a short course in connection with the National Water Well Association and the PC, and the computer program run on the IBM PC was obtained through attendance at that short course.

The highlights of this particular program are the groundwater flow solutions are formulated by finite different methods using grids and nodes. Solute transport uses mixing techniques and dispersion effects are simulated using a random walk statistical method. All of this -- this particular documentation is available and I have copies of it in case anyone would be interested.

The program can simulate water two dimensional flow in aquifers under artesian or water table conditions. It provides for output plots of solute concentration, distributions, and the effects of dispersion and dilution of waters at various concentrations can be shown by taking a look at those graphical outputs.

And I'll just briefly go through the package. It's -- what it is, I'm not going to go through and discuss each one in detail but it's there for you to take a look at.

My assumptions are given on the first page. The first two columns list the assumptions, the same assumptions that I gave in Table IV of my February 20th testimony, aquifer thickness, transmissivity.

The last column is a Flora Vista aquifer characteristics that were obtained through a report that I mentioned in my previous testimony on April the 3rd.

The log of those wells show a thickness in the area where the wells are completed of about 15 feet of aquifer thickness, saturated aquifer thickness. The total depth of the wells is about 23 feet in that area. Calculations show 100 feet per day as hydraulic conductivity. Transmissivity is calculated from the thickness of the -- saturated thickness of the aquifer and hydraulic conductivity.

The dispersivity coefficients in the X and Y direction are -- were -- are sort of averages for numbers that have been published for alluvial type conditions, alluvial type aquifers. These particular numbers come from Tom Prickett's short course notes.

Regional flow was calculated as indicated and using the information provided earlier, February 20th, in the February 20th discussion.

The calculation of particle mass and pollutant lows are given on the next page and the final concentration -- final concentrations are calculated giving a calculated use in the equation shown at the bottom of page number two.

And I'll just briefly run through these. Each page provides the conditions. Each cover page provides the conditions under which the model was run, the inputs for the model.

The source sink on page one indicates the number of gallons per day flowing into the site, which is 5 barrels per day.

Simulation information and number of particles is given at the bottom of page 1.1.

On page 1.2 an output plot for thirty days of simulation at two -- at 210 gallons per day input and a concentration of benzene at 14 milligrams per liter are shown.

The simulation is given in parts per billion.

The New Mexico Water Quality Control Commission limit for benzene concentration in groundwater is -- is 20 parts per billion and as you can see, just after thirty days with 5 barrels per day input, the computer simulation shows that you have numbers in excess of the standard in a sort of an oval shaped plume to the right and left of the injection point. The injection point in all these plots is listed as 00; sometimes it's listed as having an I and sometimes it has an actual number.

You can follow on page 1.3 for 50 days. On that first simulation the well was shut off or the discharge was shut off at 50 days and the simulations for one year and for two years follow on the subsequent pages, showing how that even after two years the -- and for these particular conditions your concentrations still exceed the standard of 20 parts per billion.

Page 1.6 we have another simulation using one barrel per day and a -- on page 1.7 after 30 days you can see that the standards have been exceeded at some distance, 15 feet or so, away from the source.

At the end of one year the standard is exceeded at 70 -- 70 feet away from the source.

At the end of two years you can see that the standard is exceeded 120 feet away from the source in the direction of the groundwater flow, which is from left to right.

And I followed that on page -- with other calculations on the first section labeled Section I. Those particular calculations use a hydraulic conductivity of 187 gallons per day per square feet, which is equivalent to 25 feet per day.

In Section II I chose the upper limit of hydraulic conductivity as reported by a pump test and also reported from the literature, and that would be 2500 feet per day. That is a pure -- almost a pure gravel, very little fines mixed in, very fast moving subsurface water. You can find that in the subsurface for limited -- in limited areas, that we have very good, very well sorted materials and gravels and cobbles.

The same simulation is shown on pages 2.2 and 2.3 for 5 barrels per day. It shows that very rapid movement of the pollutants away from the injection source, it's very quickly, and at the end of a year you have pollut-

ant movement, well, at the end of a year you have pollutant movement 600 - 700 feet away in excess of the standards, and that's on page 2.4.

At the end of two years you have movement a couple of thousand feet away and you also have movement in the horizontal direction, as well. That's on page 2.5.

On page 2.6 we talk -- the same simulation is repeated for one barrel per day and the effects of mixing and dilution become very apparent with the high conductivity of 2500 feet per day.

As you can tell, you have fast movement and lower concentrations. Again my feeling is that you -- those numbers of 2500 feet per day are certainly reported in the literature and that one particular pump test right next to the river showed the hydraulic conductivity of that -- of that high value.

The final section, Section III, shows some values from Flora Vista area, and that area is right next to the river, too, and originally I expected to find equally high values of hydraulic conductivity based on the fact that it is right next to the river. The water levels are influenced by recharge and discharge, some are seasonal areas, and so on. However, the pumping tests that were done as part of a -- or actually specific capacity tests that were done as part of a study about the availability of water for additional well fields, showed contrary to having high conductivity, it had about 100 feet per day, and I used that

number in my final simulation in Section III for concentrations or for discharges 14 milligrams per liter and values of discharge ranging from 5 barrels per day down to 2.5 gallons per day.

And the first set of simulations is for 5 barrels per day. At the end of sixty days you have concentrations scattered throughout the plotted area that are about 30 times the health standard at 300 parts per billion. Again the health standard is 10.

At the end of one year, according to the simulation, you have the health standard exceeded at a distance of 250 feet away from the injection site.

At the end of two years you have the standard exceeded at 350 feet away in the direction of groundwater flow, and at a distance of about, oh, 100 feet either side of the -- or either side perpendicular to the direction of groundwater flow.

And that's for 5 barrels per day.

The same simulation was recorded on page 3.7 for two years at one barrel per day and in that particular case I had the coordinates a little bit tighter and it shows concentrations within 100 feet either side of the injection point exceeding standards in the direction of flow. In some cases 10 to 100 times, yeah, 10 times the standard.

It was repeated again on page 3.8 and 3.9 for a half barrel per day, or 21 gallons per day, and that one also shows exceedence of the standard of 10 parts per

billion as far as 250 feet away for 730 days of simulation. Or two years.

And the last output shows 2.5 gallons per day and after two years you get numbers over the area that are less than the standard for benzene.

And I'd like to draw some conclusions from this simulation for two years of testing or two years of computer simulation.

At low hydraulic conductivity -- conductivities of the area the simulations show benzene concentrations exceeding the standard of 10 parts per billion in the vicinity of the discharge point for all volume discharges.

High -- high hydraulic conductivity simulations show benzene concentrations exceeding the standards at all 5 barrels per day simulations. In other words, where I simulated 5 barrels per day going into the ground, the standards were exceeded at all times, even with this very high discharge rate, or flushing rate of the aquifer.

At lower volumes of discharge, half barrel, one barrel per day, the average concentrations were less than the standard in some of the simulations but you may have some localized high concentrations within that area.

At the Flora Vista, using the Flora Vista aquifers values, and they were some real world aquifer values, it shows that benzene exceeds the standards as discharges of a half barrel per day or greater, and approaches

the standard of 10 parts per billion at 2.5 gallons per day discharge.

In summary, I'd like to say that use of a more sophisticated model, taking into account both the real world aquifer parameters and some of the chemical information presented by Mr. Schultz and others, shows contamination still occurring at all levels of aquifer -- for all levels of aquifer permeabilities in the area at discharge levels of 5 barrels per day.

Contamination at discharge levels of a half barrel per day were shown to exist in the computer simulations for all hydraulic conductivities inputted into the computer except for those exceptionally high hydraulic conductivities that I mentioned of 2500 feet per day.

Since hydraulic conductivity values can -- can vary widely over an area, due to geologic effects and deposition, and such, my conclusions are that we still should protect for lower discharge values by requiring that -- that pits have linings.

And that concludes my -- and certainly we should not let pits discharge at 5 barrels per day without lining, based on these computer results.

Q Okay, Mr. Boyer, just to summarize your testimony here, what you've done here is use what you call a random walk model and just --

MR. KELLAHIN: Mr. Chairman, I object to counsel summarizing the witness' testimony.

That's improper and I object to it.

MR. STAMETS: Okay. Will you ask the witness to summarize his testimony, please?

MR. KELLAHIN: I believe the witness has just summarized his testimony, Mr. Chairman.

MR. STAMETS: Are you satisfied with your summary, Mr. Boyer?

A Yes.

Q Mr. Boyer, was your -- when you did this modeling, you simply used the same assumptions as with your previous simple mixing model.

A Yes, and I used the same -- same assumptions with the exception of the Flora Vista values, which were not included in the simple mixing model because I didn't have those available.

I also included as part of my assumptions additional values that -- from the literature and from Mr. Schultz' testimony on retardation factors for benzene.

Q And basically does the use of this more complex random walk model support your findings in your earlier modeling?

A Yes, generally it does. It shows that -- if there are any differences from the earlier modeling, is that the effects of dispersion and dilution, as would be expected using a complex model, have an effect on diluting some of the -- some of the benzene values that are close to the standard. In other words, as you get further away from,

as you get further away from the source of the pit, those -- those numbers or those mechanical effects act on the concentration numbers to give lower concentration values.

However, the effects of dispersion are not so great as to eliminate a health hazard with the concentrations.

Q Thank you.

MR. TAYLOR: I have no more questions.

MR. STAMETS: I presume that there will be some questions of Mr. Boyer? Correct.

MR. KELLAHIN: Absolutely.

MR. STAMETS: Would you like to consider this over the lunch hour and then start about 1:00 o'clock?

MR. KELLAHIN: At the pleasure of the Commission.

MR. STAMETS: Let's do it. We'll recess till 1:00 o'clock.

(Thereupon the noon recess was taken.)

MR. STAMETS: The hearing will please come to order.

Mr. Kellahin, you have some questions.

MR. KELLAHIN: Yes, sir. Thank

you.

RECROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Boyer, I'd like to direct your attention back to the status of your groundwater monitoring study at the Flora Vista site.

I, sir, have also forgotten the specific dates involved, but I believe that after the April 3rd hearing in this case you were in the process of and subsequently have obtained water samples from the various groundwater monitoring wells that you have placed in the vicinity of the contaminated Flora Vista water well. Is that true?

A That's not quite correct. We sampled the -- when we installed the monitoring wells we could not use a hollow stem auger or other types of drilling equipment other than a heavy duty rig because of the presence of large cobbles and boulders.

So instead of that methodology we used a backhoe, since the water table was so low, to excavate the pit and then put a steel drive point and a -- with a piece of pipe attached to it.

Now the samples that we got were gotten at the completion of the digging of the backhoe and before the pipe was put in.

Q Mr. Kendrick identified for us on one of

his exhibits earlier this morning, I believe some five sites around the Flora Vista contaminated water well. Were there in fact five sites?

A We put in five drive points and casing points.

Q Have you had an opportunity to look at Mr. Kendrick's schematic and does that reasonably within a few feet show the location of these points?

A Yes.

Q Have you taken samples from each of those five points at some time prior to today?

A Not from the points. As I said, we sampled the dug pit but not the --not the points.

Q All right.

A Because we did not finish developing the wells so that they could -- monitoring wells so that they could be sampled.

Q We've got samples, then, from the pits the backhoe dug --

A Right.

Q -- at the same locations, then, where you will or now or later put the drive points in.

A Right.

Q All right. Did you take -- did you, in terms of having the ground -- the backhoe dig the ground at these five points, did you take care to use a clean backhoe and all those kinds of things that Mr. Hicks did in his

work?

A Yes. We steam cleaned the bucket each -- each time in between digging the pits.

Q And I assume that the sampling technique is the same that you have applied yourself to the samples that were discussed in a prior hearing and you did all those things consistent with the standards of your profession?

A Yes.

Q And have you subsequently, then, had the samples submitted to a qualified laboratory and had them analyzed for concentrations of benzene?

A Yes.

Q And what were the results of those analyses with regards to the benzene concentrations?

A From that one grab sample at the time we dug the pits for the drive points and monitoring wells, there were no detectable benzene levels in the results.

Q When we discussed what the methodology is of an hydrologist to go about studying a site of potential contamination we discussed three different levels of investigation.

We previously talked about taking certain hydraulic parameters, making some assumptions, and doing a simple dilution calculation. Do you recall that?

We talked about the next level of investigation would be to take information that you used in the dilution calculation and use a little more sophisticated

mathematical models such as the random walk computer.

A Yes.

Q And talked about that. And you agreed with me, I believe, that the final and last step in making a groundwater study would be to go out and actually monitor the groundwater with pits like you've described at Flora Vista, that kind of process --

A Right.

Q -- that you and Mr. Hicks have conducted.

And I believe you agreed with us that in terms of investigating groundwater contamination, that if we apply the same rationale that the EID did in terms of approving discharge permits, that as an applicant came before EID with a simple dilution calculation that did not bust standards, using agreed upon assumptions, then we could grant a permit.

A Right.

Q And we found that if the simple dilution calculation still showed that we busted the benzene standard, that we could go to a more sophisticated mathematical model and use the random walk and see what happens.

Agreed?

A Uh-huh.

Q All right. We found if the computer modeling of the site shows that you did not bust the standards, then we could approve the permit.

A Right.

Q And if we showed that the computer modeling of the site showed that it busted the standard, we could go and actually conduct groundwater monitoring and have site specific data, actual information to show us whether we are posing a risk to the groundwater.

A That's correct.

Q All right. And if the groundwater monitoring done by you or someone else is correct and accurate and shows no levels of contamination in excess of the standard, then we could get the permit.

A Yes.

Q All right. You've commenced on a process of developing information on that second level by using random walk, have you not?

A Yes, sir.

Q The random walk mathematical process has been conducted on how many different sites by you, sir?

A On how many different sites?

Q Yes, sir.

A It was run on the information and the -- using the assumptions that were presented in the February 3rd hearing plus the information, aquifer parameters on the Flora Vista, so it used -- I ran it with several sets of aquifer parameters based on a range of values both from the literature and also based on actual site numbers that I came up with.

I had -- the only site, I guess you could

say, the only, site specific information I've run it for is the Flora Vista area where I use the information that was gathered from a hydrologic study to get the actual aquifer parameters and thickness at that site.

Q I didn't ask my question very well but that's the answer I was trying to elicit from you, is that you're using the hydraulic data for the Flora Vista site so that you can model with random walk what the computer will project in the way of contamination at Flora Vista.

A Okay.

Q All right, is that right?

A Uh-huh.

Q Okay. In using the random walk, what were the source term parameters that you used in running any one of the three computer runs that you've discusser earlier?

A What were the source terms?

Q Yes, sir, in terms of volume and concentration that you put -- plugged into the computer?

A Okay. The -- as discussed on that third section, I ran it using different -- different volumes in barrels per day or gallons per day, five gallons per day, one gallon per day, a half gallon per day -- excuse me, let's try that again.

Five barrels per day, one barrel per day, a half barrel per day, and 2.5 gallons per day.

Now, the concentration that I ran that at

was 14. I used the same concentration, 14 milligrams per liter benzene, for everything in all those runs.

Q Do you have, sir, a copy of Tenneco's Exhibit Number Four out of Mr. Hicks' book? He refers to that as Table I, do you have a copy --

A Yes.

Q -- of that?

All right, sir.

MR. KELLAHIN: Mr. Chairman, I'll give you an extra copy of Table I for your reference.

Q In running the computer model, then, you used a benzene concentration of 14 milligrams per liter.

A Yes, the same level that I used in the February 3rd simple dilution mixing.

Q All right. Mr. Hicks has prepared and compiled for us on Table I information from the OCD field data identifying wells and indicating on the tabulation whether it's an analysis of the benzene concentration from the separator or from the pit and he's put it on the table.

A Yes.

Q Do you have any disagreement with the accuracy of the information on that table?

A No. I don't have any. We have not yet seen the information from the Geoscience Consultants but other than that, I'm personally familiar with the results of the table.

Q I meant to exclude, sir, the Geoscience

Consultants data and look at that portion of the table as it only reflects the OCD data.

A Right.

Q All right. When we actually measure -- actually sample the pit water and have that analyzed, we have an average of 3.58 milligrams per liter based upon the sampling of one, two, three, four, five, six wells, I believe.

A Yes.

Q All right, and we look at the Flora Vista sample, the third one from the top, and it shows a pit sample of 3.2 milligrams per liter.

A All right.

Q Have you plugged into random walk a benzene concentration using 3.2 milligrams per liter to see what will happen to the standard?

A No, I did not model at that level.

Q Have you attempted to use any of the field data from the Flora Vista well, including the analysis of the pit water or any of the groundwater monitoring results that you've obtained from Flora Vista in order to calibrate your computer?

A No, I haven't, and I might add the purpose of using the Flora Vista numbers was for reasons of comparison between the number of 25 feet per day hydraulic conductivity and 2500 feet per day hydraulic conductivity.

I am -- was not attempting to model any

contamination movement at Flora Vista. I was attempting instead to show what would happen with those aquifer parameters of -- Flora Vista aquifer parameters and a concentration of 14 milligrams per liter.

By no means am I attempting to provide a model of movement, or any alleged movement from the pit. I was just using those numbers because they were numbers that became available as I was looking at the record -- or record of the file at Flora Vista.

Q Would it be acceptable methodology for a hyrdrologist to take the field data that you have developed from the Flora Vista site and use that information to calibrate the random walk sampling or computer runs for that site?

A If you were, again, if you were attempting to model the movement at Flora Vista, yes, certainly should. You could use as much of the data as you have in any model.

Again, that is not my -- was not my purpose in putting data in for Flora Vista. I was just using the Flora Vista data again to provide what I felt were realistic aquifer parameters in between the range that I gave originally, that Mr. Hicks has given in his testimony.

Q You'll have to help me understand, Mr. Boyer, I'm having trouble here.

If we've got actual field data that shows an absence of contamination of groundwater from a suspected

use of an unlined pit, using the volumes we have in Flora Vista, and the actual groundwater monitoring shows no contamination, why would you not want to take that data, plug it into the computer, and use that to determine whether or not you can predict contamination for other wells that have not been subject to groundwater monitoring?

A I'm -- I'm a little bit not understanding what you're asking here.

The monitor wells we dug have not yet been developed and have not yet been completed sufficiently to get samples from them.

The data from some testing that was done in 1981 as to the aquifer parameters was used to come up with some simulations using 14 milligrams per liter.

Now I did not run a model using 3.2 milligrams per liter, but that, I could easily have done that. At the time, again, I was using just the average values of concentrations that I had from the February 3rd hearing and to make this model for -- strictly for possibly interpretive purposes as to compare the output from this model, the random walk model, with the simple dilution calculations.

And I did that and again I was not intending to try to model this, the Flora Vista. If I did, I think I would have gone in and put in the pumping wells, for example, Flora Vista wells; the well field produces a certain capacity per day. That could have been entered into the model very easily.

The model could have been oriented directly to the groundwater flow region in there. Once we come up with the numbers for gradient we could throw those in there, and there are a lot of things that could go into the model if I intended to use the model for modeling Flora Vista.

And I didn't. I just was making an interpretation of -- of aquifer parameters from the site and I did not intend to model the contamination. That was not the purpose.

Q We have water samples and analysis from the Flora Vista sites that show after you analyze them that we do not have concentrations of benzene in excess of the standard.

A Right.

Q Do you expect that information to change once we put the drive points in and take additional samples?

A I have no way of knowing at this time. The wells need to be pumped. They need to be developed. You know, I just don't know. The study has not yet gone to completion. It is very preliminary. The results I took at the time I took the samples have been reported and show no contamination, at least in those wells, at the time they were taken.

What the study is going to show when we get to going and completing it is something else again. I cannot speculate right now.

Q Why weren't these monitoring wells developed immediately at the time the backhoe dug out the pits for you?

A Because the back -- because when we put the earth back into the backhoe -- into the pit, some of the water and some of the fines went into the wells. The backhoe is not the usual way to put in monitoring wells. It was just that this case we needed -- we -- in the absence of having a heavy rig that could break through the boulders that were in some cases up to a foot in diameter, a backhoe was the most expedient way to do it.

When the wells have been properly developed and purged, I think that they will provide additional data.

I have nothing further, you know, in the way of factual information to offer at this time.

Q Can you use, I'm not sure you have and let me ask you this about the computermodeling, can you use the computer modeling, the random walk, upon which to base a study to determine whether or not we ought to have the continued use of the unlined pits, subjecting them to 5 barrels a day or less, can you use that to predict something in the vulnerable area?

A Yes. I think -- I think it -- I think within the limitations of the model, as I've discussed, it can be very useful. Certainly is a much better tool than going out and looking at a site and saying you don't have

any contamination. It provides known mathematical and physical laws and combines them together to provide some idea of what can happen when you add a certain volume of contaminants in certain concentrations.

Q You haven't reached the level of your studies that have done that yet.

A I have done that -- I have done that for generalized ranges of values.

Now, again you're talking, if you're talking about site specific things at Flora Vista, there was no attempt to model the situation at Flora Vista just to use the aquifer parameters that were available from a report.

Mr. Hicks used an aquifer parameter from Bill Stone's report.

Again, this -- there has not been, or at least not as readily available, a wide range of transmissivity and hydraulic conductivity values in the literature for this area.

You know, both Mr. Hicks and myself, and other members of the study committee, are using what is available, plus what is available from textbooks to come up with the range of values. That is why I'm not trying to base conclusions on just one hydraulic conductivity value and one aquifer thickness. You've got to look at a range of expected values and I have done that.

Is the methodology such that you would take the random walk computer and take for those well types,

say represented by the Flora Vista site, take that actual field data and plug it back into the computer model or calibrate the computer model based upon that data and then make some computer runs after you've calibrated the model?

A Yeah, certainly we could do that.

Q And after that's done, then you now have fine tuned or sensitized the computer with actual data that you can then use to develop some projections about how the other pits and other wells of this type are going to handle the produced water that's put in those pits.

A You're talking about -- you're talking about domestic water wells and the effect of the domestic water wells on the -- on the pits? Is that what you're --

Q I didn't do that very well. What I'm talking about is once we have calibrated the computer model with the Flora Vista data.

A For the Flora Vista site?

Q Yes, sir.

A Okay.

Q Then we take out the literature, you guys do what you do, and you find wells that are like the Flora Vista site, you find them on paper. They have the same general hydrology parameters. You've got the large cobbles and you've got all those kind of things. All right.

A Okay.

Q All right, you can take the calibrated model, then, use the volume of water at site X that has the

same general kinds of hydrologic parameters, run the model again on that site, and see it it will bust standards without having to go to groundwater monitoring at that other site.

A Oh, I see what you're -- where you're going.

Q I want to use the model for somthing. We built it, let's do something with it.

A Okay. I think that -- I think that one of the things that are inputs to the model or in any study, if you go out and you take a look at your gradient, you go out and take a look at your -- what your individual monitoring wells show, and because of the, if the model is specifically calibrated for the Flora Vista site, you have the -- you have the water levels in the monitor well to put in. You have the elevations. You have the pumping data from the community system, and everything else, then you can use that model to make predictions based on pages in the pumping of the community system, possible entrance of pollutants, or anything else.

The model has been calibrated for that particular site using those particular configurations of wells and distances, and if you had transmissivities for each particular well you could put that in there, and everything else. It would be very site specific.

When you do a general aquifer model for anything from an individual site to an individual -- to a

basin, it is a very site specific type of thing that will tell you for pumping at 200 feet away from this well and a pit over here, and so on and so forth, it is -- when you get that information, the T and the S's, and you put that into the computer, that is specific information that has been generated for one particular well and one particular site, and then you can run the model varying all those different conditions.

You cannot take that same model with those same wells and lift it wholesale to another site. You can use the same aquifer parameters if they're similar, and do it that way, but you can't -- because every site is different, you cannot, you know, just move a calibrated model, say, on a certain grid of a couple hundred yards, and move it to another site. It just -- you cannot do that.

Q All right, let's assume that within the vulnerable area we have well types like the Flora Vista in which we have aquifer parameters that are similar or identical to such a degree that you're comfortable.

A Uh-huh.

Q All right, then in terms of running the computer runs to predict what's going to happen at another well, the factor that we change would be the source term.

A Yes. If everything is -- if you're -- if you can make an assumption that at one particular unlined pit your saturated hydraulic conductivity is a certain -- certain value, then the rest of it, and you know the approx-

imate thickness of the water table, then the rest of it is -- you can, you know, put into the computer along with concentration and make some predictions.

Q And so if we want to make some predictions about what is happening at another well of the Flora Vista type somewhere else in the vulnerable area, we don't have to go out in the ground and start drilling monitoring wells and taking an analysis from those samples in order to come up with some reasonable projection about what will happen at that site?

A Yes, that is correct. That's why we do the -- the whole purpose is to come up whether you have a site where you have a concern with possible groundwater contamination or you have a site where you have no --no worries about it, based on the types of discharges we're talking about.

Q Just a moment. I think I understand but I want to make sure it's clear on how we calibrate the random walk for the Flora Vista data.

If we have all the hydraulic parameters that we can agree upon for Flora Vista, and we have the actual groundwater monitoring and we find from the monitoring wells that we either cannot detect benzene or that at some point near the pit we have got a certain magnitude of benzene concentration, and let's assume that it's within the standard, can you take that information and back calculate the benzene concentration or the source term that you plug

into the random walk so that you can make the computer simulate and repeat what the groundwater monitoring is going to tell you around that site?

A I'm not sure if that is a capability of that particular model or not. There are computer models that -- that you can, you know, plug in your head and concentration data and come back and -- and come up with other numbers.

I'm not that familiar with -- with the details of the main frame version of random walk as to whether or not you can indeed back out of initial conditions or if you can just move forward. I'm not that sure about that.

Q Well, let's assume either we can do it with random walk or outside of the program you as a hydrologist could back out the concentrations and then plug in a source term that's accurate based upon field data into the computer.

A Yeah, there might be models that could do that, yeah.

Q And that's entirely acceptable as a hydrologist in order to calibrate the model.

A Right.

Q At this point in your study, Mr. Boyer, you have what I will call an uncalibrated computer run on Flora Vista type wells.

A I have a -- I have a model that is more

complex than the simple mixing model that will show what the effect of certain -- the input of certain aquifer parameters and certain concentrations will have on an idealized aquifer and that is as much as I am trying to -- or saying about it right now.

I'm saying that you can get a feel or an idea of what contamination will do, how fast it will move, what the concentrations will be, based on these physical laws and the physical parameters of input.

I am not trying to, as I stated earlier, make a model of Flora Vista's particular situation.

Q We've not taken the model and using the data developed from the field, field water, groundwater quality data, that we've got either Flora Vista or one of these other sites Mr. Hicks talked about some, you have not yet done the calibration of your model to take that field data into consideration.

A No. No.

Q Thank you, sir.

MR. STAMETS: Ms. Pruett.

CROSS EXAMINATION

BY MS. PRUETT:

Q I think at one point there was some confusion, I believe, at least in my mind, I thought I heard two different numbers for New Mexico water quality standards on benzene. 20 parts per million or --

A No, 10.

Q Okay. I just wanted to get that straight.

I believe Mr. Kendrick stated in his testimony that he doesn't know of any way to test for natural gas in water.

Have you ever done those sorts of tests yourself?

A Yes.

Q What methods have you used?

A There's a method called the head space test and it uses the same -- the same 40 milliliter vials that we use to collect aromatic purgables in, and what you do is, you take a sample and instead of filling it up like you would do for aromatic purgables, you leave it about half filled and then the State Lab will run a syringe in there and take a sample and record it and guess microliters, or microliter per liters, or something like that.

Q Is that a commonly used and accepted method for testing for natural gas?

A Yes.

Q Okay. Regarding --

A Excuse me, natural gas in water.

Q In water. Regarding the Geosciences report, did the fact that they didn't find any benzene contamination convince you that there are no other problems at those sites?

A Well, for the wells they sampled they did not find benzene and some of my concerns regarding -- regarding that were brought out earlier, but also I haven't seen any data presented for any of the other things that we look for when we -- under the Water Quality regulations on any of the other standards.

We haven't seen the information for TDS or chlorides or sulfate, all of which are parameters of concern.

Q How long does it take to perform a specific specimen test?

A Thirty seconds.

Q Can you -- have other parameters such as chlorides, TDS, and phenols been found in produced water?

A Well, we sampled -- we samples TDS and chlorides and found that I would expect phenols to be also in there. No, I have not analyzed any of my produced waters for those samples.

I believe, however, some other samples were analyzed for produced waters, I mean for phenols, the ones --

Q Can you make any generalization about the behavior, for example, of chlorides in relation to what we've seen in the behavior of benzene with regard to travel time or effects of attenuation?

A Chloride is a very convervative parameter as far as sampling goes because it moves essentially with

the groundwater. Very little -- there's very little attenuation that you would expect from -- in chlorides, whereas you might have attenuation of other inorganics or organics in groundwater movement.

Q So any exemption based solely on benzene data would fail to address any potential threat to groundwater posed by these many other contaminants, such as chlorides or TDS.

A That's correct.

Q Do you believe that the three wells studied by Geosciences are indeed representative of the 1200 or 1500 produced water pits in the San Juan vulnerable area?

A Well, I believe that there a wide range of conditions in the alluvial aquifers, as I mentioned in some of my testimony about wide range of conductivies and so on and so forth.

The information presented gives some generalized estimates and I -- I would say that they aren't representative. I think that you would need additional data to determine what is representative.

Q Thank you. Regarding the Flora Vista site, do you now deep the Flora Vista Water Association -- Flora Vista Water Users Association wells were?

A They're relatively shallow, at depths of about 23 to 26 feet they run into some sort of a shale layer that is at the bottom of the coarse alluvium in that area, and they completed the wells to the top of the -- through

the alluvium and to the top of the shale.

Q And how deep is the alluvium at that -- that area?

A It's about 23 to 26 feet, at least in the well records I've seen at the site.

Q Do you believe it's reasonable to conclude that contamination from a deeper contaminated alluvium of, say, 200 - 225 feet as presented by Mr. Kendrick, has indeed contaminated that Flora Vista Water Users Association well?

A At what depth?

Q The 225.

A If there were no other artificial pathways, I would find it difficult to believe that there could be contamination in that manner.

Q Why?

A Well, again if there is a basis -- if there is indeed a shale or confining layer, you get very little movement through a confining layer, and the only way you would get movement is if you had artificial penetration, such as other wells in the area that went all the way through; such as oil and gas wells, for example.

Q Again, assuming that the Flora Vista Water Users Association well is somewhere shallower than 25 - 23 feet, do you believe it's reasonable to conclude that contamination from the blowout from the well to the west is responsible for that contaminated well?

A I would conclude that that would be very unlikely. In between the -- in between the sites you have other domestic wells that have -- that act on the aquifer or change the gradient.

The topographic gradient in that area is opposite to the direction that the contamination would have to flow to get into the Flora Vista well and the influence of additional pumping wells, what also must be factored in there is that they are much closer to -- to the -- where the well is blown out, where the blown out well was, and it would seem to me that if there was contamination as a result of the blowout, that it would be detected there instead of in an up gradient well over a mile away.

Q Do you think it's more reasonable to conclude that some sort of activity at the Mary Wheeler site contaminated that well?

A Some sort of activity, yes.

Q Now in order to model the Flora Vista situation, as suggested by Mr. Kellahin, what sort of -- what do you need to input historical data regarding the volume of water as to the pit and concentration of benzene and the period of time over which the water was added and before -- do you have that general information available to you now?

A No. Again, that's not the type of information I desired because I wasn't attempting to model the Flora Vista situation.

Q And could you in the absence of all that additional data, reasonably use the model to simulate what we would expect to see at that site today?

A In the absence of the data, yes, I could not -- I could not run a model without having some additional inputs to, you know, to, as we talked about later, to calibrate it.

Again it just, my particular model just gives a generalized idea of what would happen at some sites for those particular aquifer parameters.

Q And in order to generalize the information from that model to other well sites, indeed you would need to input significant amounts of other data --

A Yes.

Q -- such as I've just suggested, wouldn't you?

A To make it -- to make it very specific to other well sites, yes.

Q If, as I think, and I can't remember who suggested today that perhaps a reasonable alternative to a small volume exemption was some sort of pit registration form, what sorts of information and documentation would you like to see provided on that form?

A I think that probably that would require a considerable amount of thought on my part. I have not gone into it and I'd like to sort of reserve making any comments on that just off the top of my head, because I think

it would be something that needs input from myself and other people on my staff.

Q Do you think you could put together some sort of proposed list of what you'd like to see on that form as (not understood)?

A Yes.

Q I have nothing further.

MR. STAMETS: Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q Mr. Boyer, in your conduct of the investigation of the pollution at the Flora Vista water well, did you interview people and look through other records that may not have been presented here as exhibits?

A Well, again, I have not examined all the records but there were a number of other pits on the site, and currently the produced water pit is the one that is lined.

Q Is the dehydrator pit lined?

A There's a barrel. It's not lined as such. There's a barrel under the end of the pipe that catches stuff.

Q In your investigation did you determine when that barrel had been placed there?

A I'm not aware of the date, no.

Q Had that barrel been placed there prior to or after the discovery of the pollution in the water

well?

A I -- I'd have to go back to the records, Mr. Chavez. I think at the time -- I think at the time -- I'd have to go back to the records to be sure but I think at the time it was placed after the discovery.

Q If Mr. Hicks sampled the produced water in that steel drum, what would he have found?

A I don't know.

Q Have you read, in your investigation and all, have you read a report on produced water in the San Juan Basin put out in a magazine called The Workbook?

A I have read that, yes.

Q If that steel drum contained only glycol, crude oil, or other discharges from the dehydrator and let's say that steel drum wasn't placed there until after the pollution had been discovered, would you consider that may have been a source for the grease and oil found in the water samples of the Flora Vista water well?

A If I understand you correctly, if the drum was not placed till after the pollution was discovered and prior to that time anything that went into the dehydration pit was -- and the pit was unlined, could that have been a source? Yes, it could have been.

Q Mr. Boyer, the type of soil that exists at the Flora Vista site, if I were to scrape away some topsoil and dump a bucket of water on it, what would happen to that water?

A It would disappear quickly.

Q So therefore, perhaps water samples which are standing in pits are not representative of the type of water which would enter the surface of the soil at Flora Vista, is that correct?

A At the -- at any site I think if you had a separator or dehydrator that did not put out much oil but mainly water and maybe a little bit of distillate, and you had a sandy area, that water would enter very quickly into the subsurface.

I'm not sure if I've answered your question but I'm not sure if I understood it.

Q Thank you.

MR. PEARCE: I really would object to that, Mr. Chairman, that's not allowed.

MR. KELLAHIN: Sir, objection.

MR. CARR: Mr. Chairman --

MR. STAMETS: The objections are sustained.

Q Did you talk to anybody with the industry or anybody in the Oil Division about remedies that were taken at the Mary Wheeler well site after the pollution had been discovered?

A I've had some general conversations, Frank, you know, very -- as to all of the intricacies and such. I am not prepared to, you know, to go into a great amount of detail but I wasn't expecting to get into great

detail at this particular time on the Flora Vista situation.

There is a great amount of documentation in the files in EID and also, I'm sure, in the OCD files, that possibly would be of some use as far as trying to elicit all the different facts and circumstances and order of circumstances on this particular incident. We've heard different versions from different people today and I think that if there was to be a great amount of reliance on it, it should all be entered into the record as an exhibit that -- so that everybody could ascertain all the different circumstances and facts and what has been done.

There's a lot of it that I am not that personally familiar with and I have not read that closely as to the circumstances that occurred back in 1981 and '82.

MR. CHAVEZ: That's all I have.

MR. STAMETS: Mr. Carr.

CROSS EXAMINATION

BY MR. CARR:

Q Mr. Boyer, I'm going to try and understand what you've done.

In terms of your computer work, if I understand what you do, is you take certain data, you run them through the computer using this random walk model.

A You get it -- yes.

Q And from that you're reaching certain conclusions about contaminants that exist in the fresh

water.

A The potential for contaminants to move and exist, yes.

Q How many computer runs on random walk had you performed prior to doing the ones that we've had presented here today?

A Personally I've never -- I have never run the random walk; however, it is a well documented model and it's based on hydrologic principles which I'm very familiar with.

Q And what you do, you take a certain field data in this case that you drew from Flora Vista area.

A In one, yes, I used that as well as some other stuff.

Q Okay, and then you supply some general mathematical figures and you work these through the computer.

A Right, the computer works through them, right.

Q And what you've got at the end isn't based on any one particular well.

A That's right.

Q And you have not run anything that shows any one individual simulation from a well.

A That is correct.

Q In other words, what you have is a simulation that you believe is of general application.

A Yes, given those assumptions that were set out in the first page of the exhibit.

Q But these assumptions and these conclusions don't actually show a real world situation as it happens in any one particular well.

A It comes as close as you can get without going out and sampling -- digging essentially concentric circles around a particular well and sampling each point in a grid.

Q So is it your testimony that this data is really a real world situation that you're depicting?

A I think -- I think, again, within the limits of the numbers I've put in and with the assumptions that have been made, it is real world.

Q Does this model take into account the methods of attenuation that we've discussed here before?

A It takes into several methods, yes.

Q Does it take in biodegradation?

A No.

Q And is it your testimony that that does not occur in the real world?

A I think that -- I think that I have testified to the fact that biodegradation does occur and I have also testified to the fact as to why I didn't believe it was as significant as some of the other folks.

I also have testified to the fact that -- that this gives a model of -- based on physical estimates.

Q But it is your testimony that biodegradation does occur in the real world.

A Yes, I admit it occurs in the real world.

Q And that your model did not take that into consideration.

A Yes.

Q Now, you have focused your work on benzene, have you not?

A This particular, yes. These runs that I've presented today I have run with benzene, yes.

Q And the reason for focusing on benzene is as you testified in February, that that was the more important constituent now.

A Because the levels that we detected coming from the separator were orders of magnitude in excess of our health standard, whereas, some of the other constituents coming out were not so orders of magnitude.

Q So that was the primary thing --

A Yes.

Q -- that you were focusing on. Likewise, that's why we focused on it because of what you said.

Now do you have any data whatsoever today to present to this body concerning any problems, any contamination, concerning chlorides or TDS?

A The data that I collected from the produced water samples shows that in some of the samples there was high TDS and in some cases as high as 30,000, I believe,

TDS.

In some samples it was -- it was a couple of hundred.

Q In the samples that you're talking about and that you have presented testimony on, these are samples from the separator, not samples of groundwater.

A The information -- okay, back in February I presented and also at the subsequent April the 3rd hearing, I presented the tables of the analyses from the produced water that showed some of these samples to have high TDS.

I also presented historic information in the Aztec Quadrangle that listed TDS of some of the values and the average for that alluvial area was 725 TDS.

Q Have you run the random walk on anything other than benzene?

A Yes.

Q And I didn't hear all of your answer to the last question. Were some of these samples that you took and analyzed, were they from groundwater -- were they groundwater samples or just from the separator?

A Well, I have analyzed as part of my work, and when I was up in that area I have analyzed or had analyzed, several domestic water well samples from people that were in the vulnerable area.

Q But the data you presented was from the separator.

A The data -- the data that I presented at this exhibit, I mean this hearing, on my Table 8 through 12, were from the separators and some pit sampling.

Q Thank you.

MR. PEARCE: Very briefly, if I may, Mr. Chairman.

MR. STAMETS: Mr. Pearce.

CROSS EXAMINATION

BY MR. PEARCE:

Q Mr. Boyer, could you walk through the process that you used with the backhoe when you developed the five monitoring locations around the Flora Vista well?

A Well, as I stated before, we needed to use a backhoe because previously EID had tried to use a hollow stem auger and they couldn't do it, so we took the backhoe and we took it down to the well site.

We had rented a portable steam cleaner to use and we in between and each site we took it, and took the backhoe on down and -- and flushed it out thoroughly with the hot water and steam coming from the steam cleaner and then we took it back to the site and dug the ditch.

Q Okay, how deep was the ditch?

A I think it was -- maximum depth was about eight feet or so.

Q And when you got it down to that level it immediately filled with water, is that correct?

A Yes.

Q Indicating to you that you were below the water table.

A Right.

Q And after water had gone into that ditch, you snatched some sort of samples of it.

A Right.

Q How did you do that?

A The same way we sampled the others. We took a clean Mason jar on the end of a long pole and immersed it in the water and pulled it out and then we immediately put it in the 40 liter vials and capped the vials.

Q In the process of a backhoe digging holes, a backhoe does not use water the way a rotary rig uses mud or liquids.

A Right.

Q It's dry.

A Right.

Q There's no water added to the trench during the digging, is there?

A No.

Q So far as you know, Mr. Boyer, would water coming in contact with the backhoe eliminate the presence of benzene?

A Would water coming into contact with the backhoe eliminate the presence of benzene?

Q Yes, sir, if I take water with benzene in

it and pour it over a backhoe, will that eliminate the benzene?

A No. A backhoe is not a sorptive medium.

MR. PEARCE: I have nothing further, Mr. Chairman.

RECROSS EXAMINATION

BY MR. STAMETS:

Q Mr. Boyer.

A Yes, sir.

Q Mr. Kendrick said he was in the oil and gas business up there for forty years and no contamination had been found up there.

Is there any significance to that in your mind?

A I think that the fact that they haven't found it does not mean that it's not present. I think that you have -- we were not charged for looking for contaminated water wells as part of the study. We were charged with protecting water that had a potential for reasonable foreseeable use, and the fact that there has not been documented contamination in water wells may be more a function of where the water wells are placed in relation to the oil wells and the hydraulic gradient and these other aquifer parameters that we've talked about, more than the fact that they -- it has not yet been found in the water wells.

So I would say that the fact that it has

not been found is not significant given the different hydrologic actions that can occur once -- once water is disposed of in the ground, or produced water is disposed of in the ground.

Q If one discounts the organics in the produced water, is the produced water in the San Juan Basin generally of better quality than that in the southeast?

A I would say generally yes. There are high TDS and some of the samples, low TDS in some of the samples. In most of the samples it exceeds 1000 milligrams per liter, which is in the New Mexico Water Quality Control Commission regulations for -- for groundwater.

Q If one takes this generally better quality water and puts it in a pit and the factors of dispersion, dilution, absorption, and all of that works on it, could that also not be the reason why we don't see polluted groundwater up there, that in fact the pit water is diluted, et cetera, to the point where it's noncontaminated, where the fresh water is noncontaminated?

A Yes, as I've testified, I think that there are certainly areas up there where those processes are very much acting on pollutants put into the groundwater, but you also have variable situations and I don't know if you could make a generalization to the same variables being present at the same level in every area.

In fact I would venture an opinion that you could not.

Q Now, Mr. Hicks presented evidence on three sites that seemed to confirm the microbiological degradation diminution of benzene. Why should this Commission not rely on Mr. Hicks' study or be convinced by Mr. Hicks' study in reaching a decision in this case?

A Well, as I just mentioned and stressed again, and will stress again, is that Mr. Hicks' study consisted of three individual pits and as I mentioned in some of my -- or Mr. Taylor mentioned in some cross examining questions, and also as I've mentioned, you have a lot of different conditions in the San Juan Basin, in the vulnerable area we're talking about.

You have -- you have a high potential for discharge of the contaminants into the subsurface. You have mechanisms for movement of those contaminants in different directions, mainly down the hydraulic gradient. You also have some attenuation mechanisms that act at various levels at various times, some of which are delay and some of which are removal. The actual, physical impact of each one of those at a particular site would be impossible to measure.

I think that you must, the Commission must look at the -- the -- what -- what you are protecting as part of a -- you must protect for the, in this case, what is the most conservative case for these supplies.

I think that the record as far as clean up after a contamination case is both a hardship for the person whose well has been contaminated, if that happens,

and also the general clean up of the area is -- is not as effective as prevention beforehand, and again, the information I've presented shows a very reasonable and real potential for a contamination of these waters and the fact that three instances of investigation, does not remove, I think, the -- that potential.

Q Mr. Hicks' Exhibit Number Three, he shows the -- well, let's see -- the Paine Gas Unit A 1-E Well, spud date 10-23-80, turn-on date 6-1-81. That well has been on production pretty close to four years now.

A Uh-huh.

Q He shows the level of benzene, separator level, at 53,218.

A Uh-huh.

Q And 40 feet away from the edge of the pit he's got less than 1 part per billion, or if you want to measure to the center of that pit it's just 100 feet away.

A All right.

Q Doesn't that seem to indicate that these factors of volatilization and microbiological degradation of benzene actually work?

A Well, Mr. Stamets, I, again, I'd say that we have three -- we have three isolated well points placed in the -- next to the swamp in this particular area.

I think that there are additional questions that need to be asked as to maybe some of the characteristics of the bottom of the pit, some of these other

things, to make actual determination of whether or not that -- all these things that were presented as far as degradation and so on and so forth were actually occurring.

I don't think that -- I don't think, again, that you can rely on just the -- on three -- on three samples taken at one time to do that.

Q Let me see if I understand your view of the problem, then.

Are you telling me that you believe that we just don't have enough actual experimental, empirical evidence at this point to demonstrate that -- that the benzene is not a problem in the San Juan Basin? Is that --

A I agree with that. I think -- I think we do not have enough experimental evidence to demonstrate it is not a problem. I think we have sufficient hydrologic evidence to demonstrate that it is a very real and potential problem.

Q But again, isn't that a hundred percent theoretical at this point? We have not measured benzene in the groundwater that had to get there from a pit.

Is that correct?

A We have not measured the benzene in the groundwater?

Q That had to arrive in the groundwater from a pit.

A That is -- that is correct.

Q So on that side we don't have a positive

measurement for benzene in groundwater. On the other side you're telling me we don't have enough measurement saying that in fact benzene is not going to get into groundwater.

Is the net result of all of this that we just don't have enough information to arrive at an informed conclusion at this point relative to benzene?

A No, sir. Relative to benzene alone?

Q Yes.

A No, sir, I -- I think that -- I think that given the health concerns of benzene and the toxicity of the contaminant, I think that -- that we do have a -- enough evidence to -- to regulate disposition of waters that contain it.

I think that as with a lot of regulatory things, I think you need to -- you don't need to look and have documented instances of contamination all over the map before you begin the regulation.

You take a look at the information indicating what sort of potential it has to become a problem and act in a reasonable manner in that way.

Q Most of the evidence that we've heard at this hearing relates to benzene and toluene. Are there other organics in the produced water that we should be concerned about, or do you expect if there are that they will react much in the same way that benzene and toluene do?

A Well, there are other organics in the produced water, yes. We analyzed for ethylbenzene as well

as these other -- as well as the xylene. Ethylbenzene is a parameter of concern and I understand that there may be some -- there is developing some information as to possible standard for ethylbenzene.

I think that also there are other types of organic materials, we briefly refer to them polyneucle-aromatic hydrocarbons, stuff like that, I believe that's the correct terminology, and I am not familiar and don't maintain to be an expert on -- on their presence and movement.

But benzene is a very mobile organic and moves faster than most of the rest of them. So benzene, being toxic and being very mobile is a prime one to be concerned when we do these modeling studies, and the results I presented this morning also took into account Mr. Schultz' retardation factor, which indicates some sorptive properties of the soil, assuming a certain amount of organic carbon, and even with that factor, then, it still showed contamination in excess of standard for some of the simulation runs.

So I have factored in as much information as is available right now and without -- with all due respect to the gentleman that talked about biodegradation, it is just now beginning to get attention and, you know, I'm not sure that we can draw conclusions as to the viability of that particular mechanism in all cases that we're dealing with here.

Q If in the interest of gathering more data the Commission came up with a pit registration process, is

that the sort of thing that's -- would it be self-deciding that would eliminate a lot of work for the Division, a form which would say I produced X barrels of water. If this volume is over 5 barrels per day, you are prohibited from having an unlined pit. Ask for a lined pit.

Or, if the produced water is in excess of some value TDS, again the form would say, you may not have unlined pit. Go to lined pit. Get your $2500 check out.

Is that a possibility?

A Well, certainly -- certainly if the Commission decides that it wants a 5 barrel per day exemption, that certainly would make our job easy because there is not too many pits that produce over that in this particular area, but I think you could have certain conditions and request that the operator provide information with the -- with the notice that would make it sort of self -- puts it on yourself processing; however, the field people and the staff, environmental staff, would have to be able to verify all the information put down on the pit, on the form regarding the pit.

Q If such a process were used, would -- do you believe it would be necessary that the produced water be examined for all of those parameters that are in the drinking water standards of the Water Quality Control Commission, groundwater standards?

A No, I think it -- I don't think produced water would have to be looked at for all those numbers. I

mean for all those constituents. I think that you'd want to take a look at your TDS and chloride sulfates; maybe some other inorganic parameters of concern, and I think you'd want to look at your -- at least right now I'd recommend them looking at the benzene and those organics associated with those; possibly others as we get more information as to how important they are in health considerations.

Q Could you have such a list together by May the 7th?

A As to which standards we should look at?

Q Yes.

A Yes, oh, yes.

Q Now let me ask you about that.

Let's assume afor a moment that we have a pit out there that receives one barrel per day and the TDS level is 9,999.

Now, is that -- well, let's round it off, let's say just a nice 10,000. It's easy to work with.

Should that be prohibited? Is that the prohibited level or should it be something that's double the standard, four times the standard? Is there some level that could be arrived at relative to TDS or some of these other important contaminants that we could give as guidance?

Let's say, for example, on chlorides with a drinking water level of 500 --

A Two --

Q Is it 200?

A It's 250 in the groundwater standards.

Q Okay, let's say then that your chlorides are, well, four times that, or ten times that. Could a figure like that be put down on this self-deciding pit registration form? Say if your chlorides exceed this level you've got to have a lined pit?

A We're looking at the concentration and the volume put into the pit. I think it gets back to the same problems that we're having with small barrel exemptions. If you get your --

Q Could some maximum amount of worked out? Let's say that we decide on a -- just utilize now 5 barrels a day, and what's the maximum amount of chlorides you would like to see going in the groundwater at 5 barrels a day, could that volume then be used regardless of Mr. Kendrick's suggestion. That's the limit on chlorides whether you're got one barrels a day or five barrels a day?

A I think you've got to tie it to the volumes. I think that if you had 5 barrels per day, depending where you're located, I think you're going to end up with --

Q I think that's the point I'm getting at. If you've got 5 barrels a day at 250, is that not going to be the same as one barrel a day at 1000?

A Yeah, right, right. If you decide to go that methodology that there's a certain amount of pollutant load per day that you feel is acceptable for discharge to the groundwater, whether it be 5 pounds of chloride or some-

thing like that, if you make that determination, then certainly you could either do it concentraton times, you know, you could have the different variable concentration and quantity to equal that pollutant level.

Q Mr. Boyer, after listening to all the evidence presented in this case, is there any small volume exemption that you would be willing to recommend even on a temporary basis at this point? Let's say for a period of 18 months while additional data is gathered?

A Well, I think that one of the things that allayed some of my concerns was taking this random walk model and running it and taking a look at some numbers.

I think that the 5 barrels per day is clearly exceeded. I think that there is some small volume, possibly a half barrel, that I feel that -- I feel that I could live with based on this results and just taking a look at that, and coincidentally, that also happened to be the Committee recommendation the first time around, a half barrel per day exemption and some minimum distance to groundwater, which all pits have to be lined.

And I still have very many concerns over 5 barrels per day exemptions; however, after looking at the computer models and hearing some of the other testimony, I have less concerns about -- I was looking at 2.5 gallons per day, I'm a little less concerned over that and on a temporary measure I'd be willing to support half barrel per day and 10 feet to groundwater.

Q Okay. If Amoco and Tenneco, who presented evidence relative to the pits, were willing to go into some sort of a cooperative program with the Oil Conservation Division to develop more information, is that the sort of thing that you believe you could do working with their people?

A Oh, yes. Yes, sir.

MR. STAMETS: Mr. Kellahin, while we're on that subject, I believe you relayed to me earlier today that the contract -- Mr. Hicks does not believe the facilities that were installed earlier would be appropriate for a longer -- for a long term monitoring study.

Would Amoco and Tenneco be willing to engage is some sort of reasonable long term study with the Division in this matter?

MR. KELLAHIN: Mr. Chairman, my client, as well as the other clients represented today by outher counsel, I think have consistently maintained a reputation before the Commission to cooperate to the fullest extent of their ability to see if we can solve the problem once we've demonstrated that the problem exists.

I'm a little concerned about committing my client to further expenditures in this case when they've already assumed a significant expense in preparing today what I think is a solid, substantial case to show that we don't have a problem with each pit area.

If, however, the Division wants our company to participate in additional studies, we'll be happy to discuss that and see what levels of financing and staff effort we can commit to the project.

One of the things the Division requested early, and it seems like a year ago, was the short term study committee, and my clients and many of these other clients in this room have actively participated in that effort.

Now if this is to be a task assigned to the short term study committee or to the long term study committee, I know that my company will continue to participate as best they can.

The specific answer to the question about whether the Paine, the Eaton, and McCoy sites can now be used for continued sampling is that they cannot. We have not policed the area, and cannot be assured of the integrity of those well points. We in fact know that some of them have been contaminated and some of them have been removed and we'd have to drive new points.

If we can agree upon, with our hydrologist and Mr. Boyer, well sites under our control that can be the subject of groundwater monitoring, I think we can work that.

I'm sorry I can't be very specific in my response to you, but we will cooperate in any way we can. We have to get management approval for further

participation of money and staff, but we will do as we have done in the past, to contribute to study committees by the Commission and to cooperate in any way we can to solve the problem that the Commission perceives exists.

MR. STAMETS: Thank you, Mr. Kellahin.

Are there questions of Mr. Boyer?

MR. ELMER: I'd just like to ask one question, please, Mr. Chairman.

CROSS EXAMINATION

BY MR. ELMER:

Q Mr. Boyer, taking the hypothetical program that Mr. Stamets outlined, which I guess is self-registration self-policing program, is that an effective program to insure the integrity of the groundwater?

A It's hard for me to, you know, make a determination just based on, you know, the bare outline that was looked at right today.

I think that any -- however, I think that any program would require a certain amount of spot checking to make sure that -- that the self monitoring, or whatever, self-reporting is being done correctly.

Q Thank you.

MR. STAMETS: Any other questions of this witness?

He may be excused.

Is there any other direct testimony in this case?

MS. PRUETT: I don't have any direct testimony but I want some clarification in the record of the testimony in writing offered at one of the previous hearings by Mr. Lorang of El Paso Natural Gas.

Since he hasn't been produced as a witness I would ask that testimony be considered as an unsworn statement rather than a sworn statement.

MR. PEARCE: That's fine, Mr. Chairman.

MR. STAMETS: All right, thank you.

Mr. Kellahin.

MR. KELLAHIN: Mr. Chairman, in response to Mr. Taylor's rebuttal witness, we also a surrebuttal witness that will confine his comments to the random walk computer modeling that Mr. Boyer's done and we would like to forward with that witness.

Perhaps you might want to take a short break but I anticipate that our next witness' testimony may take an hour and a half to address those issues that are of most concern to us. So I know the day is running out, but I want to give this witness an opportunity to have a fair representation of his testimony.

MR. STAMETS: Let's take about

a fifteen minute recess.

(Thereupon a recess was taken.)

MR. STAMETS: Mr. Kellahin, do you have a witness?

MR. KELLAHIN: Yes, sir.

Mr. Chairman, at this time we'd like to call Alberto Gutierrez.

Mr. Gutierrez, I believe, is sworn at the prior hearing. Let the record reflect that he is still under oath. He has taken his seat in the witness chair.

ALBERTO ALEJANDRO GUTIERREZ,

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Mr. Gutierrez, for the record would you please state your name and occupation?

A Yes. My name is Alberto Alejandro Gutierrez and I'm a professional geologist. I'm President of Geoscience Consultants, Limited.

Q For the record, Mr. Gutierrez, would you please describe for us your educational background, when and

where you obtained your degree?

A Certainly. I did my undergraduate work at McGill (sic) University in Montreal and also at University of Maryland in College Park; graduated in 1977 with a BS in geomicrology from University of Maryland at College Park, with honors, and then I then continued my studies at the University of New Mexico, where I received a Master's degree in 1980 in the field of geology with a specialization in hydrology and both surface and near surface groundwater hydrology.

Q Are you a member of any professional organization in your field of experience?

A Yes. I'm a Certified Professional Geologist with the American Institute of Professional Geologists.

I'm also a Registered Professional Geologist in the State of Arizona.

I am also a member of numerous professional organizations, such as the Geological Society of America, the National Water Well Association, American Association of Petroleum Geologist, et cetera.

Q Would you describe for us what has been your experience in the field of regulatory development and implementation when it comes to matters such as groundwater?

A Certainly. In 1975, when I went from McGill to the University of Maryland at College Park, one of the primary reasons for going there was to go to work for the United States Geological Survey at the same time as I

was completing my studies in undergraduate school, and that work consisted primarily of working on environmental impact statements and regulatory development associated with the National Environmental Policy Act.

Also, in working on the development of Council Environmental Quality regulations and guidelines.

Primarily I have also worked in the private sector as a consultant to EPA and a number of other government agencies in policy issues and regulatory development.

Q What was your Master's thesis on, Mr. Gutierrez?

A I did my Master's thesis on the Near Surface Hydrology and Sediement Transport in the San Juan Basin of New Mexico.

I spent two and a half years working up there on a grant from the New Mexico Environ -- the New Mexico Energy and Minerals Department to look at hydrology of strippable coal areas in the San Juan Basin from Chaco Canyon north.

Q Have you been involved in the preparation and the submittal of applications on behalf of individuals or companies to obtain discharge permit approval from the EID of New Mexico?

A Yes. As a consequence of my employment with Geoscience Consultants, Limited, which is a firm that consists of hydrogeologists, chemical and environmental en-

gineers that specialize in hazardous waste and waste related issues.

We have a number of clients that we have not only prepared and submitted or are currently preparing and submitting discharge plan applications for, but also for a number of clients we're involved in actual clean-ups of hazardous waste sites and contamination resulting from both spills and leakages from the surface impoundments and other industrial activities.

Q Did you participate as a geohydrologist on the Oil Conservation Division Short Term Water Study Committee of the San Juan Basin?

A Yes, I did.

Q Have you had experience as a geohydrologist in using the random walk simulation of produced water disposal pits?

A Yes, I -- well, let me qualify that by saying, yes, I have run random walk but not only produced water disposal pits but I've used it in many different applications to look at the potential impacts associated with contaminants that have been discharged either onto the ground or from the soil into the groundwater at various types of sites.

MR. KELLAHIN: Mr. Chairman, we tender Mr. Gutierrez as an expert geohydrologist.

MR. STAMETS: He is considered qualified.

Q Mr. Gutierrez, I'd like you to direct your attention back to the prior hearings in this case. Did you attend the hearing we had in this case back in February 20th and again on March 3rd of this year?

A Yes, sir, I attended both those hearings.

Q And you're appearing today on behalf of Tenneco Oil Company as an expert geohydrologist?

A That's correct.

Q And pursuant to that employment as a consultant, have you made a study of produced water and disposal in the unlined pits in the vulnerable area and its potential impact upon groundwater in that area?

A Yes, sir. My firm, that would include not only myself but also Mr. Hicks and a number of our other staff have been involved in a study on the effects of produced water, the potential effects of produced water on the groundwater in the vulnerable area of the San Juan Basin.

Q Have you had an opportunity to review and study not only Mr. Boyer's testimony but the exhibits he're presented at the prior hearings?

A Yes, I've had an opportunity to review his exhibits at the prior hearings and just briefly reviewed his exhibit that he presented this afternoon, or this morning.

Q Have you conducted on behalf of Tenneco a random walk simulation of produced water disposal pits of the vulnerable area of San Juan Basin, New Mexico?

A I have not only conducted a random walk simulation but in effect we have conducted random walk simulations on a wide variety of cases in the San Juan Basin. As a matter of fact, if we -- if you'd like to go to my exhibit, we can start going through some of those.

Q All right, sir, let's turn to -- first of all, before we begin to discuss these figures and the information in the study itself, I'd like for you to give us some background, not only in the terms of the wells that you studied on behalf of Tenneco and Amoco, but the background and the methodology you will apply to addressing the potential contamination of groundwater by the use of unlined production pits.

A As Mr. Boyer's testified, the random walk model developed by Thomas Prickett and others, and included as Bulletin 65 of the State of Illinois Geological Survey Report, is a model that has been used by a number of hydrogeologists, is well accepted in the hydrogeologic community as a two-dimensional groundwater model that can be used to approximate the behavior of certain constituents in the groundwater at various locations.

So basically, I won't go into that any further other than to say that it is a well accepted model which has wide application possibilities.

Q In your opinion is it appropriate to apply random walk simulations to determine whether or not there are levels of contamination occurring in the ground-

water as projected by the computer when we're evaluating the impact of the unlined -- the use of unlined production pits?

A Certainly it's applicable. I think that the use of random walk as a method to simulate the potential effects of contaminants that may reach the groundwater as a result of disposal in an unlined pit is very useful and gives a better approximation of reality than would a simple dilution calculation.

I also think that even better yet, a field calibrated model of random walk would go even further towards demonstrating a more realistic picture of what occurs.

Q You were present in the hearing room earlier this afternoon when Mr. Boyer testified about the fact that he had not calibrated his random walk simulation. Did you hear that testimony?

A Yes, I did.

Q Would you tell us, then, what the mechanisms are for calibration of random walk and the different factors that go into calibrating random walk so that you assimilate and use the actual data derived from the groundwater monitoring and other sources that you apply in the model?

A Well, there are various methods of calibrating, not ony random walk, but any computer model of groundwater.

Those methods would obviously include

gathering of field data from monitoring wells, not only head data but also concentration data, and comparing that to the results that one obtains from running the model; also by inputting estimated hydraulic conductivities and/or determined hydraulic conductivities.

Q How -- what hydraulic conductivities were used to calibrate your walk?

A Okay. Basically, if I can go to that exhibit now.

Q All right, sir.

A If we look at Table 2 in my exhibit, you'll notice that it says Predicted Benzene Concentrations in Ground from Random Walk --

Q All right.

A -- Simulations.

Q Table 2 is page four in my book. Is mine different from yours?

A No, it's page four in my book if you do not count the cover page.

Q All right, sir, you want us to turn to Table 2 of the Exhibit Number Four?

A That's correct.

Q All right, sir, I have that. What do we do with it?

A Basically if you'll look at several major categories that were discussed in Mr. Hicks' testimony, which we have broken out the sites which Mr. Hicks surveyed

in the field and estimated hydraulic properties by visiting each one of these sites.

In addition you will note that under the category of field calibration sites it shows three sites that were used where actual groundwater -- or two sites, excuse me, that were used where actual groundwater gradients and concentrations were known, to calibrate the major, two major categories which Mr. Hicks referred to in his testimony of the river valley flood plain and the valley side slopes and side slopes and tributaries.

Q How do the hydraulic conductivity values that you used in applying the random walk analysis, how do those compare to the ones used by Mr. Boyer?

A We have used hydraulic conductivity values that are within the same ranges as those that Mr. Boyer has used and indeed we've even looked at hydraulic conductivities below those which Mr. Boyer has used in his calculations.

Q When you use the phrase "below" is that --

A Lesser in terms of transmissivity.

Q Would that be a more conservative or a more optimistic parameter?

A It would be more conservative in the sense that it would tend to predict higher concentrations in the immediate vicinity of the pits.

Q All right, sir, using then the informa-

tion on Table 2, what then is the next thing you do to calibrate your model?

A Okay. Primarily, if you'll note what we did was with the category -- the sites that Mr. Hicks visited, we fit them into the two categories that they logically fell into as we started looking at the various characteristics, both in terms of the materials, the lithology, and the hydraulic characteristics, and you'll note that for the river flood plain we've included the San Juan River cases and broken those up into high, medium, and low hydraulic conductivities with ranges of 10,000 gallons per day per foot for the hydraulic -- high hydraulic conductivity cases; 1000 to 5000 gallons per day per foot squared for medium hydraulic conductivity cases; and 10 to 100 gallons per day per foot squared for the low hydraulic conductivities.

For the Animas River, following to the next page, you'll note that we did -- we observed only one high hydraulic conductivity case of the ones that were included in our random sample, which is included in there as the Marcotte No. 1.

No medium or low hydraulic conductivity cases came up in our random sampling of the cases in the Animas River.

For the valley side slopes and tributaries we used again the same divisions in terms of high, medium, and low hydraulic conductivity.

Q Does that complete, then your recitation of how you used the hydraulic conductivities to calibrate your model?

A Well, let me just go on. I just noticed I have another two pages here of this table.

One is that the bedrock mesas cases were excluded because the produced ground -- the produced water could not really enter the groundwater since these cases will lie on bedrock in terms of entering alluvial aquifers.

Secondly, te Pictured Cliffs cases there are no simulations because basically those waters -- those gas wells tend not to produce water and not have produced water pits associated with them.

Also, the next page shows well sites that were visited for which hydraulic information was estimated and collected but which were not part of the random sample. In other words, were not selected by the random number generator in order to be included in the study.

Basically, the ranges of those hydraulic conductivities that I described were developed as Mr. Hicks described in this testimony.

Q I want to go through with you each of the different components or parameters that you plug into random walk and before we leave this parameter, which I'll simply characterize as the hydraulic conductivity parameter, I want to see what your testimony is with regards to the hydraulic gradient data on the valley slopes and the river valleys,

and whether that is an optimistic or a conservative number in relation to the actual field data gathered by Mr. Hicks.

A Well, let me address that in two ways. One by saying first that the field -- the sites were, we actually had monitor wells installed in the groundwater and where we measured depth to groundwater and had those surveyed by a surveyor. The gradient was determined exactly by that mechanism.

Q Let's take the McCoy Well. What was the hydraulic gradient in the McCoy Well that was actually observed in the field?

A Hydraulic gradient that was used for the McCoy Well determined from measurement of water levels in the wells which were implaced at that site was .0076.

Q What was the hydraulic gradient used for the McCoy type simulation that you plugged into the computer?

Mr. Gutierrez, is it not the Marcotte No. 1 entry on the second page of Table 2?

A I am looking for -- I'd have to refer back to the original computer run because my gradient measured at the -- or shown on the figure in Mr. Hicks' testimony is .0076, and the gradient on my simulation is .004. That could just be a typo. I'd have to refer to the original.

Q All right. With regards to the hydraulic gradient used for the McCoy type computer runs, did you use

a number that was actually observed in the field or one that was more conservative than the one actually measured in the field?

A Well, it's more conservative in the sense that the gradient is lesser and therefore the vertical -- I mean the speed at which contaminants could travel, the velocity would be lower, using a lower gradient for the same transmissivity.

Q After we leave the hydraulic conductivities that go into your computer model, what did you use in terms of the foot thickness of the zone?

A We used the same thickness that Mr. Boyer used in his initial calculations of 25 feet.

Q In terms of porosity, what number was used for the porosity parameter?

A Again we used the same number which was used earlier, which was a porosity of 25 percent.

Q All right, sir, in terms of the parameter of the flow rate, how was that parameter developed and used?

A Well, the flow rate is a function of the hydraulic conductivity, the porosity, and the gradient, and it's a function of hydraulic conductivity divided by the porosity times the gradient, because it's the regional, what is called the regional X flow or the velocity.

You'll note in all of the cases that we had regional X flow be a certain number; regional Y flow will be zero in all cases simply because we aligned the X axis according to the gradient direction.

Q Have you covered for us, Mr. Gutierrez, all those parameters or elements by which you used to field calibrate the random walk simulation of the operation of the produced water in the unlined pits?

A Well, frankly, I haven't really gotten into that yet.

Q All right, sir, let's do that now.

A Let me just finish by -- the discussion of the input parameters, by saying as Mr. Boyer has shown in his exhibit, as well as in ours, where you have a -- on page one, Figure 1, just shows a typical input parameters for random walk simulation. Let me emphasis that this is not the parameters that we used in every case that we have. The parameters that were used in each of the cases are written in the -- on the bottom of each of the figures associated with those.

But you'll note that the parameters include transmissivity, which is a function of hydraulic conductivity in the saturated thickness.

In all cases we used a saturated thickness of 25 feet.

Storage coefficient we used .1 in all cases.

In hydraulic conductivity, obviously was estimated in the field as Mr. Hicks described in his testimony.

Porosity, .25.

Longitudinal dispersivity of 10.

Transverse dispersivity of 2.

Retardation coefficient of 1. You'll note that in runs which Mr. -- at least from the brief look that I got of the runs that Mr. Boyer ran, he used a retardation coefficient of 7, which -- and yet higher longitudinal and transverse dispersivity values. Those factors tend to counterbalance each other and therefore with his retardation coefficient and his higher dispersivity values we're at about the same place as we are with our model.

Regional X flow is calculated as I described before.

The source term we used the value of concentration of benzene, and again we ran all these for benzene because of the fact that that parameter seemed to be the parameter of greatest concern. The source term that we used was 3500 ppb, or 3.5 milligrams per liter based on the approximate average that we derived from looking at the data on values in the pits.

We then used for a volume of water the actual volume which was produced at each one of the individual wells which we looked at. That would have been our quote/unquote uncalibrated runs.

For the calibrated runs what we did was say we had the McCoy site, which is typical of the type of lithologies and materials which Mr. Hicks observed in the river valley, river bottom areas.

We used the Eaton site to represent the types of materials and lithologic characteristics that were observed in the valley side slopes and tributaries, and consequently used the actual values of benzene monitored in the monitor wells at these two sites to determine what the appropriate source term would be since we did not have any clear quantification of what would happen to the benzene concentration or the source term from the point when it left the pit to the point where it entered the groundwater.

Q Mr. Hicks divided the well population in the vulnerable area into two major categories of wells. Have you attempted to calibrate your computer model to take into consideration the field investigations and the hydraulic parameters that Mr. Hicks attributes to each of those types of well populations?

A Our parameters which were well established at the sites which we did detailed field investigations for, those hydraulic parameters we were -- had a high level of confidence in, therefore we felt that the concentrations which we observed during the actual monitoring were a response to the source term which actually was entering the groundwater and therefore for the McCoy site we looked at first what the effect would be of running the model using the actual 3.5 milligrams per liter or 3500 ppb source term that was average from the produced water analyses in the pits and noted that the results of that model indicated good agreement with the observed concentrations in

the field without any alteration of the hydraulic parameters or that source term.

However, if you'll note under the section of my exhibit where we talk -- where it says Field Calibration Sites, I just was discussing the first site that we looked at, the McCoy site.

If you'll look at the next one, which is labeled Case Number Eaton A 1-E, where it says uncalibrated, you'll note that again we ran that model using a concentration of 3.5 milligrams per liter benzene and the predicted concentrations in the groundwater, as you can see from the contour map above, and in comparing that to the actual concentrations which were measured in the groundwater monitor wells, the model grossly overpredicted what contamination would occur in the aquifer.

We therefore --

Q Just a minute, Mr. Gutierrez, let's make sure that we're following you. I want to make sure that everybody has the uncalibrated Eaton A 1-E projection.

All right. You now have the Eaton type -- you have the Eaton Well, which is the McCoy type population?

A No, no, no.

Q I got that backwards.

A Yeah.

Q All right.

A The Eaton Well, which is characteristic

of the population of wells that fall into the category of valley side slopes and tributaries.

Q All right. We have an uncalibrated computer run on that Eaton site.

A That's correct.

Q The Eaton site had actual groundwater monitoring data that Mr. Hicks developed.

A That's correct.

Q How did the actual groundwater study compare to the uncalibrated Eaton projection by the computer?

A As presented in Mr. Hicks exhibit, which I believe is Tenneco Exhibit Four, --

Q Three.

A Three? Okay. Where you see in one of his figures the benzene concentrations in the Eaton site, you'll note that as Mr. Hicks presented, we had less than detectable, i.e., less than one part per billion in Wells 1, 5, 4, and 6, 7, and -- excuse me.

In Wells 1, 4, 6, 5, and 7, and we had a concentration of 11 parts per billion in Well 2 and a concentration of 7 parts per billion in Well 3, and you'll note that on the run which is included in my exhibit as the uncalibrated run for Eaton, in the area where these wells are located the model predicted in excess of 19.8 parts per billion.

Q All right, what conclusion do you draw from the fact that the computer uncalibrated predicts a

higher concentration of benzene than the actual groundwater study that Mr. Hicks did at the Eaton site?

A Since the hydraulic parameters at the site were well established, we concluded that in effect the one real unknown which is what's been bantered about throughout this hearing, is what happens to the organics concentrations from the point where they leave the pit to the point where they enter the groundwater.

Consequently, we felt that the model needed to be calibrated in terms of what the source term was, what the concentration was that actually entered the groundwater.

Q For the Eaton site well population all the parameters that went into the computer, are you confident that those were accurate and reliable except then for the source term information?

A Except, sir, for the source term that we estimated to be 3500 parts per billion, that's correct. I was certain of -- the source term consists of two factors, volume and concentration. I was certain, or relatively certain, of the volumes produced based on the information which we received from Amoco about that volume of water production.

Q All right, sir, and as we flip to the next page, then, we have the calibrated Eaton A 1-E computer run.

A That's right.

Q All right, what have you done in order to generate this?

A Basically it was an iterative process of running the model with lower and lower benzene concentration inputs until we were able to achieve an approximate, or the best approximation of the field data that we observed in the monitor wells.

Q Once you had the computer model calibrated with the actual field data, what conclusion did you draw about the levels of benzene detected by the computer in its simulation as calibrated of the Eaton site?

A Well, we felt that once we calibrated the source term that the computer adequately represented the observed groundwater concentrations in the monitor wells.

Q All right, sir. What then did you use the calibrated Eaton site random walk simulation for in determining how this applied to the other wells of similar type in the vulnerable area?

A Well, given the fact that Mr. Hicks had gone out and looked at a number of sites in the valley side slopes and tributary category, and those sites displayed similar characteristics to what was observed at the Eaton site where we had more detailed lithologic and hydrologic information, we concluded that it was reasonable therefore, based on the calibration of that model, to assume that the mechanisms which have been discussed by Mr. Schultz, Mr. Boyer, and Miller, and others, with respect to biodegrada

tion and others, were operating and even though we did not and could not quantify what those model -- I mean what those actual mechanisms were, that there was something happening to the benzene by the time it entered the groundwater and therefore was reasonable to reduce the source term concentrations based on that calibration -- field calibration.

Q Can you approximate for us the number of computer simulations you've done for the Eaton type wells in the vulnerable area?

A I can give you the exact number. If you'll refer to the table on -- it would be page five. It's the second page of Table 2.

Okay, you will note that the -- there were several cases included in there and I just almost got confused here myself, so I want to bring this point out for clarification.

The McCoy D 1-E that is listed in there is not the same McCoy Well that we used for the river bottom sites.

So those cases which you see listed under valley side slopes and tributaries were the ones that were run with Eaton calibrations as well as -- let's see -- yes, that's correct.

Q What conclusion do you draw from running the computer simulations of the Eaton type wells in these vulnerable well populations in terms of exceeding or being within the benzene standard?

A Well, the conclusions based on runs that we performed were that the model given that calibration of the source term did not show a tendency to exceed the groundwater standards and indeed predicted rather low concentrations at distances both close and far away from those pits.

If I may mention one other thing that would serve as a point of clarification.

It must be understood that the random walk model inputs contaminants into the groundwater by simulating the effect of an injection well, essentially, not -- it does not account for any processes which would take place in the unsaturated zone, and therefore, if you want to take into account any processes that would take place in the unsaturated zone, you must adjust the source term which you put into the groundwater.

Q Did you adjust your source term to take into consideration the mechanisms of attenuation, such as the biodegradation terms?

A We did by the mechanism which I described previously.

Q All right.

A For the cases that resemble the Eaton site.

For the cases which resemble the McCoy site, there -- since the concentrations of benzene which we observed to be the average in the pits were in effect in

some of these areas of higher transmissivities and in the river bottom closer proximity to groundwater, we concluded that these vadose zone processes would not be as prevalent in those areas and indeed the models demonstrated that even with that concentration of 3500 milligrams per liter, 3500 parts per billion, excuse me, going directly into the groundwater in the method that I described that the model puts them into, still did not result in exceedence of the standards.

Q When we take Mr. Hicks' actual groundwater study of the Eaton site, take the computer model and calibrate it, take into consideration the factors that would be typical in the Eaton type wells, calibrate the model, and run it, based upon similar wells in this type of well population, do you find wells that are going to exceed the standard by the disposal of produced water at 5 barrels a day or less in the unlined pits?

A Based on -- okay, I didn't connect that last part of the question, I'm sorry.

Q I want to know whether or not in applying the computer calibrated model, using the Eaton data, and having applied it to similar Eaton type wells in that population, whether or not you will find by using the program or the computer, wells that if -- pits, if exposed to 5 barrels a day of produced water or less, are going to exceed the benzene standard for groundwater at those sites.

A No. Based on our simulation that would

not appear to be the case.

Q When we turn now to the McCoy type population, Mr. Hicks has got groundwater monitoring and actual field data on the McCoy site, have you done computer work and random walk simulations of that type of well?

A Yes, we have.

Q And have you calibrated your random walk to take into consideration the actual data Mr. Hicks developed for the McCoy site?

A Yes, we have, as per the method I described before.

Q And have you simulated other types of McCoy wells in the vulnerable area to determine whether the computer will simulate a benzene level in the groundwater that will exceed or be within the standard?

A That's correct.

Q And did you find any computer simulated runs in which the benzene standard was exceeded by the McCoy type well population?

A Not in the cases that we ran, no, sir.

Q In using -- when you did these computer runs is there a range of values in the parameters used based upon Mr. Hicks' field observations that would make any significant difference in the way you calibrated your model?

A Well, I'd have to answer that by saying no, and for the reason that we considered cases which spanned a range of hydraulic parameters from 10 gallons per day

per square foot of hydraulic conductivity to as high as 10,000 gallons per day per foot squared of hydraulic conductivity and the estimates, based on the Freeze and Cherry table which -- of hydraulic conductivity based on lithology and using that table would certainly be within one, two, three, four, four orders of magnitude.

Q In using the computer simulations for any of these simulations that you ran, what were you using for the volume of produced water per day for each one of those computer runs? Were you using a simulated number or were you using actual numbers that had been reported to you?

A We've used the actual numbers which were reported to us by Tenneco on Tenneco wells, by Amoco on Amoco wells.

Q In terms of having the computer simulate various typs of wells in the vulnerable well population, were you using actual cases to show whether or not there is a large range of values in the well population? In other words, did -- did you use various volumes of water produced in the simulations?

A Yes, sir, volumes of water ranging from, as I recall, four barrels per day to about, oh, you know, hundredths of a barrel per day.

Q Did you -- did you use in the computer runs various hydraulic conductivities?

A Yes, I mentioned the range for those earlier, 10 to 10,000.

Q And did you use various ranges in the hydraulic gradients?

A Yes, sir, based on actual measurements and based on conservative estimates taken from -- measurements taken from topographic maps.

Q And when we run all of these field calibrated random walk simulations of what's happening in various areas of the vulnerable area with this pits, do you find any of them that bust standards on the benzene?

A Not of the runs that we did, sir, with the exception of the uncalibrated Eaton site.

Q And once the Eaton site is field calibrated with actual data you find that that is within the standard?

A That's correct, with the exception of Well No. 2, which is very near the produced water pit and exceeds the standard by one part per billion.

Q From your study of this area, Mr. Gutierrez, does this absence of the computer's ability to simulate pollution, in other words, benzene concentrations above the standard, does that surprise you as a hydrologist?

A No, not really, it doesn't surprise me.

Q Would you describe for us what conclusions that you can draw from having conducted the random sampling, the use of the random walk simulation, on the various well types within the vulnerable well populations?

A Well, my conclusions, Mr. Kellahin, would

not be based solely on the random walk runs which my firm did, but rather have to consider all the evidence which has been presented at this hearing, as well as the other parts of our study, and that evidence would lead me to conclude that within a wide range of hydraulic conductivities and a wide range of volumes of produced water disposed of in unlined pits, less than 5 barrels per day, we, one, do not see any documented cases of groundwater contamination by the parameter benzene that are attributed to produced water pits, and furthermore, that the indications based on our field studies, our groundwater monitoring at various locations and the subsequent attempt to broaden the base of the investigation by looking at numerous actual well locations and modeling them using the random walk simulation, that it's not surprising to me that we haven't had those documented cases of contamination because the risk from those low volumes to groundwater appears very small.

Q Mr. Guttierez, you have participated in the Oil Division's Short Term Water Study Committee?

A That's correct.

Q You've conducted the calibrated random walk sampling or simulations of produced water disposal pits in the vulnerable area. Your firm has done actual groundwater monitoring at sites in the vulnerable area.

The Commission is considering whether or not to exempt small volume unlined pits in the vulnerable area on a blanket basis of 5 barrels a day or less.

What is your recommendation on that issue and how should the Commission draft an order on that point?

A Well, I'm not quite sure I can answer the second part of that question about how the Commission should draft an order, but I certainly can say that based on the work that we have done, based on the data which we've seen presented, we feel that it would be unjustified and excessive to require that pits for volumes of less than 5 barrels per day of produced water be lined or otherwise taken out of service.

Q Do -- as a geohydrologist with experience in regulatory matters, do you see any purpose served by requiring the operator to file on a site by site or a well by well basis in order to have small volume pits exempted?

A Given the evidence that we've seen in the hearing, I believe that really the more appropriate route to take would be to handle the pits that, and/or sites, well sites, that present a threat to the environment and a threat to human health on a case by case basis rather than seeking to exempt a large number of sites that may indeed pose no problem on a case by case basis.

Q Thank you.

MR. KELLAHIN: Mr. Chairman, we move the introduction of Tenneco Exhibit Number Five.

MR. STAMETS: Without objection the exhibit will be admitted.

Are there questions of this

witness?

Ms. Pruett.

CROSS EXAMINATION

BY MS. PRUETT:

Q Can you explain to me on your first page where you give some of the numbers you've used, where you got the figure of 250,000 gallons per day per foot squared, which is 50 times larger than Mr. Boyer's figure of 4,675?

A Now if you'll look at -- well, I wish that you could show me Mr. Boyer's figures. I think I've got his exhibits up here.

If you'll note on the very first page of Mr. Boyer's exhibit, he has transmissivity ranges which range from 4,675 gallons per day per foot, to 11,220 gallons per day per foot, to 467,500 gallons per day per foot.

So I think that if you'll look at then at the ranges in conductivity that -- the ranges in transmissivity that we have looked at in our study, using a saturated thickness of 25 feet, as did Mr. Boyer, for our high, and we would come up with 250,000 gallons per day per foot, and for our low end we would come up with 250 gallons per day per foot.

Q Maybe I didn't quite make my question clear.

Did you get these figures from pump tests, from literature, from field data, where did you get

your actual numbers that you used?

A Oh, for hydraulic conductivities? I was -- oh, I thought you were asking me about transmissivity.

Transmissivity is a function of the hydraulic conductivity in the saturated thickness.

The hydraulic conductivity values were obtained from -- in the cases where -- let me speak first of the cases where we actually did the field work, okay?

Those cases, those hydraulic conductivity values were estimated using Freeze and Cherry's chart after we excavated in order to put in the groundwater monitoring wells, in other words, based on grain size analyses.

Also, in the case of the McCoy Well, which is very near the McMann No. 1 Well which Mr. Boyer has given us the conductivity as 2500 feet per day, we used that data.

We also used recovery data of the pits when they dug below the groundwater, as well as recovery data from the individual well points as they were bailed to evacuate them prior to sampling at both the Eaton and the McCoy sites.

So, in answer to your question, the McCoy site itself has both site specific information which we gathered from observing the lithologic materials, as well as extrapolation from the nearest available pump test performed by the U. S. Geological Survey, and in fact, a reduction of that value by almost a half for the hydraulic conductivity,

transmissivity, and at the Eaton site we used the methods which I described previously. There were no pump tests available in that area. It was again based on those types of evidence.

For the other sites, as Mr. Hicks described in his testimony, it was derived by visual inspection of the pit, the subsurface in the nearby areas on outcrops, other exposures, and on the use of that table that relates grain size to hydraulic conductivity by Freeze and Cherry.

Q I hope you'll bear with me, because I'd never heard of a random walk model before.

So transmissivity is based on hydraulic conductivity and those values are based on a visual inspection of grains at the site and applying that visual -- the experience of his professional career, his visual analysis as applied to that Freeze and Cherry chart.

A In addition to the other sources of data which I described earlier, yes.

And, let me clarify that hydraulic conductivity is the parameter that is estimated. Transmissivity is calculated from multiplying that by the saturated thickness.

Q So any weaknesses reflected in Mr. Hicks' testimony, such as failure to account for snow melt and rain, or the difficulty or unreliability of determining hydraulic conductivity from the visual inspection, would all

be weaknesses that would incorporated into the computer model.

A Well, snowfall and rain have absolutely no effect on hydraulic conductivity.

The inaccuracies that could be introduced by visual estimation of hydraulic conductivity, I would find very difficult to believe could exceed two orders of magnitude, and indeed, you'll see that the simulations that we've done span ranges of hydraulic conductivity from 10 to 10,000.

So really we're dealing with four orders of magnitude in there. We've looked at cases that span that entire range, so we feel that we've accounted for any potential errors that would, you know, result from the visual estimation of those parameters.

Q I'm not asking for you to say whether or not there are weaknesses.

I'm asking you if there are any weaknesses would they not also be incorporated into your computer modeling in the hypothetical?

A Well, I -- I can't even accept the fact that there are any hypothetical weaknesses that are -- that are -- that are caused by the inputs of rainfall and snowfall on hydraulic conductivity. That's a physical impossibility.

If you're saying that if Mr. Hicks' estimate of transmissivity -- of hydraulic conductivity was off

by two orders of magnitude, would my transmissivity and my hydraulic conductivity in my model be off by two orders of magnitude, yes, absolutely.

Q Looking at your -- your diagram for the Eaton A 1-E uncalibrated model --

A Right.

Q -- which you said, I think you said grossly overestimated the amount of benzene found, couldn't an alternative explanation for that be that the samples taken at the site did not pick up actual contamination?

Isn't that a possible explanation for the difference there?

A Okay, in other words you're saying that -- let me see if I understand your question.

You're saying that if we had the groundwater monitor wells put in in a down gradient direction from the pit and the samples that were collected from those wells showed no benzene in them, that the model, if it predicted higher concentrations, could still be right, even though we don't see it in the groundwater monitor wells? Is that what you're saying?

Q Yes.

A Well, if you ask me if it's possible, I'd say anything is possible, but it's not probable.

Q And just so that I understand what the calibration procedure is, once you saw what the computer predicted, which you felt was too high, rather than accept

this as bad news, you then went back and showed that you could run the computer model backward, starting with the results that Mr. Hicks actually obtained in the field, is that correct?

A Well, I didn't take it as bad news or good news. I mean I took it as an uncalibrated computer model and computer models typically, when it's possible, will yield much better results when calibrated in the field.

As a matter of fact, in a -- it's typical on many of the cleanups and contamination assessments that my firm has worked on, and in fact, one that they're working on now for the EID, where there is specific demands made by regulatory agencies to calibrate models using actual field data in order to be able to accurately represent what is going on in the subsurface.

So consequently, that's the procedure we followed in calibration of the Eaton models.

Q Staying with the Eaton models, in the calibrated model on the Eaton Well --

A Uh-huh.

Q -- comparing Mr. Hicks' field samples and your models, what happened to the 7 and 11 reading in Mr. Hicks' field samples? Why are the numbers shown on your calibrated model two orders of magnitude under Mr. Hicks' own field measurements?

A If you look at the kind of resolution that the model has on the basis of what cell size is chosen

to accurately predict concentrations given the number of particles which you use and the mass associated with those particles, and at the same time you try and simulate a long enough period of record that you can actually observe what's going on at a certain distance away from the site, the resolution becomes quite difficult in when you're trying to present it graphically like this in the form of, you know, when you're trying to show 300 by 400 feet, and therefore, what's going on right at the immediate vicinity of the site, if you'll note the scale on here and the scale on these maps are very, very different, and therefore, the kinds of concentrations which were observed at the wells in the Eaton site all fall within that .12 ppb level and at the locations of those particular wells closely approximate the values that we actually observed in the field.

Q Now, the Eaton A 1-E Well, as I recall Mr. Hicks' testimony, was that the actual benzene reading at the pit there was 3500 parts per billion, and my understanding is that on this, again, calibrated Eaton site chart, what you did in effect was reduce that from 3500 parts per billion to 20 parts per billion as your source term as a result, I guess, of biodegradation and other attentuation mechanisms operating, which you then fed into the computer as an actual benzene concentration.

Why did you pick 20 parts per billion? Why not 25 or 40 or 5 parts per billion?

A Well, as I described, it was an iterative

process and you keep reducing or increasing, depending on what your field data show, the source -- in other words, when you're trying to calibrate a model, okay, you take all the parameters which you're relatively sure of, okay, and you prioritize them.

You go, well, this one I know, 99 percent confidence.

This one I know, 85 percent confidence.

And on and on and on, and then you alter the parameter with the lowest confidence interval in order to be able to fit the observed data to it, because it's the one that you have a least information about, and had the least information about what the actual processes and what the quantification of those processes are from the point where the water that is in the pit at a concentration of 3.83 per liter, or actually 3,830 parts per billion, what concentration would actually reach the groundwater by the time it traveled the nine feet that it had to travel through the unsaturated zone at the Eaton site to reach that.

MR. STAMETS: Excuse me for interrupting, Ms. Pruett, but you indicated that on the calibrated model we're talking about 20 parts per billion benzene, and the way I read the exhibit, it's 200ths of a part per billion.

I have here the figure 0.02 ppb benzene.

There's some confusion here.

Did you give me the wrong number or am I reading this incorrectly?

MS. PRUETT: I think I gave it incorrectly.

MR. STAMETS: Fine.

Q Is it true that a number of the -- several of the numbers which you fed into the computer reflect higher, could reflect a higher dilution factor than did Mr. Boyer's calculations?

A Only the range of hydraulic conductivities that we used in our simulations actually can represent much slower velocities than what Mr. Boyer's calculations show, because if I can refer you to Mr. Boyer's lowest calculation -- I mean lowest assumed hydraulic conductivity, we would be looking at 25 feet per day and there's some -- there's conversion factors involved so you'll have to bear with me for a second.

That our range of 10 gallons per day per foot squared would approximate that lowest conductivity which he used in his model and therefore we feel that we've covered the same range, really.

MR. STAMETS: Let me interrupt one more time while we're talking about this modeling.

On the calibrated lower source term, your benzene concentration, I presume that's what you're talking about that's going into the pit, .02 ppb, and you also show concentrations on there in the ground of .12.

A Yeah, yeah. That's a -- that'a typo. That .02 is ppm.

MR. STAMETS: Ah ha!

A It's 20 ppb. That's where that number came from.

MR. STAMETS: Okay, so we need to correct this exhibit then, with calibrated lower source term for the Eaton A 1-E, and change that 0.002 to --

A 20.

MR. STAMETS: -- 20.

A Correct.

MR. STAMETS: All right, so that means that when I corrected Ms. Pruett awhile ago, I was wrong and she was right even though she was wrong when she was doing it.

A You were both right. It was our exhibit that was incorrect.

MR. STAMETS: Very good. I'm certain that that will clarify the record.

Q Your regional X flow of 15 you compared to Mr. Boyer's number zero.

Wouldn't that reflect a higher dilution factor?

A Well, if you compare 15 to zero, certainly, but I mean, first of all, Mr. -- I don't think that Mr. Boyer ever used a regional X flow of zero.

That would mean either that or the gra-

dient is nonexistent or -- or there's no hydraulic conductivity. The regional X flow has to be greater than zero, and again, I need to emphasize that that Figure 1 does not represent the input parameters that we used for every one of these cases. If you'll note, in some of the low hydraulic conductivity cases, let's turn to, for example, the GCU 169 E or the Romero Gas Com A-1, you'll note that regional X flow at the Romero, for example, is .02 feet per day.

Regional X flow at the Ulibarri Gas Com 1-A is .16 feet per day.

Regional X flow at the GCU 169 is also.

MR. STAMETS: Any other questions of this witness?

Mr. Taylor.

CROSS EXAMINATION

BY MR. TAYLOR:

Q Okay, first I think I have some questions about your model.

A Okay.

Q Will you tell us what computer you used to make your random walk runs?

A IBM PC.

Q Is that the same that Mr. Boyer used?

A Sure. Well, I don't know if it's the exact same configuration and memory, et cetera, et cetera, but it's the same general computer.

Q You did say you used an IBM PC.

A That's correct.

Q Do you know if the IBM PC he used allowed calibration such as you performed? I assume you used a (not understood) for this?

A No, that's not correct.

Q Oh, can you tell me how it worked, then?

A Sure. As I described, what we did is we got -- first we said, okay, here's what we measured in the pit at Eaton. Okay, let's talk about Eaton because that's the site that we were -- I think is in discussion. Is that adequate?

Q Sure.

A Okay. At the Eaton site we measured 3.whatever, 58 or 3.83 milligrams per liter, or anyway, approximately 3500 or -- milligrams per -- 3500 parts per billion. This is going to kill me this parts per billion and milligrams per liter.

But, we used that concentration on the first go around just as Mr. Boyer used 14 milligrams per liter. Okay.

We ran it through and we got a certain result, which is demonstrated in the uncalibrated version of that model.

Then, as I explained to EID's counsel, we said, here's what we observed that the model predicts, what do we see in the field? We see X concentrations that were

shown in Mr. Hicks' exhibit, and we did not really run the model backwards.

So in answer to your question, there is no mechanism of running that model backwards.

What you do is you reduce the source terms by just saying, okay, instead of 3.5 I'll use .35 and I'll run it through and see what I get.

And then, say, then take a look at the result of that and you say, does this more closely approximate what I know to be the case based on my field information.

And if that still doesn't get you there, or if it predicts too low a concentration, then you go back and you estimate another point in between and that's what I meant by iterative process.

Q So more or less, as you said, your results there would be dependent upon the accuracy of your collection data in the field when you did the water testing and the water sampling and then tested that for benzene --

A That's correct.

Q -- concentrations.

A That's correct.

Q And you said that the eventual calibrated model that you used, you put in 20 parts per billion --

A That's correct.

Q -- benzene, and I assume that that is your estimation of the benzene that is -- as it is entering

the water level, concentration of benzene as it is entering the water table.

A Based on the field data that we have and the predictions that random walk makes of the distribution of that contaminant.

Q Well, I assume that because you had levels below what you detected around in your monitor wells were not the levels as it was entering the groundwater. When you have levels at the pit and then you're correcting your model for what you consider to be degradation between the pit and some point in your groundwater?

A That's right. That's right.

Q Now I see on Mr. Hicks' exhibit on the Eaton A 1-E, I assume there were seven monitor wells at that site because there are seven numbers there.

A That's right.

Q All of them show less than one as the benzene concentration, except No. 3 and No. 2.

A No, I believe it's No. 7 and No. -- let me just -- I have to turn to that page myself.

I believe it's No. -- no, you're correct, it's No. 3 and No. 2. I'm sorry. It was 7 parts per billion that No. 3 showed.

Q Okay. And you used 20 parts per million apparently in your -- in your model, and how does that relate to the various things here? Did you start with trying to come up with an answer of what -- from your -- in cali-

brating your model to what showed up in the field, what answer are you trying to come up with, 1, 7, 11, as parts per billion?

A You're trying to simulate the distribution over that whole area.

If you took -- if you took these values that Mr. Hicks has, or if you even looked at Mr. Boyer's -- or look at Mr. Boyer's -- any one of his printouts in random walk. The way that -- matter of fact, Mr. Boyer must have a more recent version of Prickett's model because his actually outputs things in concentrations and ours took -- had to take it a step further, but in any case, if you look at his, it actually puts out what the concentration, predicted concentration is at each one of those points. Okay?

Q A grid or something like that?

A A grid, that's correct. I'm pointing to one of the grids on Mr. Boyer's exhibit.

Then what one would do in order to represent that as one would represent any randomly distributed or even non-randomly, any three dimensional or two dimensional data, one would, say, contour that data to determine, you know, what areas fall within what concentrations, based on these results.

Well, consequently, you can do the same thing based on the results of the water quality analyses to give you a picture of what's going on in the areas in between your monitor wells, so to speak. So in calibration

of the model what you try and do is simulate that overall distribution of contaminants rather than -- well, not rather than, but I mean in addition to what you would observe at each one of those monitor wells.

Did I -- am I clear?

Q I don't know, but -- well, let me kind of ask it again, because I'm not clear on it.

A Sure.

Q What you were doing is calibrating your model to what you thought was in the field.

A That's right.

Q And --

A Not what I thought; what I knew.

Q Well, you don't know because you didn't -- you didn't dig up the whole area but you did monitor wells and you calibrated that, calibrated your model with what your monitor wells showed.

A That's correct.

Q What I'm trying to get at is how your confidence level is in this thing, how confident you are that your model is correct and that your field results are correct, and so I -- what I want to get at is that on Monitor Wells 3 and 2, the high --

A Uh-huh.

Q -- levels of benzene, how were those taken into account in making your model?

A Sure. Monitor No. 2 showed 11 parts per

billion benzene; No. 3 showed 7 parts per billion benzene.

The way that's taken into account is by looking at the results from the various iterations of random walk with various source terms, and seeing which one best fit the observed concentration.

In other words, what you're trying to do is replicate that concentration which you measured in the field, make the model say it's 11 parts per billion here and 7 parts per billion there, you know, and it's of course to the fact that you maybe don't have the well falling right on a grid point in your period or, you know, those things can't be helped, but in terms of my confidence interval, it's really pretty good, and the reason being that if you look at how many monitor wells are in this site which overall, you know, we could fit in about a 200 or 200 foot square. Okay?

And you get seven monitor wells in there. To give you an example, for hazardous waste sites that are regulated under the Resource Conservation and Recovery Act, the Act requires that one monitor well be placed up gradient and that three monitor wells be placed down gradient, and that the results from the quarterly sampling of those wells is sufficient to delineate whether there is indeed any groundwater contamination that arises from that facility.

In this case we've got one, two, three, let me see exactly where the down gradient direction is, we have one, two, three, three, four wells, Nos. 2, 4, 6, and 3, which are directly down gradient of the produced water

pit or the potential source, and I believe that that's -- that if there was anything in the groundwater as indeed we did detect at Wells No. 3 and No. 2, that we would have picked it up.

In addition, let me mention that you have to notice that Well No. 3, it's kind of unusual that that far away from the produced water pit it would also show the concentration of 7 parts per billion, but if you'll note between the produced water pit and between Wells 4, 6, 4 and 6, which are down gradient from the produced water pit, there's a blowdown pit, so that represents another potential source that could account for the increased concentrations in Well No. 3.

Q Okay, well, that was a question I had later.

Are you positive enough that your gradients are correct, that assuming looking at this map that the top of it is north, that there is no need to put any -- any wells, any monitor wells to the south of the produced water pit; at least just one to make sure that you didn't have some -- any of the contaminants going in that direction because of the high number of No. 2?

A Well --

Q It would seem rational to put a monitor well to the south of that pit.

A Certainly, and if you'll look at a random walk or any simulation, or even just a qualitative look at

the movement of contaminants in groundwater, they move by primarily two processes; one advective or actually being carried in the direction of the gradient by the groundwater, and dispersive, the actual chemical gradients and dispersion that's caused by the substance in the groundwater.

If you look at those, the behavior of those species, typically you may have some limited migration in an up gradient direction from a particular source, but that is not the primary direction in which you would have movement of contaminants, so therefore that's why you typically put wells down gradient of a potential source to try and detect a problem from that source.

Now, up gradient from the source you may want to put a monitor well to detect whether indeed there is other sources that are further up gradient that may have caused what you see rather than the source that you're really trying to narrow down, and in that case you probably wouldn't want to put that well outside of the sphere of influence of that dispersive mechanism beneath that source.

So my answer to you is that basically I would anticipate to see the highest concentrations of any contaminant that entered the groundwater in the area immediately down gradient from the potential source rather than in the area immediately up gradient from the potential source.

Q Okay, but the reason I kind of wonder about this is because it seems like Mr. Hicks, or someone

else, testified that movement of groundwater or things moving through the soil, if often greater horizontally or kind of out than it is --

A Sure.

Q -- with the gradient.

A Sure. But you've got to think that what we've got in here are monitor wells that sample the saturated zone. They don't sample the unsaturated zone.

So once the contaminants entered the groundwater, which is what we're concerned with here, is the contamination of groundwater, they're going to move predominantly in a down gradient direction.

Q Now, going on with this thing about gradients, I think we talked to Mr. Hicks, and I'll just ask you the same question, relating mainly to the confidence level of your -- both your monitoring and testing, relating your model to your monitoring.

A Sure.

Q What is the possibility that there is seasonal reversal to the gradient and how does the gradient measure to compare with total groundwater gradient, that is the gradient that you --

A Sure. It -- I think that that's a very good question. I think that that's a very, you know, fair concern. They're in alluvial areas, you can have fluctuations in the gradient that are significant.

All I can say is at the point in time

when we measured the gradient at the locations where we measured, the gradient very precisely to the tenth of a foot, that it -- my confidence level is as high as it would be in any case, that that was the gradient, and indeed I could state without any qualification that that was the gradient at that point in time.

The fact that that gradient may have shifted or something like that, that, I mean that is certainly a possibility and furthermore, we know that there have -- there are fluctuations in groundwater elevations in alluvial environments and that can cause a problem

But let me -- let me point you to just one last thing in here.

If you look at the gradient around the produced water pit at the Eaton site, you can see that it's slightly steeper away from the produced water pit. So I think we're really looking at where you could have potential contamination, the greatest potential contamination.

Q Okay. Now relating to a question that I think we talked to Mr. Hicks about, which was the fact that normally petroleum products float on water but I think there's been a lot of testimony that benzene goes into solution with water, and I was interested in finding with him whether he -- or whether the sampling methods you all had come up with were intended to make sure that you got all the, you know, got the areas where it might be the highest because benzene goes into solution with water and might be

lower than the top of those water tables. Are you confident that your measurements of benzene are, you know, what you're showing here are what would be the highest in the area when you look at your model?

A Yeah, I'm very confident of that and I'll tell you why. Two reasons. One, primarily, it's standard, accepted practice and in fact required by regulatory demands and by policy, that wells be screened in the uppermost portions of aquifers to try and detect groundwater contamination, and that is indeed what we did at this site.

Furthermore, in terms of what you're trying to get at, what I perceive you're trying to get at is did we miss something that maybe flowed under our screened interval, or something like that.

In order for benzene which is in solution to go -- to move in a down -- in a vertical sense, there's going to be much less movement in the vertical sense than there is in the horizontal sense, because typically most aquifer materials have higher horizontal hydraulic conductivity than vertical hydraulic conductivities, and furthermore, in the levels of benzene concentrations that we're looking at in this area, there is no appreciable density difference between water, groundwater that has no benzene in it and groundwater that has 20 parts per billion benzene in it that would cause there to be any significant movement vertically in the -- of the contaminant.

Q What was the total number of system par-

ticles in time increments that you used?

A Okay. The time -- that varied. Okay, and the reason why it varied is because we had varying source terms and we wanted to maximize the total number of particles that our computer could handle in its little number crunching brain, and still produce some kind of a result.

If you'll look at the total simulation times, they range anywhere from a few hundred days to as much as eight years in terms of how long we carried out some of these sites in attempting to, you know, approximate a history of those wells.

In terms of the iterations, the interative time steps, generally we used 30-day time steps, and the reason being that we wanted to get a, you know, long period of record or simulation for those.

In others we used as little as half a day time step for the ones that we had -- that we wanted to look at in more detail what was occurring over shorter periods of time, and also trying to simulate a continuous source rather than just putting in a slug of contaminants and then dispersing it and moving it for 30 days or any period of time, you know.

So we tried -- the answer is basically we tried various iteration times and various total numbers of particles that represented different masses.

In general I'd say, you know, we were us-

ing in the range of 1000, 1000 to 1500 system particles, somewhere in that range, and iteration times of 30 days for the most part, although in several cases we used shorter ones.

Q Would you describe how you determined hydraulic -- hydraulic conductivities listed in Table 2 for the wells?

A Yeah, I think Mr. Hicks described that in his testimony. He determined those.

Q Could you just basically outline it again?

A Sure.

Q So I understand it.

A Once again, if you'll refer to this table in Mr. Hicks' testimony, Figure C-1, Range of Values of Hydraulic Conductivity and Permeability, Freeze and Cherry, 1979, that table was used in conjunction with Mr. Hicks' observations at the field and his completion of these field forms and photographing the materials in the pit, around the pit and outcrops, and then relating that to this chart and then reading across what the corresponding hydraulic conductivity would be.

Q You state that the model, in calibrating the model, grossly overestimated the contamination. How certain are you that the concentration decrease actually occurred?

A What concentration decrease?

Q Well, I assume the concentration decrease that -- between the calibrated and the uncalibrated.

A Well, I'm certain that --

Q How certain are you, I suppose, the real crux of the question, is how certain are you that -- that the monitoring is accurate so that the concentration decrease between your uncalibrated model and your calibrated model is actual and not just something that you put into it to try to reflect what you found in the field which might not be what is really there?

A Well, I disagree with that. I mean, what I found in the field is what is there.

We measured the concentration of benzene in water samples that were taken according to a standard, accepted, EPA approved procedures for sampling organic constituents, had them analyzed by two laboratories using EPA certified methods and complete quality assurance and quality control procedures, and therefore I have a high degree of confidence in the benzene concentrations that were measured at the monitor wells.

In terms of my level of confidence that the source strength decreased, all I can say to that effect is that of the parameters that were inputs to the model at those locations, the strength, i.e., the concentration of contaminants that were actually reaching the groundwater was the one factor that was most difficult to approximate and had the lowest level of confidence.

Therefore that was the factor which we felt most comfortable in adjusting in order to calibrate the model.

Q We talked about this a little bit further, but how do you -- is the 7 parts per billion that we see in Well No. 3, I think, do you think that's accounted for solely because of the blowdown pit that's there, or could there be other explanations?

A Well, I find it -- I find it a little -- I mean that would be the most reasonable explanation given the data that we have. That's immediately adjacent and down gradient of the blowdown pit and we have wells that are between the blowdown pit and the produced water pit that had -- that had come up essentially clean.

So, yes, that would be my most reasonable assumption of that there is some increased source from the blowdown pit.

Q I assume you did not model your random walk for anything other than benzene. Didn't do any TDS or --

A That's correct.

Q -- any other contaminants.

A That's correct.

Q I think that's all I have except that I'd like to get back to one point that we talked about that I really didn't get an answer, and that is what -- what percent confidence level do you have both in the fact that the

monitoring wells turned up accurately what is in that aquifer, not only where the wells are but at other areas in that aquifer, other places on the grid that you might have on your (not understood) and consequently, based upon your confidence level on your monitoring, your confidence level on your model for what you show.

A Okay. The confidence level that I have on the analyses is -- you mean as high as I would have? I mean there's no reasons to believe or even to speculate that the analyses may be incorrect.

Q I don't mean your confidence level in your analysis of your samples but in the fact that the monitoring wells are showing everything that's there.

A Oh, okay.

Q Not selectively or it's not --

A It's really hard to put a percentage number on it exactly, but I'd say, I mean it was in the range of 90 percent plus, because they are screened in the uppermost portion of the aquifer as would be necessary to detect the first potential contamination that would reach the aquifer.

So my confidence level is extremely high on that the monitor wells are actually showing me what is in that zone of the aquifer.

Q Do you agree that any -- any problem (not understood) but the accuracy of your monitoring would reflect on your model and make --

A On the calibration of the model, yes, I would. Yes.

Q I'm supposed to ask you this. When I ask you about confidence levels I speak in terms of statistical calculations to give you a numerical confidence level. With respect to the last two questions, did you perform such an analysis? I assume it's more or less like when you have your statistician come in and tell you what --

A Yeah. Frankly, I'm not a statistician but I don't understand how one could perform a statistical analysis to determine a confidence interval on whether your groundwater monitor well was screened in the right portion of the aquifer without, I mean, screening many different monitor wells in many different zones and then I would still find it very dubious, the results of that statistical analysis, because in fact you don't -- you can't really compare sampling one portion of the aquifer with another.

I mean we sampled the portion of the aquifer that was most likely to demonstrate contamination.

Q But you do agree that if for some strange reason contaminants were moving south of what we consider to be the blowdown pit and you had no monitoring wells there and therefore if there were concentrations of benzene or other pollutants in that area, it affects your whole model.

A Yes. I would agree that what you say is correct, that my model was be affected. However, I must take exception because I cannot envision any, any hyrologic,

chemical, or other mechanism that would account for contaminants to in effect sneak under my monitor wells and show up, you know, at some point further than they are when they're in the immediate vicinity of the potential source.

Q Thank you.

CROSS EXAMINATION

BY MR. STAMETS:

Q If we go to about the second page after the calibrated lower source term sheet, we come to the GCU 202 Well.

Your benzene concentration is 3500. Is that a measured concentration or an approximation or what?

A No, sir. All, let me just answer that not only for this one but for all of the cases.

All of those concentrations with the exception of the calibrated concentration, were concentrations that we arrived at that number of 3500 by looking at the average concentration of benzene in the pits that was taken from the OCD and our available data on those analyses.

Q You're trying to find pits or produced water that were close to the concentrations that you used in the calibration model.

A No, I'm not sure I understand that.

Q Okay.

A We --

Q Let me back up then.

A Okay.

Q When you're looking at the A 1-E, the benzene concentration there was 3500.

A Right.

Q Is that why you tried to find other pits with 3500?

A No, sir. The reason why -- we didn't try to find any pits with any particular concentration.

What we did was take the data which was presented in Mr. Hicks' exhibit, and I believe is included as, let's see, Table 1 in my exhibit, which shows the OCD data on benzene concentrations measured from, directly from the separators as well as measured in the pits, and you'll note that the mean there was 3.58, and you know, in retrospect maybe we should have used 3600, but we used 3500 for that.

Q If I use 3500, the actual ppb at that well could be different.

A Oh, certainly, certainly. At that pit, you mean?

Q Yes.

A Yes. What we did was take, since we didn't have analyses from all these pits, what we did was take the data which we did have analyses for, i.e., the Bravo A 1-E, the Flora Vista No. 1, the Zachary, et cetera, et cetera, and used the average from that.

Q I notice there are a few in here where

you used the figure 20.

A That's right.

Q And what was that based on?

A That was based on the calibration of those sites according to the way, same way which we calibrated the Eaton site, because they were similar lithologic environments, and had similar hydraulic parameters.

Q Okay.

MR. STAMETS: Any other questions of this witness?

MR. ELMER: Just one.

MR. STAMETS: Mr. Elmer.

CROSS EXAMINATION

BY MR. ELMER:

Q Your -- you mentioned resource reclamation standards and comparing a number of wells --

A Uh-huh.

Q -- but your time period isn't -- is not comparable in terms of you mentioned that under those standards it's measured quarterly.

A That's correct.

Q In this case you just measured in a one week period of time, correct?

A Yeah, and with respect to the Resource Conservation Recovery Act you typically measure those levels quarterly for one year, and then you determine how often you

have to do that after that period of time.

Q Well, for purposes of your random walk study, it was the data that was collected over the one week period of time.

A That's correct. What I was -- what I was trying to recheck there was more, not the frequency but the number of wells that are required in a down gradient direction.

Q Uh-huh, thank you.

MR. STAMETS: Any other questions of this witness?

He may be excused.

I presume no one has anything else that they wish to offer in direct evidence.

Very good.

MR. CHAVEZ: I have -- would ask for a clarification of one matter.

MR. CHAVEZ: I would like to --

MR. GUTIERREZ: Should I leave or stay?

MR. STAMETS: I believe he's going to ask to clarify something.

MR. CHAVEZ: Of you.

Mr. Stamets, you asked me earlier if I knew of any incidents where produced water had polluted groundwater. Were you talking about a source of drinking water or a particular water well used for drinking?

MR. STAMETS: Water well used for drinking.

MR. CHAVEZ: Thank you.

MR. STAMETS: How about closing statements? Who all wishes to make them and how many people can limit them to five minutes?

Okay, if closing statements can be limited to five minutes, we can take closing statements.

MR. PEARCE: Before we begin with that, if I may, Mr. Chairman, when we began this, I said that in addition to appearing for Meridian Oil, Incorporated, I was appearing on behalf of Giant Industries.

Giant Industries has prepared a written statement for submission and has asked that the witness who has -- must have run out of breathe by now, be allowed to summarize that statement orally into the record and that we present copies of that.

I think that can be done even more quickly than --

MR. GUTIERREZ: Less than one minute.

MR. STAMETS: Very good.

MR. GUTIERREZ: Basically, I sat on the Short Term Study Committee representing Giant Industries and assisting them in keeping track of how these things were developing and tried by actively participating in the process of developing some drafts, recommendations

for a draft order and which criteria should be considered in developing such an order, and they really just want to say that Giant strenously supports the January 18th recommendations of the Short Term Study Group on all the points in which the committee was in agreement, and that includes the definitions and prohibitions and exemptions which the committee agreed on, and which are listed in the written statement, basically with respect to the delineation of the vulnerable area and the exclusion of any pits that are already governed by other statutes.

And furthermore, that based on the analysis of the available data, that it is our opinion that a low volume exemption within the vulnerable area of approximately 5 barrels per day should be permitted at the present time, and that that opinion is based on the available data and that -- and existing Federal practices.

Also that Giant will continue to participate in the Long Term Study Committee, which will still examine this question and that they look forward to continuing participation in the Long Term Committee and congratulate the Division, Oil Conservation Division on their foresight in involving all the intrested parties in the regulatory development process.

MR. STAMETS: Thank you. Mr. Pearce, are you next?

MR. TAYLOR: May I have a question about the statement?

MR. STAMETS: No.

Mr. Pearce?

MR. PEARCE: May it please the Commission, the Commission has now had four days of testimony in this case. We've received into evidence a substantial quantity of written material.

The first part of this case dealt with those items which were agreed to in a committee process. We believe that it is important that these agreed upon recommendations be affirmed by the Commission.

The great majority of the record in this proceeding obviously relates to whether or not produced water disposal pits in northwest New Mexico, which receive five barrels per day, or less, need to be lined in order to protect underground water.

During my opening statement on April the 3rd, I indicated that I believed some additional reality needed to be injected into this. That's been referenced several times since.

I indicated at that time that our discussion would not be amenable to easy mathematical description but that it was a discussion of mechanisms of attenuation of pollution in produced water which were recognized by scientific, technicological and regulatory communities.

In fact the record shows that both the staff of the OCD and EID do recognize these mechan-

isms but they have opted for simple or more complex mathematical models which do not reflect actual test results rather than grappling with much more complicated realities.

Let's look at the record for a few minutes, if we can, to see what evidence most appropriately reflects these realities as it's been demonstrated in these four days of hearing.

The OCD staff began this case relying on a one dimensional flow model, which assumed discharge out the bottom of a produced water pit, the saturation of a perfect column, and the subsequent straight discharge into groundwater of all of the pollutants that were contained in a separator.

The staff presented no evidence that they had done any testing of a pit which demonstrated those characteristics. The staff next talked about a much more sophisticated model, a model which by its maker was apparently calibrated to describe in some terms the universe as a whole.

The OCD staff, the EID staff, whoever was running those random walk calculations, and I don't know if it was said in this setting, I missed it, but whoever was running it did not attempt to take the universe as a whole in the random walk model and make that random walk model more appropriate to the San Juan Basin of New Mexico, which is the only area we're talking about.

In contrast, the proponents of

the requested small volume exemption demonstrated that the columnar flow model was overly simplified, that substantial amounts of organic pollutants are eliminated by flash volatilization, volatilization from the pit, volatilization from the subsurface environment, and biodegradation.

They also presented scientifically reliable, supported testimony amounts of organic pollutants are delayed through travel along indirect flow paths and sorption.

The proponents of the small volume exemption also have presented a model which has been refined to reflect the area that we're talking about through a representative selection of wells refined to deal with the area we're specifically concerned with here today rather than the universe as a whole, shows that pollution should not be found and pollution has not been found.

That, I submit to the Commission, is substantial evidence which goes to the question of whether or not this is a real problem.

The opponents of the small pit exemption argue that even allowing produced water pits which receive small amounts, allowing those will endanger underground water. The only case of pollution which they have discovered is the Flora Vista case, which since its coming to light in apparently 1981, has been subjected to serious scrutiny by multiple regulatory agencies. Nobody has been able to come into this room today and tell you that a small

volume pit caused that problem. After all those years of looking at that problem, nobody can tell you that.

What that means is that we do not have on record in this proceeding a single case in which a small volume pit polluted a water well.

In contrast, the proponents of the small pit exemption presented historical information which indicates that other sources of pollution at Flora Vista are much more likely to have caused the problem. The proponents of the small pit exemption did actual field studies of statistically representative sample wells in the vulnerable area and found the levels of contaminants predicted by the two models relied upon by the OCD staff and the EID staff were not there. The level of pollution predicted by the models on which they relied have not been found. They haven't found them and we haven't found them.

There's no evidence in this record that those models are at all reliable. In fact, the only substantial evidence in this record is that those models are not reliable.

During the course of this hearing two suggestions have been made for resolving the dilemma.

One suggestion is that some sort of pit registration procedure be developed.

The other is a suggestion that some extremely low level, a half a barrel a day, be allowed

for eighteen months pending further study.

I don't think the record in this case will support either of those alternatives. Either of those alternatives represents a substantial burden to industry. It increases to no provable extent the reflection of records of the OCD of any problem, any well that produced more than half a barrel a day and less than five barrels a day, would have to be lined or tanked.

If in fact the only substantial evidence in this record turns out to be correct, that money would be lost.

If the Commission believes that a further study is necessary, I'd like to suggest that what's appropriate is to adopt the consensus recommendation of that committee to allow for a period of eighteen months that any well that produces five -- any pit that receives five barrels per day or less be continued to be unlined. There's no evidence that that's a problem.

If at the end of eighteen months the staff of the Oil Conservation Division or the Environmental Improvement Division have done additional field work and can demonstrate with substantial evidence that those are a problem, then I believe we need to have that evidence in a record before any order is entered to which parties have not agreed.

I'm not frankly sure that the producers should have agreed to the five barrels, because we

haven't seen anything in this record other than a letter written, I believe, in 1961 by Mr. Kendrick that a pit which received between 50 and a hundred barrels a day of 80,000 parts water should be lined.

Well, I'm not sure that there's a problem with a 25 barrel a day pit. It hasn't been demonstrated in this hearing. But, as I say, the industry is willing to accept that because of its consistency with other regulatory agencies.

I submit that the record in this proceeding contains no substantial evidence on which this Commission can enter an order requiring the lining of those pits with the resultant expenditure and waste of natural resource, which is appropriate.

Thank you.

MR. STAMETS: Mr. Carr.

MR. CARR: Mr. Stamets, first I have a written statement from ARCO Oil and Gas Company. ARCO has participated in the preparation and financing of certain technical testimony presented here today.

I do not intend to read this statement. I would ask it be included with the record as an unsworn statement and I have copies for anyone who's interested in that.

I also have a statement, a brief statement that will less than five minutes for Northwest Pipeline Corporation.

This case, as you are aware, was called by the Oil Conservation Commission to define the vertical and areal extent of the aquifers potentially vulnerable to contamination by the surface disposition of water produced in conjunction with the production of oil and gas in certain counties in northwest New Mexico.

Even though this is the Commission's case, and in view of the way the case has been called, I presume that it as not been prejudged and that when we come before you in a proceeding of this nature, we can expect you to render a decision based on the evidence which is presented to you.

That being the case, the next point which must be addressed in a proceeding of this nature, who bears the burden of proof? In this case , as in all cases, that burden falls on the applicant, on the staff of the Oil Conservation Division and those who have joined with them.

And we submit to you, on the record before you in this matter, they have failed to meet that burden of proof, for they have simply shown no contamination.

Talk as they will about Flora Vista, they simply have been unable to connect this or any other contamination problem to the disposal of produced water in any surface pit.

I thought Mr. Boyer's comment

today was particularly interesting on this point. He talked about weighin the problems that this situation could pose to various people in the area, and he stated, it will be, and I quote, a hardship for those whose well is contaminated. And then he said, if that happens.

I think right there you have an admission that they cannot and have not shown that there is any contamination which they can connect with surface disposal of produced waters in the San Juan Basin. They have failed to carry their burden of proof.

Their effort to prove a potential problem was been feeble, indeed. They've used inadequate sampling techniques, outdaed concepts, and incomplete information.

They've used models which they have not calibrated to consider field data. In fact, they have shown no real world problem.

The evidence of their failure to carry the burden I think is underscored by today's last ditch effort to shift from benzene and toluene to chlorides and total dissolved solids.

They're asking you to take the most conservative case. Well, the most conservative case would be to stop all human activity in the area, but the reason they moved toward this is what they need to have you do is without proof protect against a problem which they cannot show exists.

On this record you should dismiss this case.

Following the February 20, 1985 hearing some of us met and concluded that no matter what the inadequacies of the other case might be, we were being asked to come before you and prove the negative. We sat down and got to work and we think that we have done a pretty good job.

We've presented testimony which we submit is scientifically sound. We've given you a complete explanation of what's happening in the San Juan Basin. We've reviewed six mechanisms of attenuation that work to abate, in fact, to eliminate, the very thing that they're concerned about. We've used laboratory work. We've used the most sophisticated laboratory work available. We've called the most respected experts around and they have testified that their conclusions do work in the field and that they have confirmed this with field samples.

The other side, of course, wants to scoff at biodegradation but when they do that, I think they should come forward with an explanation of what's happening in the real world, and they've failed to do that.

Recently the environmental function of the Oil Conservation Commission has been emphasized and it now stands on an equal footing with the traditional functions of waste prevention and protection of correlative rights. I assume these still are equal functions

and that environmental advocates will be expected when they come before you to make the same showing as those who represent the industry. If they are, we submit there's only one case before you which is factually and technically adequate, and that's the case presented by Tom Schultz, Gary Miller, Randy Hicks, Al Kendrick, and Alberto Gutierrez.

On the record before you, you should not enter an order defining any area as vulnerable and susceptible to contamination in the San Juan Basin, but if you must, on this record certainly you cannot fall below the five barrel per day small barrel exemption. If you go beyond this, we state that you've further elevated the environmental function and that you've turned your back on the traditional duties of this Commission.

MR. STAMETS: Mr. Kellahin.

MR. KELLAHIN: Thank you, Mr. Chairman.

I have prepared for your consideration a proposed order that is attached as Exhibit A to a memorandum on legal issues we think are important in order to frame the action the Oil Conservation Commission will take on this issue, and if you'll give me a moment, sir, I'll distribute those copies.

MR. STAMETS: While you're doing that, I would note that any other participant who wishes to submit a proposed order may, is invited to do so.

MR. KELLAHIN: Mr. Chairman, I

have had the privilege and honor of appearing before the Oil Conservation Commission and Division since early in 1972 and this is the first case in which I have participated directly or one in which I am aware in the last thirteen years in which members of the industry have been placed in an adversarial role with the staff members of the Division.

It is uncomfortable for me. I assume it's uncomfortable for you. It's a difficult task that you have to wear two hats and try to separate your function as Director from your duties and responsibilities as Chairman of the Commission. Were this the typical case with competing operators fighting over an unorthodox well location or some other issue to address, then it's easy to sit back and be objective about the proof that's been submitted to you.

It's also difficult and a problem for me to discuss the quality of the Oil Conservation Division's case today because I have the greatest respect and admiration for Mr. Boyer. I knew of his reputation before the Environmental Improvement Division. I know his reputation as a competent and experienced hydrologist.

I also am an admirer of Mr. Chavez. I am a supporter of his willingness to undertake the resonsibilities of administering the Oil Conservation Division in Aztec and I have set back and watched him practice being a lawyer in the last four days of hearings and for this case, and he's made some interesting points that I

think are important.

Setting aside those problems I have about criticizing those people that I have to do business with on a daily basis, and on which my livelihood relies and my ability to pay the rent, I'm going to say some things that I think need to be said.

It has been a great length of time before the Oil Conservation since the Oil Conservation Division has entered an order that has been reversed by the New Mexico Supreme Court.

Mr. Carr at that time, I think, was Staff Attorney. He well knows what it takes in order to prove a case at the Oil Conservation Division and Mr. Carr holds the unique standing in this community as being the last Commission lawyer reversed by the Supreme Court.

That was the Faskin case and you will remember it is a case very much like this case. The Division Examiner and Mr. Carr can correct me any time I mess this up, the Division Examiner and the staff sat back and listened to Mr. Faskin present a case. It was uncontested in terms of the record.

Mr. Faskin came in with his expert and advocated under sworn testimony a particular position or request. I've long since forgotten what it was.

The Commission staff denied the application. There was nothing in the record to show any reason by the staff or the Division to deny that order. The

Supreme Court says, guys, you can't operate that way. If you don't like what he's doing, if you don't believe it, put the staff on, put some contrary evidence in the record, and you judge the record as a whole.

That's not unlike the case we have here today. I was thinking as I came back from lunch and I crossed the Santa Fe River and was taking a moment to look at water that is not frequently there. I found that the Oil Conservation Division offices are directly up gradient from the Supreme Court Building and I maintain to you, sir, that if we enter an order based upon this record, we are going to find contamination that goes downstream and is going to be monitored and controlled and changed for you by the New Mexico Supreme Court.

The problem with this case is the burden of proof. There are numbers of instances in the record in which the staff, either through Mr. Chavez, Mr. Boyer, or Mr. Taylor, make references to a degree or standard that sets us far up and above any standard applied to this type of situation by the Environmental Improvement Division.

The testimony has been that New Mexico, through the Environmental Improvement Division sets forth some of the most stringent standards in this country to control groundwater.

I believe that the attitude of the staff in this case is one that sets us up with a stand

ard of proof that's impossible to meet, and you should not apply that standard to us.

It's typified on page 120 of the transcript on January 20th. I'm sorry, February 20th.

Mr. Chavez' question: Therefore we're addressing only pollution that might occur from oil and gas activities as a preventative measure, is that correct?

Mr. Boyer's answer: That is right.

Now, that's not the degree of proof required before the Division. That's not the standard we have in our Supreme Court decisions on this type of hearing. We are not required to prove the negative. We are not required to take every possible means to prevent contamination because somebody suspects it might happen.

I think you remember how this all started. I certainly remember it.

When it happened eighteen months ago, sixteen months ago, I was reminded of the story of Chicken Little running through the barnyard screaming, the sky is falling.

Chicken Little's gone. He didn't testify here in any of these hearings but he has left our barnyard in turmoil. We have been faced with arm waving and all kinds of problems about unlined produced pits.

Gentlemen, Chicken Little is

not here and the sky didn't fall.

Tenneco Oil Company has devoted a considerable amount of time, money, and effort to this problem because it's important, not only for the Commission to understand that they were willing to devote resources to an environmental question as opposed to how much oil and gas we can get out fo the ground, it's important for our own self-respect for you to know that we're environmentalists, too.

Mr. Shuey and these others are not the only environmentalists in New Mexico. Mr. Shuey does not live in Farmington. We employ more than a hundred people in this area. We spend millions of dollars every year. We don't want our people contaminated, polluted groundwater. We are good environmentalists. We're going to stick here and we are going to study this problem until you're tired of studying it. But I'm telling you now on this record with what we have you have no other choice but to let those unlined pits using small five barrel a day volumes continue. There's no reason to go any further with what we've done.

We have contributed Marty Buys to the Short Term Study Committee. Marty has sat through all the hearings. He has participated in that process. I think that was an intelligent decision by the Commission in terms of not only appointing a person of his quality and calibre to that committee but it was important to put together

a study committee composed of industry people, of people that were concerned about the water, and study it from that point of view.

It was early on in that process that Mr. Buys and other industry people volunteered and suggested to the other participants that they do the very study that Mr. Hicks and Mr. Gutierrez have done. There were no takers, sir, there were no takers.

Mr. Boyer and the OCD did not take that offer. We could have kept this in the form of a study committee. We could have studied it until you're happy that we've examined every possible parameter. It did not take that course of action. The study committee was stagnated on the issue of a small volume exemption. We have turned this into an adversarial case and we've gone about it in that fashion.

We have proved, we have undertaken the task that the Short Term Study Committee was invited to take. They refused, and we have spent the money, our own dollars, we've studied the problem and we've proved there is no contamination.

Let's enter the order and go about something else.

Thank you.

MR. STAMETS: Thank you, Mr. Kellahin. I'm not certain that this is a unique situation. It seems to me that some years ago when I was a staff member

proposing regulations for the Underground Injection Control Program, I was probably accused of being Chicken Little at the time, was beaten soundly about the head and shoulders, and ultimately I think we arrived at some rules that are workable and beneficial to the state.

Ms. Pruett, do you have a closing statement?

MS. PRUETT: Well, I do, but frankly, I'd rather submit it in writing when I've got the rest of the data in, if I may.

MR. STAMETS: You most certainly may.

Mr. Taylor.

MR. TAYLOR: Thank you. I'd like to on behalf of the Division reserve our statement on the findings until we've had a time to review further information from the industry.

I would, however, just like to make a comment that, especially in response to the previous comments, that although this case has been somewhat adversarial, I think that it does not need to be either confrontational or unpleasant for those of us who are doing it.

The Commission is here to find the truth. The members of the Division are here to try to enforce the laws. One of those laws is to protect fresh water resources of this state, and the staff undertook to present this case because it was their belief that unregu-

lated dumping of produced water onto the ground or into unlined pits could affect the health of the citizens.

Industry disagrees. They have a right to disagree. They have a right to either put on their case or not put on a case and the burden of proof doesn't change if they don't put on a case.

It's still up to the applicant in these hearings to prove the case and we've either done that or haven't and it's not -- it doesn't depend on whether industry responds to our proposal as to whether that burden is carried.

Money is a problem with OCD and we have other problems in presenting these. Obviously we couldn't run out and do a lot of testing but we are grateful to industry for their cooperation in the Study Committee and for their presentation of witnesses here, who we think tried to show us to the best of their ability what they think the true situation is. The Division has done its best in doing the same thing.

We're only, as I said, we're only here to protect the health and resources of the State, to preserve fresh water resources, and I think we all need to cooperate in doing that and not get off into whether the staff is out to get industry or not.

Certainly I don't have that feeling. We're all professionals here. We're trying to do a good job and I think this hearing has proved that we can

do that very well and I just wish the Commission luck in trying to come up with a conclusion.

Thank you.

MR. STAMETS: Perhaps wishing us wisdom would be better than luck.

Before we conclude this case I would like to publicly thank Marty Buys, who did chair the Short Term Study Committee, and all of those persons within industry, within government, private citizens, who participated in the valuable work of the committee.

Certainly this whole process, even though it's gone on for four days would have been much longer without the work of these people and we certainly wish to thank all that participated.

Also before we conclude this, I'd just like to announce that it is the intention of Commissioner Kelley and I to adopt an open meetings resolution immediately after we take this case under advisement, which would call for us to issue on a regular notice under Rule 1204, and by mailing copies of the dockets to any party who chooses to be on the dockets list.

If there's nothing further, then, in this case, one -- one final thing.

May the 7th is the date to have all of the information together that's going to be exchanged.

How long would everybody like

in addition to that for any final comments?

Another ten days? Two weeks? Is that acceptable to everyone?

All right, it will --

MR. TAYLOR: We have until May 7th to exchange the information?

MR. STAMETS: Yes, and then it will be May the 23rd for any final submittals, any comments on the information to change hands.

With that, then the case will be taken under advisement, and the hearing is adjourned.

(Hearing concluded.)

# C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR