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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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A P P E A R A N C E S

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(Hereafter 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. Chair-
man, 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 circu-
lated 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?

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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

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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.

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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.

1
2 Q All right, sir, what type of well is
3 that?

4 A That was a Farmington oil well.

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

7 A The green dot represents the J. Glenn
8 Turner Osborn No. 1 Well in the southwest quarter of Section
9 22.

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

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

14 It's a Mesaverde gas well.

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

18 A The last --

19 Q -- a blue well dot.

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

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

24 A The dark blue dot represents one of the
25 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 --

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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

1
2 and Jim S. Hinds. That paper is entitled "Geology and Fuel
3 Resources of the Fruitland Formation and Kirtland Shale of
4 the San Juan Basin, New Mexico and Colorado."

5 The squares on this plat represent town-
6 ships. Township 30 North, Range 12 West, which is the area
7 of interest in my testimony, is located between Farmington
8 and Aztec.

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

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

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

21 The Ojo Alamo outcrops on the west and
22 south and east edges of the San Juan Basin. It does not
23 outcrop on the north edge of the Basin, so that the low
24 points in the Ojo Alamo outcrop are along the Animas and San
25 Juan River Valleys. Any percolation into the Ojo Alamo for-
mation 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

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

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

7 This oil well was not a prolific pro-
8 ducer, however, it was located about one mile south and
9 three miles west of the Flora Vista Water Users Associa-
10 tion's water wells.

11 Q This is the well that's identified on Ex-
12 hibit Number One as the black dot.

13 A Yes, sir.

14 Q All right, sir.

15 A The significance of the outcrop map shown
16 on Exhibit Two and of this history is to show that the Far-
17 mington Sandstone does exist in this proximity.

18 Q All right, sir, let's go to Exhibit Num-
19 ber Four.

20 A Exhibit Number Four is the tabulation of
21 information I know from my own knowledge from having been
22 associated with the J. Glenn Turner Osborn No. 1 being drill-
23 ed in 1961. It's identified by the green dot in the south-
24 west quarter of Section 22. It's about one mile west of the
25 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

1
2 at that time was into the Mesaverde formation and thus the
3 Flora Vista Mesaverde Gas Pool was discovered.

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

7 Q When was this, Mr. Kendrick?

8 A In 1961.

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

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

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

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

23 So that gas did break to the surface from
24 this gas blowout and could possibly have contaminated sev-
25 eral 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.

1
2 Q Did you visit the site of the McCoy Ranch
3 and see indications of gas breaking through the surface?

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

7 Q Did you make an investigation to deter-
8 mine the extent at which the gas migrated in the shallow
9 soil areas beyond this immediate vicinity?

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

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

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

19 Q What conclusion do you draw, Mr. Ken-
20 drick, from the information that you have compiled in terms
21 of this incident at the Osborn Well?

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

25 Q All right, sir. Let's direct your atten-
tion now to Exhibit Number Five.

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

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

4 Q This information consists of correspond-
5 ence between you and what operator or individuals?

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

13 Q We're looking now for Exhibit Number Five
14 at the well dot on Exhibit One that's identified with a yel-
15 low dot?

16 A Yes.

17 Q While you were involved with the Oil Con-
18 servation Division in Aztec, Mr. Kendrick, would you de-
19 scribe for us what was the practice and policy of the Dis-
20 trict with regards to potential groundwater contamination by
21 oil and gas operations?

22 A Our policy at that time and prior to that
23 time was to attempt to protect the water from any contamina-
24 tion from any source created by the oil industry.

25 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?

1
2 A The first two pages of this letter ex-
3 change is to show we were interested in protecting the qual-
4 ity of the water in the river by requiring a lined pit to
5 contain the produced salt water.

6 Q Why had you reached the conclusion that
7 it was necessary to protect the groundwater from the pro-
8 duced water from this well?

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

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

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

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

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

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

1
2 if any existed.

3 Q In terms of the relationship of this Mon-
4 santo well to the Flora Vista water wells, is there any sig-
5 nificance to draw from the relationship?

6 A The Monsanto Well was upstream about some
7 1700 feet from the -- from the Manana Gas Mary Wheeler No.
8 1-E Well. If there were a casing failure in the Monsanto
9 Chemical Well to cause it to fail to produce or to cease to
10 produce, a casing leak in this well could have charged the
11 river sands or provided a source of contamination for the --
12 Flora Vista water well.

13 Q All right, sir, let me direct your atten-
14 tion to Exhibit Number Six, Mr. Kendrick, and have you iden-
15 tify this exhibit.

16 A Exhibit Number Six is a memorandum I re-
17 cently picked up in Frank Chavez' office.

18 This memorandum was issued February the
19 13th, 1961, and it's entitled "Stream Contamination."

20 This memorandum was issued within a month
21 of the blowout of the Osborn Well but it did not mention
22 blowouts. It mentioned produced oil, excuse me, this men-
23 tions drilling fluids and cautioned the operating company to
24 see that the drilling contractors confine their drilling
25 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

1
2 tanks had firewalls around them to contain any spills and
3 keep the spills from reaching the irrigation canals or the
4 rivers.

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

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

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

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

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

20 The red dot is the Mary Wheeler Well.

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

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

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

A Yes, sir.

1
2 Q Would you turn now to Exhibit Number
3 Eight?

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

7 It was spud January the 28th, 1980.

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

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

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

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

25 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.

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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

1
2 the abandoned water well of the Flora Vista Water Well Users
3 Group, or excuse me, the contaminated well.

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

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

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

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

18 Then I went back to the road --

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

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

25 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

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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

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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-

1
2 tion, Mr. Kendrick, can you give us the sequence or the
3 chronology in which these various wells were drilled?

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

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

10 Q Which one, the contaminated --

11 A No, sir, the --

12 Q -- water well?

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

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

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

19 Q All right.

20 A But this well was drilled to a depth of
21 23 feet and abandoned because they had drilled into gooey
22 clay and stinking water, according to Mr. Thurston.

23 MS. PRUETT: Excuse me. Mr.
24 Chairman, I'm going to have to make a hearsay objection to
25 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

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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.

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2 Q Mr. Kendrick, if the capped water well,
3 the first one drilled, encounters gooey clay and stinking
4 water, and if that well is drilled prior to the Manana Mary
5 Wheeler gas well, can you draw any conclusions from that se-
6 quence of events?

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

11 Q Upon what basis do you reach that opin-
12 ion?

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

16 Q Let me direct your attention, Mr. Ken-
17 drick, to what your opinion is with regards to the reason-
18 able probability that the use of the unlined surface pits by
19 the Manana Mary Wheeler Well would be the most likely source
20 of contamination of the Flora Vista wells, based upon what
21 you've studied and learned.

22 A The first report that I heard orally of
23 the contamination of one of the Flora Vista Water Users As-
24 sociation's wells was that it had natural gas in it.

25 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,

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

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

8 Q Let me turn your attention now, Mr. Ken-
9 drick, to Exhibit Number Ten and from the perspective of you
10 as a consultant for the Four Corners Gas Producers Associa-
11 tion, can you describe for us what would be the impact upon
12 your membership of an order issued by the Commission that
13 would ban the use of unlined surface pits for produced water
14 and other ancillary unlined pits in the vulnerable area of
15 San Juan Basin?

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

20 Small operators cannot do that, especial-
21 ly those who only own a few wells.

22 The cost of lining and maintaining pits
23 will reduce the ultimate recovery of natural gas from the
24 San Juan Basin by causing early abandonment from the low
25 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-

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

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

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

15 A No, sir.

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

19 Were you present in the earlier hearing
20 in this case, Mr. Kendrick, when Mr. Boyer showed a schema-
21 tic of pits in relation to oil and gas wells?

22 A Yes, sir.

23 Q I show you what is marked as Exhibit Num-
24 ber Thirteen and ask you to identify that exhibit.

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

MR. TAYLOR: Excuse me, Mr.

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

3 MR. KELLAHIN: Neither do I.

4 A Let's put it on the --

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

8 A About thirty years.

9 Q And you have seen Mr. Boyer's drawing of
10 wellbore arrangement and the pit arrangements that he pre-
11 sented earlier?

12 A Yes, sir.

13 Q You've had an opportunity to review Exhi-
14 bit Number Thirteen?

15 A Yes, sir.

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

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

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

25 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-

1
2 tailed every possible pit that one would encounter on a lo-
3 cation; not necessarily required on that location but a type
4 of pit for each type that would be designed for a location
5 and including some of the pipeline pits.

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

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

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

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

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

21 A This would be typical for most Dakota
22 wells, most Mesaverde wells, some other wells, in that the
23 wellhead is shown to the upper left. It shows the flow line
24 to a separator, the separator pit to the north, or top part
25 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.

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

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

13 A The separator pit.

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

18 A Yes, sir.

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

21 A Very, very seldom.

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

24 A No, sir.

25 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

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

3 A No, sir. Traditionally the separator and
4 dehydrator are separated by a sufficient distance that uti-
5 lization of one pit would not be economical.

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

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

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

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

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

The first item that I would recommend is

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

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

6 Allow exceptions when the operator or the
7 owner of the pit demonstrates that the water being dis-
8 charged into that pit is below 10,000 parts per million to-
9 tal solids.

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

14 This would eliminate a lot of paper work
15 of granting exceptions to a required lining order. It would
16 put the burden of proof on the operator of the well, not on
17 the regulatory agencies. It would tend to give some simpli-
18 city to the rules in that the regulatory agency of the state
19 could be with the same, similar rule with the Federal
20 government and thereby simplify the regulations for pits
21 and not cause the operators the concern of trying to deter-
22 mine which set of rules which pit has to qualify under.

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

26 Q One of the issues discussed yesterday af-
27 ternoon was the possibility of setting up a pit registration
28 mechanism that included having the operators submit various

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2 items of information to the Division.

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

6 A One of the remarks we got early on in the
7 organization of the Water Study Committees and the research
8 we've been doing in the committee meetings was that the reg-
9 ulatory agency for the state does not have sufficient per-
10 sonnel or funding to go into a big program to regulate the
11 pits.

12 When we start a pit registration situa-
13 tion we immediately require people to process the applica-
14 tions and thereby causing a load on the staff of the Oil
15 Conservation Division.

16 The costs of obtaining samples for all
17 the water produced at the quality that was asked for yester-
18 day would be in the range of several hundred or a thousand
19 dollars per sample to be run.

20 If we go into a pit registration process
21 and we have a pit on the north side of the location and
22 elect to move it to the south side, it's quite possible we'd
23 have to go through the same expense just to move a pit to
24 the other side of the location because of the required loca-
25 tion 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-

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2 sociation as a member of the short term Water Study Commit-
3 tee?

4 A Yes, sir.

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

10 A No, sir.

11 Q What conclusions do you reach based upon
12 your study, Mr. Kendrick?

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

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

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

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2 The produced water in the San Juan Basin
3 historically has been of a whole lot better quality than the
4 water produced in the southeast part of New Mexico, where
5 there has been some crisis because of the high total dis-
6 solved solids.

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

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

16 A Yes, sir.

17 Q And what is that opinion?

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

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

23 A Yes, sir.

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

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

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2 Are there questions of this
3 witness?

4 Mr. Chavez.

5 QUESTIONS BY MR. CHAVEZ:

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

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

11 A Yes, sir.

12 Q Was a fiberglass pit installed there in-
13 stalled to prevent water pollution?

14 A Yes, sir.

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

17 A I beg your pardon?

18 Q According to Mr. Hicks' testimony pre-
19 viously would you say that this pit has functioned and pre-
20 vented pollution from the produced water from the Mary
21 Wheeler No. 1?

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

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

26 A I'm not sure that the fiberglass pit pre-
27 vented pollution because I don't know the quality of water

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2 produced by the well so I don't know whether there was pol-
3 lution without the pit.

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

6 A Yes, sir.

7 Q Is there any petroleum products in that
8 fiberglass pit?

9 A Yes, sir.

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

12 A Yes, sir.

13 Q Would you describe them, what they are?

14 A There is an abandoned pit sitting just to
15 the downstream side of the fenced compound around the li-
16 quids tank that is an abandoned pit that was used in the
17 same position as where the present fiberglass lined pit is
18 installed.

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

21 A I'm not sure.

22 Q Are there any other fiberglass pits to
23 your knowledge and belief on any other well in the vulner-
24 able area?

25 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

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2 but I have not seen another fiberglass lined pit.

3 Q Well, if I could stimulate your recollec-
4 tion, in the Cedar Hill area where Amoco has production on
5 the McCoy Well, do recall if fiberglass pits have been in-
6 stalled there along the river?

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

9 Q Mr. Kendrick, has any pit, produced water
10 pit, to your knowledge ever introduced any petroleum pro-
11 ducts as in benzene or even crude oil from the pit into the
12 ground, such as in the El Paso Lindsay "A" No. 1 Well along
13 the San Juan River or from any pit in the Cedar Hill area?

14 A I don't know of -- about any benzene con-
15 tamination. I have no equipment to test it. I have no ex-
16 perience with that.

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

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

23 A If it traveled from the tank, it was sit-
24 ting on the sandbar. The distance would have been two or
25 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

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2 that tank.

3 Q At that time did you direct the operator
4 to take action to prevent the introduction of any more pro-
5 ducts from either the pit or the tank at that site?

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

8 We did ask the operator of the nearby
9 wells and the pipeline operator, or pipeline company repre-
10 sentatives to excavate a canal alongside of the water canal
11 and burn the petroleum product out of the sandbar.

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

15 A No, sir.

16 Q Mr. Kendrick, I notice on your Exhibit
17 Thirteen you don't show a blowdown pit and you said that re-
18 presents about half the wells, Basin Dakota and Blanco Mesa-
19 verde wells in the San Juan Basin.

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

22 A I don't recall very many having blowdown
23 pits. Amoco's wells normally have blowdown pits but a lot
24 of El Paso's wells and a lot of other operators do not main-
25 tain 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?

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

6 If the operator does not install a separ-
7 ator, then they in self protection install a drip.

8 Q So therefore those Pictured Cliffs loca-
9 tions that Mr. Hicks mentioned that do not have separators
10 would have a drip pot, is that correct?

11 A For the most part, yes.

12 Q Mr. Kendrick, in your examination of pro-
13 duced water pits, what percentage of them had oil products
14 flowing on them or not?

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

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

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

26 Q Mr. Kendrick, in listening to the pre-
27 vious testimony and from your own study you came to the con-
28 clusion that a casing leak in the Monsanto Well could have

1
2 been a possible source of contamination at the Flora Vista
3 site.

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

7 A If the well produced into a sandbar and
8 overwhelmed the bacteria and was trapped into a buried sand-
9 bar, it's possible that there would have been little degra-
10 dation for that 1700 feet of lateral movement.

11 Q Mr. Kendrick, was there ever any gas pre-
12 sent in any of the water wells that were drilled, to your
13 recollection, in your talks with Mr. Thurston?

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

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

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

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

24 A I would not have any basis to make that
25 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

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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

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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

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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.

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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 dig-
ging the new water well?

A No, sir.

Q And the events have occurred subsequent
to the drilling of the contaminated well and the Mary Wheel-
er 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 be-
low the water well in the valley and any gas well on either
side of the river had experienced a casing failure and con-
taminated 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 essen-
tially 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 un-
less 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

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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

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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

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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?

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

6 Q I don't think that we need to have people
7 to die. I think all we have to have is evidence that conta-
8 mination is there and we would make an investigation and de-
9 termine the source as best we can, but because of one point
10 of contamination in the San Juan Basin, we can't compare
11 that to one automobile wreck and ban automobiles.

12 Q But could we put seat belts in automo-
13 biles, what could we do comparable to that in oil and gas
14 wells?

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

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

19 A I'm not sure that it does.

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

21 MR. STAMETS: Are there other
22 questions?

23 Mr. Chavez.

24 QUESTIONS BY MR. CHAVEZ:

25 Q Mr. Kendrick, Mr. Hicks and your testi-
26 mony pretty well indicate that produced water from the
27 fiberglass pit, not positively, but probably would not cause

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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

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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

1
2 the production separator ever malfunction and put oil into
3 the hydrator such that it dumped oil into the unlined dehy-
4 drator pit?

5 A I do not know.

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

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

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

12 A I do not know.

13 Q That's all the questions I have.

14 MR. STAMETS: Ms. Pruett?

15 CROSS EXAMINATION

16 BY MS. PRUETT:

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

20 A Or any combination of the three.

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

23 A That's true.

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

27 A Yes.

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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

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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 there 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

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2 contamination.

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

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

12 281 represents the distance from the left
13 end of the black line to the confluence of the red and black
14 lines in feet.

15 285 feet would then be the hypotenuse of
16 a triangle from the black line and the red line and across
17 the left end of those down there so that the distance from
18 the quote contaminated well in the center of the page to the
19 producing water well in the lower lefthand corner is about
20 285 feet, but the measured distance with a steel tape be-
21 tween the water well in the lefthand corner and the capped
22 well is 49 feet. I measured that with one piece of tape so
23 that there;s not any conjecture on my part. That is the
24 distance between the centers of those wells, and one is con-
25 taminated and one is not. I can't explain why. Like I say,
Mother Nature does some queer things.

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

1
2 a sudden the Flora Vista Water Users discovered bad water in
3 that well if the alluvium from the Mary Wheeler gas well had
4 been charged years and years and years before?

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

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

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

13 Q Then go ahead.

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

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

19 MR. STAMETS: Mr. Kendrick, be-
20 fore you answer that question, let's make sure that you and
21 Ms. Pruett are talking about the same well.

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

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

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

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

4 MR. STAMETS: All right. There
5 are two wells which could be contaminated. There's the ini-
6 tial well, which is -- has been referred to as the capped
7 well.

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

10 MR. STAMETS: You're talking
11 about the well which Mr. Kendrick has shown at the con-
12 fluence of the red and black lines.

13 MS. PRUETT: Right, number 27.

14 MR. STAMETS: Okay.

15 A The 27 on there is the distance but with

16 --

17 MS. PRUETT: Okay.

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

19 Q Right.

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

25 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

1
2 show of gas was found when surface casing was set on that
3 well at the depth of 225 feet, and that the gas was sealed
4 off after the pipe was cemented.

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

7 A I don't know how deep they are.

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

9 A That's true.

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

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

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

18 Q I'm sorry.

19 A They asked me how to dispose of it and I
20 told them to line the pit, but the wellbore itself is approx-
21 imately 1700 feet, I think, from the Mary Wheeler Well and
22 so that would make it some 1900 feet from the quote contami-
nated well.

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

25 A I don't know.

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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

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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

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2 greater from liquid hydrocarbons than produced water in this
3 area and such liquid hydrocarbons can get out in pits as re-
4 sults of upsets.

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

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

12 Q Would not the lined pit at the tank bat-
13 tery provide additional insurance, though, against upset
14 causing hydrocarbons to get into the fresh water?

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

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

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

22 A Well, if we --

23 Q Or a month?

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

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2 in the production of that well or a regulatory agency repre-
3 sentative asked for a test, then we would ask that the Oil
4 Conservation Division people witness the test.

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

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

16 MR. STAMETS: Any other ques-
17 tions of this witness?

18 Mr. Kellahin.

19 MR. KELLAHIN: Thank you, sir.

20 REDIRECT EXAMINATION

21 BY MR. KELLAHIN:

22 Q In response to some questions by Mr. Sta-
23 mets, Mr. Kendrick, this hearing is set up to discuss
24 whether or not we should line pits for produced water.

25 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

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

6 A I think the rule that prohibits the stor-
7 age of oil in open pits is as effective as a new rule which
8 says the same thing.

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

14 A The frequency depends on the individual
15 well in question.

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

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

20 Q Based upon your knowledge and experience
21 in the industry, Mr. Kendrick, do you believe that the oil
22 field operations, as well as the Oil Commission rules and
23 regulations now, are adequate to provide a contingency plan
24 to take care of spills and upsets, that will allow the pum-
25 per 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-

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

Q Thank you, sir, nothing further.

MR. STAMETS: Ms. Pruett.

REXCROSS 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 --

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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.

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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

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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.

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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

1
2 leaks be reported?

3 A Yes, sir.

4 Q And were those events routinely reported?

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

7 Q Do you recall when that rule was enacted?

8 A Not precisely.

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

11 A I'd say somewhere around 1970.

12 Q I have before me, sir, a copy of Oil Con-
13 servation Division Rule 116, entitled "Notification of Fire
14 Breaks, Leaks, Spills, and Blowouts".

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

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

22 The report shall also detail the measures
23 that have been taken and are being taken to remedy the sit-
24 uation reported."

25 In your employment with the Oil Conserva-
tion Division during the time that rule was in effect, is it
your experience that those reports came in periodically and
reflected the required information?

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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.

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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

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2 that is reserved.

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

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

16 If that is to be a subject of
17 consideration, we'd request that that be docketed as a sep-
18 arate case.

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

21 CROSS EXAMINATION

22 BY MR. ELMER:

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

A Rainfall?

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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 groundwater 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

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

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

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

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

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

17 Q Yes.

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

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

23 A The pit was indeed constructed into the
24 water table.

25 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 di-
luted by the groundwater as it passed through the pit.

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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.

RE CROSS 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

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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

1
2 you're testing these wells during a period of March 11th,
3 12th, 13th, and subsequent to that a week later was the only
4 testing that you did and this was not a process of where you
5 tested water for several weeks or a month to determine if
6 contaminants were showing up, but it was essentially a one
7 or two times testing procedure and you didn't find large
8 amounts of the contaminants at that time, although some did
9 show up in the water supply, is that correct?

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

16 So the further wells away would actually
17 be reflective of what has happened in the past. The closer
18 wells would be reflective of what's happening in the recent
19 past and the pit itself would be reflective of what's hap-
20 pening at that instant.

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

24 A Three limited locations that are reflec-
25 tive of a much larger population and in fact are the worst

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2 case scenario or what we believe to be the worst case scen-
3 ario of those populations. That's correct.

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

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

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

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

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

23 A There's --

24 Q -- did this in the monitor wells?

25 A There's three water level maps which doc-
ument that we did in fact test the depth to water and in
fact surveyed in the elevations so that we would have accu-
rate water level maps so that the depth to water and the --

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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 to 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

1
2 task with Mr. Taylor, I have prepared a list of a number of
3 questions myself that we need to discuss.

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

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

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

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

16 MR. HICKS: I'm fine.

17 MR. STAMETS: Please be as
18 brief as possible.

19 MS. PRUETT: Surely.

20 RE-CROSS EXAMINATION

21 BY MS. PRUETT:

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

What volume is that?

A The pit itself is approximately 10 x 10

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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

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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

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

4 Q Would you check and make those available
5 to us?

6 A Yes.

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

9 MR. KELLAHIN: If the Commis-
10 sion please.

11 REDIRECT EXAMINATION

12 BY MR. KELLAHIN:

13 Q Mr. Hicks, do you have a calculator?

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

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

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

25 MR. BUYS: Barrels.

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

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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.

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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

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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

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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 because 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?

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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

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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

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

7 Mr. Baca previously stated that -- that
8 solutions of benzene in solution with water would have less
9 of a capacity to flash off than if it was just pure benzene,
10 so I think that number of 14 parts per million is -- is a
11 good one. We sampled stuff coming from the separator and we
12 certainly have higher numbers than that, so I'll stick with
13 14.

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

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

21 Q From tests of --

22 A Of produced water. Well, it was includ-
23 ing the pits, right, and it had everything at that time.

24 Q Do you feel that Mr. Hicks values of ben-
25 zene 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 --

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

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

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

20 For example, if you had four to five
21 inches of snow fall on a pit or if you convert that to rain-
22 fall, a half an inch of rain, and you get -- include the
23 runoff from any -- from the sides of the pit going in, and
24 you add that to six or eight inches of -- of standing pro-
25 duced water, I think that can lower the -- the benzene con-
centration in the -- or lower the concentration of pollut-

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2 ants in the pit.

3 For example, in Table I of Mr. Hicks' ex-
4 hibit, I think that was Exhibit Number One, I believe, that
5 he prepared, he showed that there is one pit that had a con-
6 centration of 10.2 milligrams per liter, and that was -- I
7 believe that to be more representative when you have stand-
8 ing fluids out there, more representative than the average
9 of 3.58.

10 So I'm going to stick with the 14.

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

15 A Well, I think that the study shows that,
16 again, for the dates that he sampled and the locations he
17 sampled, those were the results he got. I think that there
18 is a wide variety of conditions in the San Juan Basin, in
19 the alluvial areas of the San Juan Basin, as I testified to
20 earlier, with a wide range of different hydraulic conducti-
21 vities and aquifer conditions.

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

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

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

1
2 marked as Division's Exhibit Number Eighteen, and would ask
3 you to explain that for us.

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

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

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

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

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

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

1
2 This particular, these particular simula-
3 tions were used -- were run on an IBM PC. Mr. Prickett of-
4 fers a short course in connection with the National Water
5 Well Association and the PC, and the computer program run on
6 the IBM PC was obtained through attendance at that short
7 course.

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

15 The program can simulate water two dimen-
16 sional flow in aquifers under artesian or water table condi-
17 tions. It provides for output plots of solute concentra-
18 tion, distributions, and the effects of dispersion and dilu-
19 tion of waters at various concentrations can be shown by
20 taking a look at those graphical outputs.

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

25 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 tes-
timony, aquifer thickness, transmissivity.

1
2 The last column is a Flora Vista aquifer
3 characteristics that were obtained through a report that I
4 mentioned in my previous testimony on April the 3rd.

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

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

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

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

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

1
2 The source sink on page one indicates the
3 number of gallons per day flowing into the site, which is 5
4 barrels per day.

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

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

10 The simulation is given in parts per
11 billion.

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

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

1
2 Page 1.6 we have another simulation using
3 one barrel per day and a -- on page 1.7 after 30 days you
4 can see that the standards have been exceeded at some dis-
5 tance, 15 feet or so, away from the source.

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

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

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

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

25 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-

1
2 ant movement, well, at the end of a year you have pollutant
3 movement 600 - 700 feet away in excess of the standards, and
4 that's on page 2.4.

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

8 On page 2.6 we talk -- the same simula-
9 tion is repeated for one barrel per day and the effects of
10 mixing and dilution become very apparent with the high con-
ductivity of 2500 feet per day.

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

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

1
2 number in my final simulation in Section III for concentra-
3 tions or for discharges 14 milligrams per liter and values
4 of discharge ranging from 5 barrels per day down to 2.5 gal-
5 lons per day.

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

11 At the end of one year, according to the
12 simulation, you have the health standard exceeded at a dis-
13 tance of 250 feet away from the injection site.

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

19 And that's for 5 barrels per day.

20 The same simulation was recorded on page
21 3.7 for two years at one barrel per day and in that particu-
22 lar case I had the coordinates a little bit tighter and it
23 shows concentrations within 100 feet either side of the in-
24 jection point exceeding standards in the direction of flow.
25 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

1 billion as far as 250 feet away for 730 days of simulation.
2 Or two years.
3

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

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

10 At low hydraulic conductivity -- conduct-
11 ivities of the area the simulations show benzene concentra-
12 tions exceeding the standard of 10 parts per billion in the
13 vicinity of the discharge point for all volume discharges.

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

20 At lower volumes of discharge, half bar-
21 rel, one barrel per day, the average concentrations were
22 less than the standard in some of the simulations but you
23 may have some localized high concentrations within that
24 area.

25 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 dis-
charges of a half barrel per day or greater, and approaches

1
2 the standard of 10 parts per billion at 2.5 gallons per day
3 discharge.

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

10 Contamination at discharge levels of a
11 half barrel per day were shown to exist in the computer sim-
12 ulations for all hydraulic conductivities inputted into the
13 computer except for those exceptionally high hydraulic con-
14 ductivities that I mentioned of 2500 feet per day.

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

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

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

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

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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,

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

5 However, the effects of dispersion are
6 not so great as to eliminate a health hazard with the con-
7 centrations.

8 Q Thank you.

9 MR. TAYLOR: I have no more
10 questions.

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

13 MR. KELLAHIN: Absolutely.

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

17 MR. KELLAHIN: At the pleasure
18 of the Commission.

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

21 (Thereupon the noon recess was taken.)

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

24 Mr. Kellahin, you have some
25 questions.

MR. KELLAHIN: Yes, sir. Thank

1
2 you.

3
4 RE CROSS EXAMINATION

5 BY MR. KELLAHIN:

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

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

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

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

25 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

1
2 his exhibits earlier this morning, I believe some five sites
3 around the Flora Vista contaminated water well. Were there
4 in fact five sites?

5 A We put in five drive points and casing
6 points.

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

10 A Yes.

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

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

15 Q All right.

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

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

21 A Right.

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

24 A Right.

25 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

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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

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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.

1
2 Q And if we showed that the computer mod-
3 eling of the site showed that it busted the standard, we
4 could go and actually conduct groundwater monitoring and
5 have site specific data, actual information to show us
6 whether we are posing a risk to the groundwater.

7 A That's correct.

8 Q All right. And if the groundwater moni-
9 toring done by you or someone else is correct and accurate
10 and shows no levels of contamination in excess of the stand-
11 ard, then we could get the permit.

12 A Yes.

13 Q All right. You've commenced on a process
14 of developing information on that second level by using ran-
15 dom walk, have you not?

16 A Yes, sir.

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

19 A On how many different sites?

20 Q Yes, sir.

21 A It was run on the information and the --
22 using the assumptions that were presented in the February
23 3rd hearing plus the information, aquifer parameters on the
24 Flora Vista, so it used -- I ran it with several sets of
25 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

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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 discussed 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

1
2 was 14. I used the same concentration, 14 milligrams per
3 liter benzene, for everything in all those runs.

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

7 A Yes.

8 Q -- of that?

9 All right, sir.

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

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

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

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

21 A Yes.

22 Q Do you have any disagreement with the ac-
23 curacy of the information on that table?

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

28 Q I meant to exclude, sir, the Geoscience

1
2 Consultants data and look at that portion of the table as it
3 only reflects the OCD data.

4 A Right.

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

9 A Yes.

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

13 A All right.

14 Q Have you plugged into random walk a ben-
15 zene concentration using 3.2 milligrams per liter to see
what will happen to the standard?

16 A No, I did not model at that level.

17 Q Have you attempted to use any of the
18 field data from the Flora Vista well, including the analysis
19 of the pit water or any of the groundwater monitoring re-
20 sults that you've obtained from Flora Vista in order to cal-
21 ibrate your computer?

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

25 I am -- was not attempting to model any

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2 contamination movement at Flora Vista. I was attempting in-
3 stead to show what would happen with those aquifer parame-
4 ters of -- Flora Vista aquifer parameters and a concentra-
5 tion of 14 milligrams per liter.

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

10 Q Would it be acceptable methodology for a
11 hydrologist to take the field data that you have developed
12 from the Flora Vista site and use that information to cali-
13 brate the random walk sampling or computer runs for that
site?

14 A If you were, again, if you were at-
15 tempting to model the movement at Flora Vista, yes, certain-
16 ly should. You could use as much of the data as you have in
17 any model.

18 Again, that is not my -- was not my pur-
19 pose in putting data in for Flora Vista. I was just using
20 the Flora Vista data again to provide what I felt were real-
21 istic aquifer parameters in between the range that I gave
originally, that Mr. Hicks has given in his testimony.

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

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

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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.

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

8 And I didn't. I just was making an in-
9 terpretation of -- of aquifer parameters from the site and I
10 did not intend to model the contamination. That was not the
11 purpose.

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

16 A Right.

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

19 A I have no way of knowing at this time.
20 The wells need to be pumped. They need to be developed.
21 You know, I just don't know. The study has not yet gone to
22 completion. It is very preliminary. The results I took at
23 the time I took the samples have been reported and show no
24 contamination, at least in those wells, at the time they
25 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.

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2 Q Why weren't these monitoring wells devel-
3 oped immediately at the time the backhoe dug out the pits
4 for you?

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

13 When the wells have been properly devel-
14 oped and purged, I think that they will provide additional
15 data.

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

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

25 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

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2 any contamination. It provides known mathematical and phys-
3 ical laws and combines them together to provide some idea of
4 what can happen when you add a certain volume of contami-
5 nants in certain concentrations.

6 Q You haven't reached the level of your
7 studies that have done that yet.

8 A I have done that -- I have done that for
9 generalized ranges of values.

10 Now, again you're talking, if you're
11 talking about site specific things at Flora Vista, there was
12 no attempt to model the situation at Flora Vista just to use
13 the aquifer parameters that were available from a report.

14 Mr. Hicks used an aquifer parameter from
15 Bill Stone's report.

16 Again, this -- there has not been, or at
17 least not as readily available, a wide range of transmis-
18 sivity and hydraulic conductivity values in the literature
19 for this area.

20 You know, both Mr. Hicks and myself, and
21 other members of the study committee, are using what is
22 available, plus what is available from textbooks to come up
23 with the range of values. That is why I'm not trying to
24 base conclusions on just one hydraulic conductivity value
25 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,

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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

1
2 same general kinds of hydrologic parameters, run the model
3 again on that site, and see if it will bust standards with-
4 out having to go to groundwater monitoring at that other
5 site.

6 A Oh, I see what you're -- where you're
7 going.

8 Q I want to use the model for something. We
9 built it, let's do something with it.

10 A Okay. I think that -- I think that one
11 of the things that are inputs to the model or in any study,
12 if you go out and you take a look at your gradient, you go
13 out and take a look at your -- what your individual monitor-
14 ing wells show, and because of the, if the model is specifi-
15 cally calibrated for the Flora Vista site, you have the --
16 you have the water levels in the monitor well to put in.
17 You have the elevations. You have the pumping data from the
18 community system, and everything else, then you can use that
19 model to make predictions based on changes in the pumping of
20 the community system, possible entrance of pollutants, or
21 anything else.

22 The model has been calibrated for that
23 particular site using those particular configurations of
24 wells and distances, and if you had transmissivities for
25 each particular well you could put that in there, and every-
thing else. It would be very site specific.

26 When you do a general aquifer model for
27 anything from an individual site to an individual -- to a

1
2 basin, it is a very site specific type of thing that will
3 tell you for pumping at 200 feet away from this well and a
4 pit over here, and so on and so forth, it is -- when you get
5 that information, the T and the S's, and you put that into
6 the computer, that is specific information that has been
7 generated for one particular well and one particular site,
8 and then you can run the model varying all those different
9 conditions.

9 You cannot take that same model with
10 those same wells and lift it wholesale to another site. You
11 can use the same aquifer parameters if they're similar, and
12 do it that way, but you can't -- because every site is dif-
13 ferent, you cannot, you know, just move a calibrated model,
14 say, on a certain grid of a couple hundred yards, and move
15 it to another site. It just -- you cannot do that.

15 Q All right, let's assume that within the
16 vulnerable area we have well types like the Flora Vista in
17 which we have aquifer parameters that are similar or identi-
18 cal to such a degree that you're comfortable.

19 A Uh-huh.

20 Q All right, then in terms of running the
21 computer runs to predict what's going to happen at another
22 well, the factor that we change would be the source term.

23 A Yes. If everything is -- if you're -- if
24 you can make an assumption that at one particular unlined
25 pit your saturated hydraulic conductivity is a certain --
certain value, then the rest of it, and you know the approx-

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2 imate thickness of the water table, then the rest of it is
3 -- you can, you know, put into the computer along with con-
4 centration and make some predictions.

5 Q And so if we want to make some predic-
6 tions about what is happening at another well of the Flora
7 Vista type somewhere else in the vulnerable area, we don't
8 have to go out in the ground and start drilling monitoring
9 wells and taking an analysis from those samples in order to
10 come up with some reasonable projection about what will hap-
pen at that site?

11 A Yes, that is correct. That's why we do
12 the -- the whole purpose is to come up whether you have a
13 site where you have a concern with possible groundwater con-
14 tamination or you have a site where you have no --no worries
15 about it, based on the types of discharges we're talking
about.

16 Q Just a moment. I think I understand but
17 I want to make sure it's clear on how we calibrate the ran-
18 dom walk for the Flora Vista data.

19 If we have all the hydraulic parameters
20 that we can agree upon for Flora Vista, and we have the ac-
21 tual groundwater monitoring and we find from the monitoring
22 wells that we either cannot detect benzene or that at some
23 point near the pit we have got a certain magnitude of ben-
24 zene concentration, and let's assume that it's within the
25 standard, can you take that information and back calculate
the benzene concentration or the source term that you plug

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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

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2 complex than the simple mixing model that will show what the
3 effect of certain -- the input of certain aquifer parameters
4 and certain concentrations will have on an idealized aquifer
5 and that is as much as I am trying to -- or saying about it
6 right now.

7 I'm saying that you can get a feel or an
8 idea of what contamination will do, how fast it will move,
9 what the concentrations will be, based on these physical
10 laws and the physical parameters of input.

11 I am not trying to, as I stated earlier,
12 make a model of Flora Vista's particular situation.

13 Q We've not taken the model and using the
14 data developed from the field, field water, groundwater
15 quality data, that we've got either Flora Vista or one of
16 these other sites Mr. Hicks talked about some, you have not
17 yet done the calibration of your model to take that field
18 data into consideration.

19 A No. No.

20 Q Thank you, sir.

21 MR. STAMETS: Ms. Pruett.

22 CROSS EXAMINATION

23 BY MS. PRUETT:

24 Q I think at one point there was some con-
25 fusion, 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 --

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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?

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2 A Well, for the wells they sampled they did
3 not find benzene and some of my concerns regarding -- re-
4 garding that were brought out earlier, but also I haven't
5 seen any data presented for any of the other things that we
6 look for when we -- under the Water Quality regulations on
7 any of the other standards.

8 We haven't seen the information for TDS
9 or chlorides or sulfate, all of which are parameters of con-
cern.

10 Q How long does it take to perform a speci-
11 fic specimen test?

12 A Thirty seconds.

13 Q Can you -- have other parameters such as
14 chlorides, TDS, and phenols been found in produced water?

15 A Well, we sampled -- we samples TDS and
16 chlorides and found that I would expect phenols to be also
17 in there. No, I have not analyzed any of my produced waters
for those samples.

18 I believe, however, some other samples
19 were analyzed for produced waters, I mean for phenols, the
20 ones --

21 Q Can you make any generalization about the
22 behavior, for example, of chlorides in relation to what
23 we've seen in the behavior of benzene with regard to travel
time or effects of attenuation?

24 A Chloride is a very conservervative parameter
25 as far as sampling goes because it moves essentially with

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2 the groundwater. Very little -- there's very little atten-
3 uation that you would expect from -- in chlorides, whereas
4 you might have attenuation of other inorganics or organics
5 in groundwater movement.

6 Q So any exemption based solely on benzene
7 data would fail to address any potential threat to ground-
8 water posed by these many other contaminants, such as chlor-
9 ides or TDS.

10 A That's correct.

11 Q Do you believe that the three wells
12 studied by Geosciences are indeed representative of the 1200
13 or 1500 produced water pits in the San Juan vulnerable area?

14 A Well, I believe that there a wide range
15 of conditions in the alluvial aquifers, as I mentioned in
16 some of my testimony about wide range of conductivities and so
17 on and so forth.

18 The information presented gives some
19 generalized estimates and I -- I would say that they aren't
20 representative. I think that you would need additional data
21 to determine what is representative.

22 Q Thank you. Regarding the Flora Vista
23 site, do you now deep the Flora Vista Water Association --
24 Flora Vista Water Users Association wells were?

25 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

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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?

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2 A I would conclude that that would be very
3 unlikely. In between the -- in between the sites you have
4 other domestic wells that have -- that act on the aquifer or
5 change the gradient.

6 The topographic gradient in that area is
7 opposite to the direction that the contamination would have
8 to flow to get into the Flora Vista well and the influence
9 of additional pumping wells, what also must be factored in
10 there is that they are much closer to -- to the -- where the
11 well is blown out, where the blown out well was, and it
12 would seem to me that if there was contamination as a result
13 of the blowout, that it would be detected there instead of
14 in an up gradient well over a mile away.

15 Q Do you think it's more reasonable to con-
16 clude that some sort of activity at the Mary Wheeler site
17 contaminated that well?

18 A Some sort of activity, yes.

19 Q Now in order to model the Flora Vista
20 situation, as suggested by Mr. Kellahin, what sort of --
21 what do you need to input historical data regarding the vol-
22 ume of water as to the pit and concentration of benzene and
23 the period of time over which the water was added and before
24 -- do you have that general information available to you
25 now?

26 A No. Again, that's not the type of infor-
27 mation I desired because I wasn't attempting to model the
28 Flora Vista situation.

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2 Q And could you in the absence of all that
3 additional data, reasonably use the model to simulate what
4 we would expect to see at that site today?

5 A In the absence of the data, yes, I could
6 not -- I could not run a model without having some addition-
7 al inputs to, you know, to, as we talked about later, to
8 calibrate it.

9 Again it just, my particular model just
10 gives a generalized idea of what would happen at some sites
11 for those particular aquifer parameters.

12 Q And in order to generalize the informa-
13 tion from that model to other well sites, indeed you would
14 need to input significant amounts of other data --

15 A Yes.

16 Q -- such as I've just suggested, wouldn't
17 you?

18 A To make it -- to make it very specific
19 to other well sites, yes.

20 Q If, as I think, and I can't remember who
21 suggested today that perhaps a reasonable alternative to a
22 small volume exemption was some sort of pit registration
23 form, what sorts of information and documentation would you
24 like to see provided on that form?

25 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 com-
ments on that just off the top of my head, because I think

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2 it would be something that needs input from myself and other
3 people on my staff.

4 Q Do you think you could put together some
5 sort of proposed list of what you'd like to see on that form
6 as (not understood)?

7 A Yes.

8 Q I have nothing further.

9 MR. STAMETS: Mr. Chavez.

10 QUESTIONS BY MR. CHAVEZ:

11 Q Mr. Boyer, in your conduct of the inves-
12 tigation of the pollution at the Flora Vista water well, did
13 you interview people and look through other records that may
14 not have been presented here as exhibits?

15 A Well, again, I have not examined all the
16 records but there were a number of other pits on the site,
17 and currently the produced water pit is the one that is
lined.

18 Q Is the dehydrator pit lined?

19 A There's a barrel. It's not lined as
20 such. There's a barrel under the end of the pipe that
21 catches stuff.

22 Q In your investigation did you determine
23 when that barrel had been placed there?

24 A I'm not aware of the date, no.

25 Q Had that barrel been placed there prior
to or after the discovery of the pollution in the water

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2 well?

3 A I -- I'd have to go back to the records,
4 Mr. Chavez. I think at the time -- I think at the time --
5 I'd have to go back to the records to be sure but I think at
6 the time it was placed after the discovery.

7 Q If Mr. Hicks sampled the produced water
8 in that steel drum, what would he have found?

9 A I don't know.

10 Q Have you read, in your investigation and
11 all, have you read a report on produced water in the San
12 Juan Basin put out in a magazine called The Workbook?

13 A I have read that, yes.

14 Q If that steel drum contained only glycol,
15 crude oil, or other discharges from the dehydrator and let's
16 say that steel drum wasn't placed there until after the pol-
17 lution had been discovered, would you consider that may have
18 been a source for the grease and oil found in the water sam-
19 ples of the Flora Vista water well?

20 A If I understand you correctly, if the
21 drum was not placed till after the pollution was discovered
22 and prior to that time anything that went into the dehydra-
23 tion pit was -- and the pit was unlined, could that have
24 been a source? Yes, it could have been.

25 Q Mr. Boyer, the type of soil that exists
at the Flora Vista site, if I were to scrape away some top-
soil and dump a bucket of water on it, what would happen to
that water?

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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

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2 detail at this particular time on the Flora Vista situation.

3 There is a great amount of documentation
4 in the files in EID and also, I'm sure, in the OCD files,
5 that possibly would be of some use as far as trying to eli-
6 cit all the different facts and circumstances and order of
7 circumstances on this particular incident. We've heard dif-
8 ferent versions from different people today and I think that
9 if there was to be a great amount of reliance on it, it
10 should all be entered into the record as an exhibit that --
11 so that everybody could ascertain all the different circum-
stances and facts and what has been done.

12 There's a lot of it that I am not that
13 personally familiar with and I have not read that closely as
14 to the circumstances that occurred back in 1981 and '82.

15 MR. CHAVEZ: That's all I have.

16 MR. STAMETS: Mr. Carr.

17 CROSS EXAMINATION

18 BY MR. CARR:

19 Q Mr. Boyer, I'm going to try and
20 understand what you've done.

21 In terms of your computer work, if I un-
22 derstand what you do, is you take certain data, you run them
23 through the computer using this random walk model.

24 A You get it -- yes.

25 Q And from that you're reaching certain
conclusions about contaminants that exist in the fresh

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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.

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2 A Yes, given those assumptions that were
3 set out in the first page of the exhibit.

4 Q But these assumptions and these conclu-
5 sions don't actually show a real world situation as it hap-
6 pens in any one particular well.

7 A It comes as close as you can get without
8 going out and sampling -- digging essentially concentric
9 circles around a particular well and sampling each point in
10 a grid.

11 Q So is it your testimony that this data is
12 really a real world situation that you're depicting?

13 A I think -- I think, again, within the
14 limits of the numbers I've put in and with the assumptions
15 that have been made, it is real world.

16 Q Does this model take into account the
17 methods of attenuation that we've discussed here before?

18 A It takes into several methods, yes.

19 Q Does it take in biodegradation?

20 A No.

21 Q And is it your testimony that that does
22 not occur in the real world?

23 A I think that -- I think that I have tes-
24 tified to the fact that biodegradation does occur and I have
25 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.

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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,

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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.

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2 A The data -- the data that I presented at
3 this exhibit, I mean this hearing, on my Table 8 through 12,
4 were from the separators and some pit sampling.

5 Q Thank you.

6 MR. PEARCE: Very briefly, if I
7 may, Mr. Chairman.

8 MR. STAMETS: Mr. Pearce.

9 CROSS EXAMINATION

10 BY MR. PEARCE:

11 Q Mr. Boyer, could you walk through the
12 process that you used with the backhoe when you developed
13 the five monitoring locations around the Flora Vista well?

14 A Well, as I stated before, we needed to
15 use a backhoe because previously EID had tried to use a hol-
16 low stem auger and they couldn't do it, so we took the back-
17 hoe and we took it down to the well site.

18 We had rented a portable steam cleaner to
19 use and we in between and each site we took it, and took the
20 backhoe on down and -- and flushed it out thoroughly with
21 the hot water and steam coming from the steam cleaner and
22 then we took it back to the site and dug the ditch.

23 Q Okay, how deep was the ditch?

24 A I think it was -- maximum depth was about
25 eight feet or so.

26 Q And when you got it down to that level it
27 immediately filled with water, is that correct?

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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

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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.

RECCROSS 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

1
2 not been found is not significant given the different hydro-
3 logic actions that can occur once -- once water is disposed
4 of in the ground, or produced water is disposed of in the
5 ground.

6 Q If one discounts the organics in the pro-
7 duced water, is the produced water in the San Juan Basin
8 generally of better quality than that in the southeast?

9 A I would say generally yes. There are
10 high TDS and some of the samples, low TDS in some of the
11 samples. In most of the samples it exceeds 1000 milligrams
12 per liter, which is in the New Mexico Water Quality Control
13 Commission regulations for -- for groundwater.

14 Q If one takes this generally better qual-
15 ity water and puts it in a pit and the factors of disper-
16 sion, dilution, absorption, and all of that works on it,
17 could that also not be the reason why we don't see polluted
18 groundwater up there, that in fact the pit water is diluted,
19 et cetera, to the point where it's noncontaminated, where
20 the fresh water is noncontaminated?

21 A Yes, as I've testified, I think that
22 there are certainly areas up there where those processes are
23 very much acting on pollutants put into the groundwater, but
24 you also have variable situations and I don't know if you
25 could make a generalization to the same variables being pre-
sent at the same level in every area.

26 In fact I would venture an opinion that
27 you could not.

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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,

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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

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2 things, to make actual determination of whether or not that
3 -- all these things that were presented as far as degrada-
4 tion and so on and so forth were actually occurring.

5 I don't think that -- I don't think,
6 again, that you can rely on just the -- on three -- on three
7 samples taken at one time to do that.

8 Q Let me see if I understand your view of
9 the problem, then.

10 Are you telling me that you believe that
11 we just don't have enough actual experimental, empirical
12 evidence at this point to demonstrate that -- that the ben-
13 zene is not a problem in the San Juan Basin? Is that --

14 A I agree with that. I think -- I think we
15 do not have enough experimental evidence to demonstrate it
16 is not a problem. I think we have sufficient hydrologic
17 evidence to demonstrate that it is a very real and potential
18 problem.

19 Q But again, isn't that a hundred percent
20 theoretical at this point? We have not measured benzene in
21 the groundwater that had to get there from a pit.

22 Is that correct?

23 A We have not measured the benzene in the
24 groundwater?

25 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

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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

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2 as these other -- as well as the xylene. Ethylbenzene is a
3 parameter of concern and I understand that there may be some
4 -- there is developing some information as to possible
5 standard for ethylbenzene.

6 I think that also there are other types
7 of organic materials, we briefly refer to them polynucle-
8 aromatic hydrocarbons, stuff like that, I believe that's the
9 correct terminology, and I am not familiar and don't main-
tain to be an expert on -- on their presence and movement.

10 But benzene is a very mobile organic and
11 moves faster than most of the rest of them. So benzene,
12 being toxic and being very mobile is a prime one to be con-
13 cerned when we do these modeling studies, and the results I
14 presented this morning also took into account Mr. Schultz'
15 retardation factor, which indicates some sorptive properties
16 of the soil, assuming a certain amount of organic carbon,
17 and even with that factor, then, it still showed contamina-
tion in excess of standard for some of the simulation runs.

18 So I have factored in as much information
19 as is available right now and without -- with all due re-
20 spect to the gentleman that talked about biodegradation, it
21 is just now beginning to get attention and, you know, I'm
22 not sure that we can draw conclusions as to the viability of
23 that particular mechanism in all cases that we're dealing
with here.

24 Q If in the interest of gathering more data
25 the Commission came up with a pit registration process, is

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2 that the sort of thing that's -- would it be self-deciding
3 that would eliminate a lot of work for the Division, a form
4 which would say I produced X barrels of water. If this vol-
5 ume is over 5 barrels per day, you are prohibited from hav-
6 ing an unlined pit. Ask for a lined pit.

7 Or, if the produced water is in excess of
8 some value TDS, again the form would say, you may not have
9 unlined pit. Go to lined pit. Get your \$2500 check out.

10 Is that a possibility?

11 A Well, certainly -- certainly if the Com-
12 mission decides that it wants a 5 barrel per day exemption,
13 that certainly would make our job easy because there is not
14 too many pits that produce over that in this particular
15 area, but I think you could have certain conditions and re-
16 quest that the operator provide information with the -- with
17 the notice that would make it sort of self -- puts it on
18 yourself processing; however, the field people and the
19 staff, environmental staff, would have to be able to verify
20 all the information put down on the pit, on the form regard-
21 ing the pit.

22 Q If such a process were used, would -- do
23 you believe it would be necessary that the produced water be
24 examined for all of those parameters that are in the drink-
25 ing 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

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2 mean for all those constituents. I think that you'd want to
3 take a look at your TDS and chloride sulfates; maybe some
4 other inorganic parameters of concern, and I think you'd
5 want to look at your -- at least right now I'd recommend
6 them looking at the benzene and those organics associated
7 with those; possibly others as we get more information as to
8 how important they are in health considerations.

8 Q Could you have such a list together by
9 May the 7th?

10 A As to which standards we should look at?

11 Q Yes.

12 A Yes, oh, yes.

13 Q Now let me ask you about that.

14 Let's assume afor a moment that we have a
15 pit out there that receives one barrel per day and the TDS
16 level is 9,999.

17 Now, is that -- well, let's round it off,
18 let's say just a nice 10,000. It's easy to work with.

19 Should that be prohibited? Is that the
20 prohibited level or should it be something that's double the
21 standard, four times the standard? Is there some level that
22 could be arrived at relative to TDS or some of these other
23 important contaminants that we could give as guidance?

24 Let's say, for example, on chlorides with
25 a drinking water level of 500 --

26 A Two --

27 Q Is it 200?

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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-

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2 thing like that, if you make that determination, then cer-
3 tainly you could either do it concentraton times, you know,
4 you could have the different variable concentration and
5 quantity to equal that pollutant level.

6 Q Mr. Boyer, after listening to all the
7 evidence presented in this case, is there any small volume
8 exemption that you would be willing to recommend even on a
9 temporary basis at this point? Let's say for a period of 18
months while additional data is gathered?

10 A Well, I think that one of the things that
11 allayed some of my concerns was taking this random walk
12 model and running it and taking a look at some numbers.

13 I think that the 5 barrels per day is
14 clearly exceeded. I think that there is some small volume,
15 possibly a half barrel, that I feel that -- I feel that I
16 could live with based on this results and just taking a look
17 at that, and coincidentally, that also happened to be the
18 Committee recommendation the first time around, a half bar-
19 rel per day exemption and some minimum distance to ground-
water, which all pits have to be lined.

20 And I still have very many concerns over
21 5 barrels per day exemptions; however, after looking at the
22 computer models and hearing some of the other testimony, I
23 have less concerns about -- I was looking at 2.5 gallons per
24 day, I'm a little less concerned over that and on a tempor-
25 ary measure I'd be willing to support half barrel per day
and 10 feet to groundwater.

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2 Q Okay. If Amoco and Tenneco, who pre-
3 sented evidence relative to the pits, were willing to go in-
4 to some sort of a cooperative program with the Oil Conserva-
5 tion Division to develop more information, is that the sort
6 of thing that you believe you could do working with their
7 people?

8 A Oh, yes. Yes, sir.

9 MR. STAMETS: Mr. Kellahin,
10 while we're on that subject, I believe you relayed to me
11 earlier today that the contract -- Mr. Hicks does not be-
12 lieve the facilities that were installed earlier would be
13 appropriate for a longer -- for a long term monitoring
14 study.

15 Would Amoco and Tenneco be willing to en-
16 gage in some sort of reasonable long term study with the
17 Division in this matter?

18 MR. KELLAHIN: Mr. Chairman, my
19 client, as well as the other clients represented today by
20 ousher counsel, I think have consistently maintained a repu-
21 tation before the Commission to cooperate to the fullest ex-
22 tent of their ability to see if we can solve the problem
23 once we've demonstrated that the problem exists.

24 I'm a little concerned about
25 committing my client to further expenditures in this case
when they've already assumed a significant expense in pre-
paring today what I think is a solid, substantial case to
show that we don't have a problem with each pit area.

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2 If, however, the Division wants
3 our company to participate in additional studies, we'll be
4 happy to discuss that and see what levels of financing and
5 staff effort we can commit to the project.

6 One of the things the Division
7 requested early, and it seems like a year ago, was the short
8 term study committee, and my clients and many of these other
9 clients in this room have actively participated in that ef-
10 fort.

11 Now if this is to be a task as-
12 signed to the short term study committee or to the long term
13 study committee, I know that my company will continue to
14 participate as best they can.

15 The specific answer to the
16 question about whether the Paine, the Eaton, and McCoy sites
17 can now be used for continued sampling is that they cannot.
18 We have not policed the area, and cannot be assured of the
19 integrity of those well points. We in fact know that some
20 of them have been contaminated and some of them have been
21 removed and we'd have to drive new points.

22 If we can agree upon, with our
23 hydrologist and Mr. Boyer, well sites under our control that
24 can be the subject of groundwater monitoring, I think we can
25 work that.

I'm sorry I can't be very spe-
cific in my response to you, but we will cooperate in any
way we can. We have to get management approval for further

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2 participation of money and staff, but we will do as we have
3 done in the past, to contribute to study committees by the
4 Commission and to cooperate in any way we can to solve the
5 problem that the Commission perceives exists.

6 MR. STAMETS: Thank you, Mr.
7 Kellahin.

8 Are there questions of Mr.
9 Boyer?

10 MR. ELMER: I'd just like to
11 ask one question, please, Mr. Chairman.

12 CROSS EXAMINATION

13 BY MR. ELMER:

14 Q Mr. Boyer, taking the hypothetical pro-
15 gram that Mr. Stamets outlined, which I guess is self-regis-
16 tration self-policing program, is that an effective program
17 to insure the integrity of the groundwater?

18 A It's hard for me to, you know, make a de-
19 termination just based on, you know, the bare outline that
20 was looked at right today.

21 I think that any -- however, I think that
22 any program would require a certain amount of spot checking
23 to make sure that -- that the self monitoring, or whatever,
24 self-reporting is being done correctly.

25 Q Thank you.

MR. STAMETS: Any other ques-
tions of this witness?

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2 He may be excused.

3 Is there any other direct tes-
4 timony in this case?

5 MS. PRUETT: I don't have any
6 direct testimony but I want some clarification in the record
7 of the testimony in writing offered at one of the previous
8 hearings by Mr. Lorang of El Paso Natural Gas.

9 Since he hasn't been produced
10 as a witness I would ask that testimony be considered as an
11 unsworn statement rather than a sworn statement.

12 MR. PEARCE: That's fine, Mr.
13 Chairman.

14 MR. STAMETS: All right, thank
15 you.

16 Mr. Kellahin.

17 MR. KELLAHIN: Mr. Chairman, in
18 response to Mr. Taylor's rebuttal witness, we also a surre-
19 buttal witness that will confine his comments to the random
20 walk computer modeling that Mr. Boyer's done and we would
21 like to forward with that witness.

22 Perhaps you might want to take
23 a short break but I anticipate that our next witness' testi-
24 mony may take an hour and a half to address those issues
25 that are of most concern to us. So I know the day is run-
ning out, but I want to give this witness an opportunity to
have a fair representation of his testimony.

MR. STAMETS: Let's take about

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2 a fifteen minute recess.

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4 (Thereupon a recess was taken.)

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6 MR. STAMETS: Mr. Kellahin, do
7 you have a witness?

8 MR. KELLAHIN: Yes, sir.

9 Mr. Chairman, at this time we'd
10 like to call Alberto Gutierrez.

11 Mr. Gutierrez, I believe, is
12 sworn at the prior hearing. Let the record reflect that he
13 is still under oath. He has taken his seat in the witness
14 chair.

15 ALBERTO ALEJANDRO GUTIERREZ,
16 being called as a witness and being duly sworn upon his
17 oath, testified as follows, to-wit:

18 DIRECT EXAMINATION

19 BY MR. KELLAHIN:

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

22 A Yes. My name is Alberto Alejandro
23 Gutierrez and I'm a professional geologist. I'm President
24 of Geoscience Consultants, Limited.

25 Q For the record, Mr. Gutierrez, would you
please describe for us your educational background, when and

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2 where you obtained your degree?

3 A Certainly. I did my undergraduate work
4 at McGill (sic) University in Montreal and also at Univer-
5 sity of Maryland in College Park; graduated in 1977 with a
6 BS in geomicrology from University of Maryland at College
7 Park, with honors, and then I then continued my studies at
8 the University of New Mexico, where I received a Master's
9 degree in 1980 in the field of geology with a specialization
10 in hydrology and both surface and near surface groundwater
hydrology.

11 Q Are you a member of any professional or-
12 ganization in your field of experience?

13 A Yes. I'm a Certified Professional Geolo-
14 gist with the American Institute of Professional Geologists.

15 I'm also a Registered Professional Geolo-
16 gist in the State of Arizona.

17 I am also a member of numerous profes-
18 sional organizations, such as the Geological Society of
19 America, the National Water Well Association, American Asso-
ciation of Petroleum Geologist, et cetera.

20 Q Would you describe for us what has been
21 your experience in the field of regulatory development and
22 implementation when it comes to matters such as groundwater?

23 A Certainly. In 1975, when I went from
24 McGill to the University of Maryland at College Park, one of
25 the primary reasons for going there was to go to work for
the United States Geological Survey at the same time as I

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2 was completing my studies in undergraduate school, and that
3 work consisted primarily of working on environmental impact
4 statements and regulatory development associated with the
5 National Environmental Policy Act.

6 Also, in working on the development of
7 Council Environmental Quality regulations and guidelines.

8 Primarily I have also worked in the pri-
9 vate sector as a consultant to EPA and a number of other go-
10 vernment agencies in policy issues and regulatory develop-
ment.

11 Q What was your Master's thesis on, Mr.
12 Gutierrez?

13 A I did my Master's thesis on the Near Sur-
14 face Hydrology and Sediement Transport in the San Juan Basin
15 of New Mexico.

16 I spent two and a half years working up
17 there on a grant from the New Mexico Environ -- the New Mex-
18 ico Energy and Minerals Department to look at hydrology of
19 strippable coal areas in the San Juan Basin from Chaco Can-
yon north.

20 Q Have you been involved in the preparation
21 and the submittal of applications on behalf of individuals
22 or companies to obtain discharge permit approval from the
EID of New Mexico?

23 A Yes. As a consequence of my employment
24 with Geoscience Consultants, Limited, which is a firm that
25 consists of hydrogeologists, chemical and environmental en-

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2 engineers that specialize in hazardous waste and waste related
3 issues.

4 We have a number of clients that we have
5 not only prepared and submitted or are currently preparing
6 and submitting discharge plan applications for, but also for
7 a number of clients we're involved in actual clean-ups of
8 hazardous waste sites and contamination resulting from both
9 spills and leakages from the surface impoundments and other
10 industrial activities.

11 Q Did you participate as a geohydrologist
12 on the Oil Conservation Division Short Term Water Study Com-
13 mittee of the San Juan Basin?

14 A Yes, I did.

15 Q Have you had experience as a geohydrolo-
16 gist in using the random walk simulation of produced water
17 disposal pits?

18 A Yes, I -- well, let me qualify that by
19 saying, yes, I have run random walk but not only produced
20 water disposal pits but I've used it in many different ap-
21 plications to look at the potential impacts associated with
22 contaminants that have been discharged either onto the
23 ground or from the soil into the groundwater at various
24 types of sites.

25 MR. KELLAHIN: Mr. Chairman,
we tender Mr. Gutierrez as an expert geohydrologist.

 MR. STAMETS: He is considered
qualified.

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2 Q Mr. Gutierrez, I'd like you to direct
3 your attention back to the prior hearings in this case. Did
4 you attend the hearing we had in this case back in February
5 20th and again on March 3rd of this year?

6 A Yes, sir, I attended both those hearings.

7 Q And you're appearing today on behalf of
8 Tenneco Oil Company as an expert geohydrologist?

9 A That's correct.

10 Q And pursuant to that employment as a con-
11 sultant, have you made a study of produced water and dispo-
12 sal in the unlined pits in the vulnerable area and its po-
13 tential impact upon groundwater in that area?

14 A Yes, sir. My firm, that would include
15 not only myself but also Mr. Hicks and a number of our other
16 staff have been involved in a study on the effects of pro-
17 duced water, the potential effects of produced water on the
18 groundwater in the vulnerable area of the San Juan Basin.

19 Q Have you had an opportunity to review and
20 study not only Mr. Boyer's testimony but the exhibits he're
21 presented at the prior hearings?

22 A Yes, I've had an opportunity to review
23 his exhibits at the prior hearings and just briefly reviewed
24 his exhibit that he presented this afternoon, or this morn-
25 ing.

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?

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2 A I have not only conducted a random walk
3 simulation but in effect we have conducted random walk sim-
4 ulations on a wide variety of cases in the San Juan Basin.
5 As a matter of fact, if we -- if you'd like to go to my ex-
6 hibit, we can start going through some of those.

7 Q All right, sir, let's turn to -- first of
8 all, before we begin to discuss these figures and the infor-
9 mation in the study itself, I'd like for you to give us some
10 background, not only in the terms of the wells that you
11 studied on behalf of Tenneco and Amoco, but the background
12 and the methodology you will apply to addressing the poten-
13 tial contamination of groundwater by the use of unlined pro-
14 duction pits.

15 A As Mr. Boyer's testified, the random walk
16 model developed by Thomas Prickett and others, and included
17 as Bulletin 65 of the State of Illinois Geological Survey
18 Report, is a model that has been used by a number of hydro-
19 geologists, is well accepted in the hydrogeologic community
20 as a two-dimensional groundwater model that can be used to
21 approximate the behavior of certain constituents in the
22 groundwater at various locations.

23 So basically, I won't go into that any
24 further other than to say that it is a well accepted model
25 which has wide application possibilities.

26 Q In your opinion is it appropriate to ap-
27 ply random walk simulations to determine whether or not
28 there are levels of contamination occurring in the ground-

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2 water as projected by the computer when we're evaluating the
3 impact of the unlined -- the use of unlined production pits?

4 A Certainly it's applicable. I think that
5 the use of random walk as a method to simulate the potential
6 effects of contaminants that may reach the groundwater as a
7 result of disposal in an unlined pit is very useful and
8 gives a better approximation of reality than would a simple
9 dilution calculation.

10 I also think that even better yet, a
11 field calibrated model of random walk would go even further
12 towards demonstrating a more realistic picture of what oc-
13 curs.

14 Q You were present in the hearing room ear-
15 lier this afternoon when Mr. Boyer testified about the fact
16 that he had not calibrated his random walk simulation. Did
17 you hear that testimony?

18 A Yes, I did.

19 Q Would you tell us, then, what the mechan-
20 isms are for calibration of random walk and the different
21 factors that go into calibrating random walk so that you as-
22 similate and use the actual data derived from the ground-
23 water monitoring and other sources that you apply in the
24 model?

25 A Well, there are various methods of cali-
brating, not only random walk, but any computer model of
groundwater.

Those methods would obviously include

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2 gathering of field data from monitoring wells, not only head
3 data but also concentration data, and comparing that to the
4 results that one obtains from running the model; also by in-
5 putting estimated hydraulic conductivities and/or determined
6 hydraulic conductivities.

7 Q How -- what hydraulic conductivities were
8 used to calibrate your walk?

9 A Okay. Basically, if I can go to that ex-
hibit now.

10 Q All right, sir.

11 A If we look at Table 2 in my exhibit,
12 you'll notice that it says Predicted Benzene Concentrations
13 in Ground from Random Walk --

14 Q All right.

15 A -- Simulations.

16 Q Table 2 is page four in my book. Is mine
different from yours?

17 A No, it's page four in my book if you do
18 not count the cover page.

19 Q All right, sir, you want us to turn to
20 Table 2 of the Exhibit Number Four?

21 A That's correct.

22 Q All right, sir, I have that. What do we
do with it?

23 A Basically if you'll look at several major
24 categories that were discussed in Mr. Hicks' testimony,
25 which we have broken out the sites which Mr. Hicks surveyed

1
2 in the field and estimated hydraulic properties by visiting
3 each one of these sites.

4 In addition you will note that under the
5 category of field calibration sites it shows three sites
6 that were used where actual groundwater -- or two sites, ex-
7 cuse me, that were used where actual groundwater gradients
8 and concentrations were known, to calibrate the major, two
9 major categories which Mr. Hicks referred to in his testi-
10 mony of the river valley flood plain and the valley side
slopes and side slopes and tributaries.

11 Q How do the hydraulic conductivity values
12 that you used in applying the random walk analysis, how do
13 those compare to the ones used by Mr. Boyer?

14 A We have used hydraulic conductivity
15 values that are within the same ranges as those that Mr.
16 Boyer has used and indeed we've even looked at hydraulic
17 conductivities below those which Mr. Boyer has used in his
calculations.

18 Q When you use the phrase "below" is that

19 --

20 A Lesser in terms of transmissivity.

21 Q Would that be a more conservative or a
22 more optimistic parameter?

23 A It would be more conservative in the
24 sense that it would tend to predict higher concentrations in
the immediate vicinity of the pits.

25 Q All right, sir, using then the informa-

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2 tion on Table 2, what then is the next thing you do to cali-
3 brate your model?

4 A Okay. Primarily, if you'll note what we
5 did was with the category -- the sites that Mr. Hicks
6 visited, we fit them into the two categories that they logi-
7 cally fell into as we started looking at the various charac-
8 teristics, both in terms of the materials, the lithology,
9 and the hydraulic characteristics, and you'll note that for
10 the river flood plain we've included the San Juan River
11 cases and broken those up into high, medium, and low
12 hydraulic conductivities with ranges of 10,000 gallons per
13 day per foot for the hydraulic -- high hydraulic conductiv-
14 ity cases; 1000 to 5000 gallons per day per foot squared for
15 medium hydraulic conductivity cases; and 10 to 100 gallons
16 per day per foot squared for the low hydraulic conductivi-
17 ties.

18 For the Animas River, following to the
19 next page, you'll note that we did -- we observed only one
20 high hydraulic conductivity case of the ones that were in-
21 cluded in our random sample, which is included in there as
22 the Marcotte No. 1.

23 No medium or low hydraulic conductivity
24 cases came up in our random sampling of the cases in the
25 Animas River.

 For the valley side slopes and tributa-
ries we used again the same divisions in terms of high, med-
ium, and low hydraulic conductivity.

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2 Q Does that complete, then your recitation
3 of how you used the hydraulic conductivities to calibrate
4 your model?

5 A Well, let me just go on. I just noticed
6 I have another two pages here of this table.

7 One is that the bedrock mesas cases were
8 excluded because the produced ground -- the produced water
9 could not really enter the groundwater since these cases
10 will lie on bedrock in terms of entering alluvial aquifers.

11 Secondly, the Pictured Cliffs cases there
12 are no simulations because basically those waters -- those
13 gas wells tend not to produce water and not have produced
14 water pits associated with them.

15 Also, the next page shows well sites that
16 were visited for which hydraulic information was estimated
17 and collected but which were not part of the random sample.
18 In other words, were not selected by the random number
19 generator in order to be included in the study.

20 Basically, the ranges of those hydraulic
21 conductivities that I described were developed as Mr. Hicks
22 described in this testimony.

23 Q I want to go through with you each of the
24 different components or parameters that you plug into random
25 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,

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2 and whether that is an optimistic or a conservative number
3 in relation to the actual field data gathered by Mr. Hicks.

4 A Well, let me address that in two ways.
5 One by saying first that the field -- the sites were, we ac-
6 tually had monitor wells installed in the groundwater and
7 where we measured depth to groundwater and had those sur-
8 veyed by a surveyor. The gradient was determined exactly by
9 that mechanism.

10 Q Let's take the McCoy Well. What was the
11 hydraulic gradient in the McCoy Well that was actually ob-
12 served in the field?

13 A Hydraulic gradient that was used for the
14 McCoy Well determined from measurement of water levels in
15 the wells which were implaced at that site was .0076.

16 Q What was the hydraulic gradient used for
17 the McCoy type simulation that you plugged into the compu-
18 ter?

19 Mr. Gutierrez, is it not the Marcotte No.
20 1 entry on the second page of Table 2?

21 A I am looking for -- I'd have to refer
22 back to the original computer run because my gradient
23 measured at the -- or shown on the figure in Mr. Hicks' tes-
24 timony is .0076, and the gradient on my simulation is .004.
25 That could just be a typo. I'd have to refer to the origi-
nal.

Q All right. With regards to the hydraulic
gradient used for the McCoy type computer runs, did you use

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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.

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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.

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2 Longitudinal dispersivity of 10.

3 Transverse dispersivity of 2.

4 Retardation coefficient of 1. You'll
5 note that in runs which Mr. -- at least from the brief look
6 that I got of the runs that Mr. Boyer ran, he used a retar-
7 dation coefficient of 7, which -- and yet higher longitudi-
8 nal and transverse dispersivity values. Those factors tend
9 to counterbalance each other and therefore with his retarda-
10 tion coefficient and his higher dispersivity values we're at
about the same place as we are with our model.

11 Regional X flow is calculated as I de-
12 scribed before.

13 The source term we used the value of con-
14 centration of benzene, and again we ran all these for ben-
15 zene because of the fact that that parameter seemed to be
16 the parameter of greatest concern. The source term that we
17 used was 3500 ppb, or 3.5 milligrams per liter based on the
18 approximate average that we derived from looking at the data
on values in the pits.

19 We then used for a volume of water the
20 actual volume which was produced at each one of the indivi-
21 dual wells which we looked at. That would have been our
quote/unquote uncalibrated runs.

22 For the calibrated runs what we did was
23 say we had the McCoy site, which is typical of the type of
24 lithologies and materials which Mr. Hicks observed in the
25 river valley, river bottom areas.

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2 We used the Eaton site to represent the
3 types of materials and lithologic characteristics that were
4 observed in the valley side slopes and tributaries, and con-
5 sequently used the actual values of benzene monitored in the
6 monitor wells at these two sites to determine what the ap-
7 propriate source term would be since we did not have any
8 clear quantification of what would happen to the benzene
9 concentration or the source term from the point when it left
10 the pit to the point where it entered the groundwater.

11 Q Mr. Hicks divided the well population in
12 the vulnerable area into two major categories of wells.
13 Have you attempted to calibrate your computer model to take
14 into consideration the field investigations and the
15 hydraulic parameters that Mr. Hicks attributes to each of
16 those types of well populations?

17 A Our parameters which were well estab-
18 lished at the sites which we did detailed field investiga-
19 tions for, those hydraulic parameters we were -- had a high
20 level of confidence in, therefore we felt that the concen-
21 trations which we observed during the actual monitoring
22 were a response to the source term which actually was enter-
23 ing the groundwater and therefore for the McCoy site we
24 looked at first what the effect would be of running the
25 model using the actual 3.5 milligrams per liter or 3500 ppb
source term that was average from the produced water ana-
lyses in the pits and noted that the results of that model
indicated good agreement with the observed concentrations in

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2 the field without any alteration of the hydraulic parameters
3 or that source term.

4 However, if you'll note under the section
5 of my exhibit where we talk -- where it says Field Calibra-
6 tion Sites, I just was discussing the first site that we
7 looked at, the McCoy site.

8 If you'll look at the next one, which is
9 labeled Case Number Eaton A 1-E, where it says uncalibrated,
10 you'll note that again we ran that model using a concentra-
11 tion of 3.5 milligrams per liter benzene and the predicted
12 concentrations in the groundwater, as you can see from the
13 contour map above, and in comparing that to the actual con-
14 centrations which were measured in the groundwater monitor
15 wells, the model grossly overpredicted what contamination
16 would occur in the aquifer.

17 We therefore --

18 Q Just a minute, Mr. Gutierrez, let's make
19 sure that we're following you. I want to make sure that
20 everybody has the uncalibrated Eaton A 1-E projection.

21 A All right. You now have the Eaton type
22 -- you have the Eaton Well, which is the McCoy type popula-
23 tion?

24 A No, no, no.

25 Q I got that backwards.

 A Yeah.

 Q All right.

 A The Eaton Well, which is characteristic

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2 of the population of wells that fall into the category of
3 valley side slopes and tributaries.

4 Q All right. We have an uncalibrated com-
5 puter run on that Eaton site.

6 A That's correct.

7 Q The Eaton site had actual groundwater
8 monitoring data that Mr. Hicks developed.

9 A That's correct.

10 Q How did the actual groundwater study com-
11 pare to the uncalibrated Eaton projection by the computer?

12 A As presented in Mr. Hicks exhibit, which
13 I believe is Tenneco Exhibit Four, --

14 Q Three.

15 A Three? Okay. Where you see in one of
16 his figures the benzene concentrations in the Eaton site,
17 you'll note that as Mr. Hicks presented, we had less than
18 detectable, i.e., less than one part per billion in Wells 1,
19 5, 4, and 6, 7, and -- excuse me.

20 In Wells 1, 4, 6, 5, and 7, and we had a
21 concentration of 11 parts per billion in Well 2 and a con-
22 centration of 7 parts per billion in Well 3, and you'll note
23 that on the run which is included in my exhibit as the
24 uncalibrated run for Eaton, in the area where these wells
25 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

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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.

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2 Q All right, what have you done in order to
3 generate this?

4 A Basically it was an iterative process of
5 running the model with lower and lower benzene concentration
6 inputs until we were able to achieve an approximate, or the
7 best approximation of the field data that we observed in the
8 monitor wells.

9 Q Once you had the computer model cali-
10 brated with the actual field data, what conclusion did you
11 draw about the levels of benzene detected by the computer in
12 its simulation as calibrated of the Eaton site?

13 A Well, we felt that once we calibrated the
14 source term that the computer adequately represented the ob-
15 served groundwater concentrations in the monitor wells.

16 Q All right, sir. What then did you use
17 the calibrated Eaton site random walk simulation for in de-
18 termining how this applied to the other wells of similar
19 type in the vulnerable area?

20 A Well, given the fact that Mr. Hicks had
21 gone out and looked at a number of sites in the valley side
22 slopes and tributary category, and those sites displayed
23 similar characteristics to what was observed at the Eaton
24 site where we had more detailed lithologic and hydrologic
25 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

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2 tion and others, were operating and even though we did not
3 and could not quantify what those model -- I mean what those
4 actual mechanisms were, that there was something happening
5 to the benzene by the time it entered the groundwater and
6 therefore was reasonable to reduce the source term concen-
7 trations based on that calibration -- field calibration.

8 Q Can you approximate for us the number of
9 computer simulations you've done for the Eaton type wells in
10 the vulnerable area?

11 A I can give you the exact number. If
12 you'll refer to the table on -- it would be page five. It's
13 the second page of Table 2.

14 Okay, you will note that the -- there
15 were several cases included in there and I just almost got
16 confused here myself, so I want to bring this point out for
17 clarification.

18 The McCoy D 1-E that is listed in there
19 is not the same McCoy Well that we used for the river bottom
20 sites.

21 So those cases which you see listed un-
22 der valley side slopes and tributaries were the ones that
23 were run with Eaton calibrations as well as -- let's see --
24 yes, that's correct.

25 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?

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2 A Well, the conclusions based on runs that
3 we performed were that the model given that calibration of
4 the source term did not show a tendency to exceed the
5 groundwater standards and indeed predicted rather low con-
6 centrations at distances both close and far away from those
7 pits.

8 If I may mention one other thing that
9 would serve as a point of clarification.

10 It must be understood that the random
11 walk model inputs contaminants into the groundwater by simu-
12 lating the effect of an injection well, essentially, not --
13 it does not account for any processes which would take place
14 in the unsaturated zone, and therefore, if you want to take
15 into account any processes that would take place in the un-
16 saturated zone, you must adjust the source term which you
17 put into the groundwater.

18 Q Did you adjust your source term to take
19 into consideration the mechanisms of attenuation, such as
20 the biodegradation terms?

21 A We did by the mechanism which I described
22 previously.

23 Q All right.

24 A For the cases that resemble the Eaton
25 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

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2 some of these areas of higher transmissivities and in the
3 river bottom closer proximity to groundwater, we concluded
4 that these vadose zone processes would not be as prevalent
5 in those areas and indeed the models demonstrated that even
6 with that concentration of 3500 milligrams per liter, 3500
7 parts per billion, excuse me, going directly into the
8 groundwater in the method that I described that the model
9 puts them into, still did not result in exceedence of the
standards.

10 Q When we take Mr. Hicks' actual ground-
11 water study of the Eaton site, take the computer model and
12 calibrate it, take into consideration the factors that would
13 be typical in the Eaton type wells, calibrate the model, and
14 run it, based upon similar wells in this type of well popu-
15 lation, do you find wells that are going to exceed the
16 standard by the disposal of produced water at 5 barrels a
day or less in the unlined pits?

17 A Based on -- okay, I didn't connect that
18 last part of the question, I'm sorry.

19 Q I want to know whether or not in applying
20 the computer calibrated model, using the Eaton data, and
21 having applied it to similar Eaton type wells in that popu-
22 lation, whether or not you will find by using the program or
23 the computer, wells that if -- pits, if exposed to 5 barrels
24 a day of produced water or less, are going to exceed the
benzene standard for groundwater at those sites.

25 A No. Based on our simulation that would

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2 not appear to be the case.

3 Q When we turn now to the McCoy type popu-
4 lation, Mr. Hicks has got groundwater monitoring and actual
5 field data on the McCoy site, have you done computer work
6 and random walk simulations of that type of well?

7 A Yes, we have.

8 Q And have you calibrated your random walk
9 to take into consideration the actual data Mr. Hicks devel-
10 oped for the McCoy site?

11 A Yes, we have, as per the method I de-
12 scribed before.

13 Q And have you simulated other types of
14 McCoy wells in the vulnerable area to determine whether the
15 computer will simulate a benzene level in the groundwater
16 that will exceed or be within the standard?

17 A That's correct.

18 Q And did you find any computer simulated
19 runs in which the benzene standard was exceeded by the McCoy
20 type well population?

21 A Not in the cases that we ran, no, sir.

22 Q In using -- when you did these computer
23 runs is there a range of values in the parameters used based
24 upon Mr. Hicks' field observations that would make any sig-
25 nificant 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 span-
ned a range of hydraulic parameters from 10 gallons per day

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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 types 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.

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2 Q And did you use various ranges in the hy-
3 draulic gradients?

4 A Yes, sir, based on actual measurements
5 and based on conservative estimates taken from -- measure-
6 ments taken from topographic maps.

7 Q And when we run all of these field cali-
8 brated random walk simulations of what's happening in var-
9 ious areas of the vulnerable area with this pits, do you
10 find any of them that bust standards on the benzene?

11 A Not of the runs that we did, sir, with
12 the exception of the uncalibrated Eaton site.

13 Q And once the Eaton site is field cali-
14 brated with actual data you find that that is within the
15 standard?

16 A That's correct, with the exception of
17 Well No. 2, which is very near the produced water pit and
18 exceeds the standard by one part per billion.

19 Q From your study of this area, Mr. Gutier-
20 rez, does this absence of the computer's ability to simulate
21 pollution, in other words, benzene concentrations above the
22 standard, does that surprise you as a hydrologist?

23 A No, not really, it doesn't surprise me.

24 Q Would you describe for us what conclu-
25 sions that you can draw from having conducted the random
26 sampling, the use of the random walk simulation, on the var-
27 ious well types within the vulnerable well populations?

28 A Well, my conclusions, Mr. Kellahin, would

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2 not be based solely on the random walk runs which my firm
3 did, but rather have to consider all the evidence which has
4 been presented at this hearing, as well as the other parts
5 of our study, and that evidence would lead me to conclude
6 that within a wide range of hydraulic conductivities and a
7 wide range of volumes of produced water disposed of in un-
8 lined pits, less than 5 barrels per day, we, one, do not see
9 any documented cases of groundwater contamination by the
10 parameter benzene that are attributed to produced water
11 pits, and furthermore, that the indications based on our
12 field studies, our groundwater monitoring at various loca-
13 tions and the subsequent attempt to broaden the base of the
14 investigation by looking at numerous actual well locations
15 and modeling them using the random walk simulation, that
16 it's not surprising to me that we haven't had those docu-
17 mented cases of contamination because the risk from those
18 low volumes to groundwater appears very small.

17 Q Mr. Guttierrez, you have participated in
18 the Oil Division's Short Term Water Study Committee?

19 A That's correct.

20 Q You've conducted the calibrated random
21 walk sampling or simulations of produced water disposal pits
22 in the vulnerable area. Your firm has done actual ground-
23 water monitoring at sites in the vulnerable area.

24 The Commission is considering whether or
25 not to exempt small volume unlined pits in the vulnerable
area on a blanket basis of 5 barrels a day or less.

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2 What is your recommendation on that issue
3 and how should the Commission draft an order on that point?

4 A Well, I'm not quite sure I can answer the
5 second part of that question about how the Commission should
6 draft an order, but I certainly can say that based on the
7 work that we have done, based on the data which we've seen
8 presented, we feel that it would be unjustified and exces-
9 sive to require that pits for volumes of less than 5 barrels
10 per day of produced water be lined or otherwise taken out of
11 service.

12 Q Do -- as a geohydrologist with experience
13 in regulatory matters, do you see any purpose served by re-
14 quiring the operator to file on a site by site or a well by
15 well basis in order to have small volume pits exempted?

16 A Given the evidence that we've seen in the
17 hearing, I believe that really the more appropriate route to
18 take would be to handle the pits that, and/or sites, well
19 sites, that present a threat to the environment and a threat
20 to human health on a case by case basis rather than seeking
21 to exempt a large number of sites that may indeed pose no
22 problem on a case by case basis.

23 Q Thank you.

24 MR. KELLAHIN: Mr. Chairman, we
25 move the introduction of Tenneco Exhibit Number Five.

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

Are there questions of this

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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

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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,

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2 transmissivity, and at the Eaton site we used the methods
3 which I described previously. There were no pump tests
4 available in that area. It was again based on those types
5 of evidence.

6 For the other sites, as Mr. Hicks de-
7 scribed in his testimony, it was derived by visual inspec-
8 tion of the pit, the subsurface in the nearby areas on out-
9 crops, other exposures, and on the use of that table that
10 relates grain size to hydraulic conductivity by Freeze and
11 Cherry.

12 Q I hope you'll bear with me, because I'd
13 never heard of a random walk model before.

14 So transmissivity is based on hydraulic
15 conductivity and those values are based on a visual inspec-
16 tion of grains at the site and applying that visual -- the
17 experience of his professional career, his visual analysis
18 as applied to that Freeze and Cherry chart.

19 A In addition to the other sources of data
20 which I described earlier, yes.

21 And, let me clarify that hydraulic con-
22 ductivity is the parameter that is estimated. Transmissiv-
23 ity is calculated from multiplying that by the saturated
24 thickness.

25 Q So any weaknesses reflected in Mr. Hicks'
26 testimony, such as failure to account for snow melt and
27 rain, or the difficulty or unreliability of determining hy-
28 draulic conductivity from the visual inspection, would all

1
2 be weaknesses that would incorporated into the computer
3 model.

4 A Well, snowfall and rain have absolutely
5 no effect on hydraulic conductivity.

6 The inaccuracies that could be introduced
7 by visual estimation of hydraulic conductivity, I would find
8 very difficult to believe could exceed two orders of magni-
9 tude, and indeed, you'll see that the simulations that we've
10 done span ranges of hydraulic conductivity from 10 to
10,000.

11 So really we're dealing with four orders
12 of magnitude in there. We've looked at cases that span that
13 entire range, so we feel that we've accounted for any poten-
14 tial errors that would, you know, result from the visual es-
14 timation of those parameters.

15 Q I'm not asking for you to say whether or
16 not there are weaknesses.

17 I'm asking you if there are any weaknes-
18 ses would they not also be incorporated into your computer
19 modeling in the hypothetical?

20 A Well, I -- I can't even accept the fact
21 that there are any hypothetical weaknesses that are -- that
22 are -- that are caused by the inputs of rainfall and snow-
23 fall on hydraulic conductivity. That's a physical impos-
23 sibility.

24 If you're saying that if Mr. Hicks' esti-
25 mate of transmissivity -- of hydraulic conductivity was off

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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

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2 this as bad news, you then went back and showed that you
3 could run the computer model backward, starting with the re-
4 sults that Mr. Hicks actually obtained in the field, is that
5 correct?

6 A Well, I didn't take it as bad news or
7 good news. I mean I took it as an uncalibrated computer
8 model and computer models typically, when it's possible,
9 will yield much better results when calibrated in the field.

10 As a matter of fact, in a -- it's typical
11 on many of the cleanups and contamination assessments that
12 my firm has worked on, and in fact, one that they're working
13 on now for the EID, where there is specific demands made by
14 regulatory agencies to calibrate models using actual field
15 data in order to be able to accurately represent what is
16 going on in the subsurface.

17 So consequently, that's the procedure we
18 followed in calibration of the Eaton models.

19 Q Staying with the Eaton models, in the
20 calibrated model on the Eaton Well --

21 A Uh-huh.

22 Q -- comparing Mr. Hicks' field samples and
23 your models, what happened to the 7 and 11 reading in Mr.
24 Hicks' field samples? Why are the numbers shown on your
25 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

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2 to accurately predict concentrations given the number of
3 particles which you use and the mass associated with those
4 particles, and at the same time you try and simulate a long
5 enough period of record that you can actually observe what's
6 going on at a certain distance away from the site, the reso-
7 lution becomes quite difficult in when you're trying to pre-
8 sent it graphically like this in the form of, you know, when
9 you're trying to show 300 by 400 feet, and therefore, what's
10 going on right at the immediate vicinity of the site, if
11 you'll note the scale on here and the scale on these maps
12 are very, very different, and therefore, the kinds of con-
13 centrations which were observed at the wells in the Eaton
14 site all fall within that .12 ppb level and at the locations
15 of those particular wells closely approximate the values
16 that we actually observed in the field.

15 Q Now, the Eaton A 1-E Well, as I recall
16 Mr. Hicks' testimony, was that the actual benzene reading at
17 the pit there was 3500 parts per billion, and my understand-
18 ing is that on this, again, calibrated Eaton site chart,
19 what you did in effect was reduce that from 3500 parts per
20 billion to 20 parts per billion as your source term as a re-
21 sult, I guess, of biodegradation and other attenuation
22 mechanisms operating, which you then fed into the computer
23 as an actual benzene concentration.

23 Why did you pick 20 parts per billion?
24 Why not 25 or 40 or 5 parts per billion?

25 A Well, as I described, it was an iterative

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2 process and you keep reducing or increasing, depending on
3 what your field data show, the source -- in other words,
4 when you're trying to calibrate a model, okay, you take all
5 the parameters which you're relatively sure of, okay, and
6 you prioritize them.

7 You go, well, this one I know, 99 percent
8 confidence.

9 This one I know, 85 percent confidence.

10 And on and on and on, and then you alter
11 the parameter with the lowest confidence interval in order
12 to be able to fit the observed data to it, because it's the
13 one that you have a least information about, and had the
14 least information about what the actual processes and what
15 the quantification of those processes are from the point
16 where the water that is in the pit at a concentration of
17 3.83 per liter, or actually 3,830 parts per billion, what
18 concentration would actually reach the groundwater by the
19 time it traveled the nine feet that it had to travel through
20 the unsaturated zone at the Eaton site to reach that.

21 MR. STAMETS: Excuse me for in-
22 terrupting, Ms. Pruett, but you indicated that on the cali-
23 brated model we're talking about 20 parts per billion ben-
24 zene, and the way I read the exhibit, it's 200ths of a part
25 per billion.

 I have here the figure 0.02 ppb
benzene.

 There's some confusion here.

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2 Did you give me the wrong number or am I reading this incor-
3 rectly?

4 MS. PRUETT: I think I gave it
5 incorrectly.

6 MR. STAMETS: Fine.

7 Q Is it true that a number of the --
8 several of the numbers which you fed into the computer re-
9 flect higher, could reflect a higher dilution factor than
10 did Mr. Boyer's calculations?

11 A Only the range of hydraulic conductivi-
12 ties that we used in our simulations actually can represent
13 much slower velocities than what Mr. Boyer's calculations
14 show, because if I can refer you to Mr. Boyer's lowest cal-
15 culation -- I mean lowest assumed hydraulic conductivity, we
16 would be looking at 25 feet per day and there's some --
17 there's conversion factors involved so you'll have to bear
18 with me for a second.

19 That our range of 10 gallons per day per
20 foot squared would approximate that lowest conductivity
21 which he used in his model and therefore we feel that we've
22 covered the same range, really.

23 MR. STAMETS: Let me interrupt
24 one more time while we're talking about this modeling.

25 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.

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2 dient is nonexistent or -- or there's no hydraulic conducti-
3 vity. The regional X flow has to be greater than zero, and
4 again, I need to emphasize that that Figure 1 does not re-
5 present the input parameters that we used for every one of
6 these cases. If you'll note, in some of the low hydraulic
7 conductivity cases, let's turn to, for example, the GCU 169
8 E or the Romero Gas Com A-1, you'll note that regional X
9 flow at the Romero, for example, is .02 feet per day.

10 Regional X flow at the Ulibarri Gas Com
11 1-A is .16 feet per day.

12 Regional X flow at the GCU 169 is also,
13 MR. STAMETS: Any other ques-
14 tions of this witness?

15 Mr. Taylor.

16 CROSS EXAMINATION

17 BY MR. TAYLOR:

18 Q Okay, first I think I have some questions
19 about your model.

20 A Okay.

21 Q Will you tell us what computer you used
22 to make your random walk runs?

23 A IBM PC.

24 Q Is that the same that Mr. Boyer used?

25 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.

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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

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2 shown in Mr. Hicks' exhibit, and we did not really run the
3 model backwards.

4 So in answer to your question, there is
5 no mechanism of running that model backwards.

6 What you do is you reduce the source
7 terms by just saying, okay, instead of 3.5 I'll use .35 and
8 I'll run it through and see what I get.

9 And then, say, then take a look at the
10 result of that and you say, does this more closely approxi-
11 mate what I know to be the case based on my field informa-
12 tion.

13 And if that still doesn't get you there,
14 or if it predicts too low a concentration, then you go back
15 and you estimate another point in between and that's what I
16 meant by iterative process.

17 Q So more or less, as you said, your re-
18 sults there would be dependent upon the accuracy of your
19 collection data in the field when you did the water testing
20 and the water sampling and then tested that for benzene --

21 A That's correct.

22 Q -- concentrations.

23 A That's correct.

24 Q And you said that the eventual calibrated
25 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

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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-

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2 brating your model to what showed up in the field, what an-
3 swer are you trying to come up with, 1, 7, 11, as parts per
4 billion?

5 A You're trying to simulate the distribu-
6 tion over that whole area.

7 If you took -- if you took these values
8 that Mr. Hicks has, or if you even looked at Mr. Boyer's --
9 or look at Mr. Boyer's -- any one of his printouts in random
10 walk. The way that -- matter of fact, Mr. Boyer must have a
11 more recent version of Prickett's model because his actually
12 outputs things in concentrations and ours took -- had to
13 take it a step further, but in any case, if you look at his,
14 it actually puts out what the concentration, predicted con-
15 centration is at each one of those points. Okay?

16 Q A grid or something like that?

17 A A grid, that's correct. I'm pointing to
18 one of the grids on Mr. Boyer's exhibit.

19 Then what one would do in order to
20 represent that as one would represent any randomly
21 distributed or even non-randomly, any three dimensional or
22 two dimensional data, one would, say, contour that data to
23 determine, you know, what areas fall within what
24 concentrations, based on these results.

25 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

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2 of the model what you try and do is simulate that overall
3 distribution of contaminants rather than -- well, not rather
4 than, but I mean in addition to what you would observe at
5 each one of those monitor wells.

6 Did I -- am I clear?

7 Q I don't know, but -- well, let me kind of
8 ask it again, because I'm not clear on it.

9 A Sure.

10 Q What you were doing is calibrating your
11 model to what you thought was in the field.

12 A That's right.

13 Q And --

14 A Not what I thought; what I knew.

15 Q Well, you don't know because you didn't
16 -- you didn't dig up the whole area but you did monitor
17 wells and you calibrated that, calibrated your model with
18 what your monitor wells showed.

19 A That's correct.

20 Q What I'm trying to get at is how your
21 confidence level is in this thing, how confident you are
22 that your model is correct and that your field results are
23 correct, and so I -- what I want to get at is that on Moni-
24 tor Wells 3 and 2, the high --

25 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

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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

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2 pit or the potential source, and I believe that that's --
3 that if there was anything in the groundwater as indeed we
4 did detect at Wells No. 3 and No. 2, that we would have
5 picked it up.

6 In addition, let me mention that you have
7 to notice that Well No. 3, it's kind of unusual that that
8 far away from the produced water pit it would also show the
9 concentration of 7 parts per billion, but if you'll note be-
10 tween the produced water pit and between Wells 4, 6, 4 and
11 6, which are down gradient from the produced water pit,
12 there's a blowdown pit, so that represents another potential
13 source that could account for the increased concentrations
14 in Well No. 3.

15 Q Okay, well, that was a question I had
16 later.

17 Are you positive enough that your gra-
18 dients are correct, that assuming looking at this map that
19 the top of it is north, that there is no need to put any --
20 any wells, any monitor wells to the south of the produced
21 water pit; at least just one to make sure that you didn't
22 have some -- any of the contaminants going in that direction
23 because of the high number of No. 2?

24 A Well --

25 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

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2 the movement of contaminants in groundwater, they move by
3 primarily two processes; one advective or actually being
4 carried in the direction of the gradient by the groundwater,
5 and dispersive, the actual chemical gradients and dispersion
6 that's caused by the substance in the groundwater.

7 If you look at those, the behavior of
8 those species, typically you may have some limited migra-
9 tion in an up gradient direction from a particular source,
10 but that is not the primary direction in which you would
11 have movement of contaminants, so therefore that's why you
12 typically put wells down gradient of a potential source to
13 try and detect a problem from that source.

14 Now, up gradient from the source you may
15 want to put a monitor well to detect whether indeed there is
16 other sources that are further up gradient that may have
17 caused what you see rather than the source that you're real-
18 ly trying to narrow down, and in that case you probably
19 wouldn't want to put that well outside of the sphere of in-
20 fluence of that dispersive mechanism beneath that source.

21 So my answer to you is that basically I
22 would anticipate to see the highest concentrations of any
23 contaminant that entered the groundwater in the area imme-
24 diately down gradient from the potential source rather than
25 in the area immediately up gradient from the potential
source.

26 Q Okay, but the reason I kind of wonder
27 about this is because it seems like Mr. Hicks, or someone

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2 else, testified that movement of groundwater or things mov-
3 ing through the soil, if often greater horizontally or kind
4 of out than it is --

5 A Sure.

6 Q -- with the gradient.

7 A Sure. But you've got to think that what
8 we've got in here are monitor wells that sample the satu-
9 rated zone. They don't sample the unsaturated zone.

10 So once the contaminants entered the
11 groundwater, which is what we're concerned with here, is the
12 contamination of groundwater, they're going to move predomi-
13 nantly in a down gradient direction.

14 Q Now, going on with this thing about gra-
15 dients, I think we talked to Mr. Hicks, and I'll just ask
16 you the same question, relating mainly to the confidence
17 level of your -- both your monitoring and testing, relating
18 your model to your monitoring.

19 A Sure.

20 Q What is the possibility that there is
21 seasonal reversal to the gradient and how does the gradient
22 measure to compare with total groundwater gradient, that is
23 the gradient that you --

24 A Sure. It -- I think that that's a very
25 good question. I think that that's a very, you know, fair
concern. They're in alluvial areas, you can have fluctua-
tions in the gradient that are significant.

All I can say is at the point in time

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2 when we measured the gradient at the locations where we
3 measured, the gradient very precisely to the tenth of a
4 foot, that it -- my confidence level is as high as it would
5 be in any case, that that was the gradient, and indeed I
6 could state without any qualification that that was the gra-
7 dient at that point in time.

8 The fact that that gradient may have
9 shifted or something like that, that, I mean that is cer-
10 tainly a possibility and furthermore, we know that there
11 have -- there are fluctuations in groundwater elevations in
12 alluvial environments and that can cause a problem

13 But let me -- let me point you to just
14 one last thing in here.

15 If you look at the gradient around the
16 produced water pit at the Eaton site, you can see that it's
17 slightly steeper away from the produced water pit. So I
18 think we're really looking at where you could have potential
19 contamination, the greatest potential contamination.

20 Q Okay. Now relating to a question that I
21 think we talked to Mr. Hicks about, which was the fact that
22 normally petroleum products float on water but I think
23 there's been a lot of testimony that benzene goes into solu-
24 tion with water, and I was interested in finding with him
25 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

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2 lower than the top of those water tables. Are you confident
3 that your measurements of benzene are, you know, what you're
4 showing here are what would be the highest in the area when
5 you look at your model?

6 A Yeah, I'm very confident of that and I'll
7 tell you why. Two reasons. One, primarily, it's standard,
8 accepted practice and in fact required by regulatory demands
9 and by policy, that wells be screened in the uppermost por-
10 tions of aquifers to try and detect groundwater contamina-
11 tion, and that is indeed what we did at this site.

12 Furthermore, in terms of what you're
13 trying to get at, what I perceive you're trying to get at is
14 did we miss something that maybe flowed under our screened
15 interval, or something like that.

16 In order for benzene which is in solution
17 to go -- to move in a down -- in a vertical sense, there's
18 going to be much less movement in the vertical sense than
19 there is in the horizontal sense, because typically most
20 aquifer materials have higher horizontal hydraulic conducti-
21 vity than vertical hydraulic conductivities, and further-
22 more, in the levels of benzene concentrations that we're
23 looking at in this area, there is no appreciable density
24 difference between water, groundwater that has no benzene in
25 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-

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articles 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 interactive 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-

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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?

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2 Q Well, I assume the concentration decrease
3 that -- between the calibrated and the uncalibrated.

4 A Well, I'm certain that --

5 Q How certain are you, I suppose, the real
6 crux of the question, is how certain are you that -- that
7 the monitoring is accurate so that the concentration de-
8 crease between your uncalibrated model and your calibrated
9 model is actual and not just something that you put into it
10 to try to reflect what you found in the field which might
11 not be what is really there?

12 A Well, I disagree with that. I mean, what
13 I found in the field is what is there.

14 We measured the concentration of benzene
15 in water samples that were taken according to a standard,
16 accepted, EPA approved procedures for sampling organic con-
17 stituents, had them analyzed by two laboratories using EPA
18 certified methods and complete quality assurance and quality
19 control procedures, and therefore I have a high degree of
20 confidence in the benzene concentrations that were measured
21 at the monitor wells.

22 In terms of my level of confidence that
23 the source strength decreased, all I can say to that effect
24 is that of the parameters that were inputs to the model at
25 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.

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2 Therefore that was the factor which we
3 felt most comfortable in adjusting in order to calibrate the
4 model.

5 Q We talked about this a little bit fur-
6 ther, but how do you -- is the 7 parts per billion that we
7 see in Well No. 3, I think, do you think that's accounted
8 for solely because of the blowdown pit that's there, or
could there be other explanations?

9 A Well, I find it -- I find it a little --
10 I mean that would be the most reasonable explanation given
11 the data that we have. That's immediately adjacent and down
12 gradient of the blowdown pit and we have wells that are be-
13 tween the blowdown pit and the produced water pit that had
14 -- that had come up essentially clean.

15 So, yes, that would be my most reasonable
16 assumption of that there is some increased source from the
blowdown pit.

17 Q I assume you did not model your random
18 walk for anything other than benzene. Didn't do any TDS or

19 --

20 A That's correct.

21 Q -- any other contaminants.

22 A That's correct.

23 Q I think that's all I have except that I'd
24 like to get back to one point that we talked about that I
25 really didn't get an answer, and that is what -- what per-
cent confidence level do you have both in the fact that the

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2 monitoring wells turned up accurately what is in that aqui-
3 fer, not only where the wells are but at other areas in that
4 aquifer, other places on the grid that you might have on
5 your (not understood) and consequently, based upon your
6 confidence level on your monitoring, your confidence level
7 on your model for what you show.

8 A Okay. The confidence level that I have
9 on the analyses is -- you mean as high as I would have? I
10 mean there's no reasons to believe or even to speculate that
11 the analyses may be incorrect.

12 Q I don't mean your confidence level in
13 your analysis of your samples but in the fact that the moni-
14 toring wells are showing everything that's there.

15 A Oh, okay.

16 Q Not selectively or it's not --

17 A It's really hard to put a percentage num-
18 ber on it exactly, but I'd say, I mean it was in the range
19 of 90 percent plus, because they are screened in the upper-
20 most portion of the aquifer as would be necessary to detect
21 the first potential contamination that would reach the aqui-
22 fer.

23 So my confidence level is extremely high
24 on that the monitor wells are actually showing me what is in
25 that zone of the aquifer.

Q Do you agree that any -- any problem (not
understood) but the accuracy of your monitoring would re-
flect on your model and make --

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2 A On the calibration of the model, yes, I
3 would. Yes.

4 Q I'm supposed to ask you this. When I ask
5 you about confidence levels I speak in terms of statistical
6 calculations to give you a numerical confidence level. With
7 respect to the last two questions, did you perform such an
8 analysis? I assume it's more or less like when you have
your statistician come in and tell you what --

9 A Yeah. Frankly, I'm not a statistician
10 but I don't understand how one could perform a statistical
11 analysis to determine a confidence interval on whether your
12 groundwater monitor well was screened in the right portion
13 of the aquifer without, I mean, screening many different
14 monitor wells in many different zones and then I would still
15 find it very dubious, the results of that statistical analy-
16 sis, because in fact you don't -- you can't really compare
sampling one portion of the aquifer with another.

17 I mean we sampled the portion of the
18 aquifer that was most likely to demonstrate contamination.

19 Q But you do agree that if for some strange
20 reason contaminants were moving south of what we consider to
21 be the blowdown pit and you had no monitoring wells there
22 and therefore if there were concentrations of benzene or
other pollutants in that area, it affects your whole model.

23 A Yes. I would agree that what you say is
24 correct, that my model was be affected. However, I must
25 take exception because I cannot envision any, any hydrologic,

1
2 chemical, or other mechanism that would account for conta-
3 minants to in effect sneak under my monitor wells and show
4 up, you know, at some point further than they are when
5 they're in the immediate vicinity of the potential source.

6 Q Thank you.

7 CROSS EXAMINATION

8 BY MR. STAMETS:

9 Q If we go to about the second page after
10 the calibrated lower source term sheet, we come to the GCU
11 202 Well.

12 Your benzene concentration is 3500. Is
13 that a measured concentration or an approximation or what?

14 A No, sir. All, let me just answer that
15 not only for this one but for all of the cases.

16 All of those concentrations with the ex-
17 ception of the calibrated concentration, were concentrations
18 that we arrived at that number of 3500 by looking at the
19 average concentration of benzene in the pits that was taken
20 from the OCD and our available data on those analyses.

21 Q You're trying to find pits or produced
22 water that were close to the concentrations that you used in
23 the calibration model.

24 A No, I'm not sure I understand that.

25 Q Okay.

A We --

Q Let me back up then.

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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

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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

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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?

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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

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2 for a draft order and which criteria should be considered in
3 developing such an order, and they really just want to say
4 that Giant strenuously supports the January 18th recommenda-
5 tions of the Short Term Study Group on all the points in
6 which the committee was in agreement, and that includes the
7 definitions and prohibitions and exemptions which the com-
8 mittee agreed on, and which are listed in the written state-
9 ment, basically with respect to the delineation of the vul-
10 nerable area and the exclusion of any pits that are already
governed by other statutes.

11 And furthermore, that based on the analy-
12 sis of the available data, that it is our opinion that a low
13 volume exemption within the vulnerable area of approximately
14 5 barrels per day should be permitted at the present time,
15 and that that opinion is based on the available data and
that -- and existing Federal practices.

16 Also that Giant will continue to partici-
17 pate in the Long Term Study Committee, which will still exa-
18 mine this question and that they look forward to continuing
19 participation in the Long Term Committee and congratulate
20 the Division, Oil Conservation Division on their foresight
21 in involving all the intrested parties in the regulatory de-
velopment process.

22 MR. STAMETS: Thank you. Mr.
23 Pearce, are you next?

24 MR. TAYLOR: May I have a ques-
25 tion about the statement?

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2 MR. STAMETS: No.

3 Mr. Pearce?

4 MR. PEARCE: May it please the
5 Commission, the Commission has now had four days of
6 testimony in this case. We've received into evidence a
7 substantial quantity of written material.

8 The first part of this case
9 dealt with those items which were agreed to in a committee
10 process. We believe that it is important that these agreed
11 upon recommendations be affirmed by the Commission.

12 The great majority of the
13 record in this proceeding obviously relates to whether or
14 not produced water disposal pits in northwest New Mexico,
15 which receive five barrels per day, or less, need to be
16 lined in order to protect underground water.

17 During my opening statement on
18 April the 3rd, I indicated that I believed some additional
19 reality needed to be injected into this. That's been
20 referenced several times since.

21 I indicated at that time that
22 our discussion would not be amenable to easy mathematical
23 description but that it was a discussion of mechanisms of
24 attenuation of pollution in produced water which were recog-
25 nized by scientific, technicological and regulatory communi-
ties.

26 In fact the record shows that
27 both the staff of the OCD and EID do recognize these mechan-

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2 isms but they have opted for simple or more complex mathema-
3 tical models which do not reflect actual test results rather
4 than grappling with much more complicated realities.

5 Let's look at the record for a
6 few minutes, if we can, to see what evidence most appropri-
7 ately reflects these realities as it's been demonstrated in
8 these four days of hearing.

9 The OCD staff began this case
10 relying on a one dimensional flow model, which assumed dis-
11 charge out the bottom of a produced water pit, the satura-
12 tion of a perfect column, and the subsequent straight dis-
13 charge into groundwater of all of the pollutants that were
14 contained in a separator.

15 The staff presented no evidence
16 that they had done any testing of a pit which demonstrated
17 those characteristics. The staff next talked about a much
18 more sophisticated model, a model which by its maker was ap-
19 parently calibrated to describe in some terms the universe
20 as a whole.

21 The OCD staff, the EID staff,
22 whoever was running those random walk calculations, and I
23 don't know if it was said in this setting, I missed it, but
24 whoever was running it did not attempt to take the universe
25 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

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2 the requested small volume exemption demonstrated that the
3 columnar flow model was overly simplified, that substantial
4 amounts of organic pollutants are eliminated by flash vola-
5 tilization, volatilization from the pit, volatilization from
6 the subsurface environment, and biodegradation.

7 They also presented scientifi-
8 cally reliable, supported testimony amounts of organic pol-
9 lutants are delayed through travel along indirect flow paths
10 and sorption.

11 The proponents of the small
12 volume exemption also have presented a model which has been
13 refined to reflect the area that we're talking about through
14 a representative selection of wells refined to deal with the
15 area we're specifically concerned with here today rather
16 than the universe as a whole, shows that pollution should
17 not be found and pollution has not been found.

18 That, I submit to the Commis-
19 sion, is substantial evidence which goes to the question of
20 whether or not this is a real problem.

21 The opponents of the small pit
22 exemption argue that even allowing produced water pits which
23 receive small amounts, allowing those will endanger under-
24 ground water. The only case of pollution which they have
25 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

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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

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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

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2 haven't seen anything in this record other than a letter
3 written, I believe, in 1961 by Mr. Kendrick that a pit which
4 received between 50 and a hundred barrels a day of 80,000
5 parts water should be lined.

6 Well, I'm not sure that there's
7 a problem with a 25 barrel a day pit. It hasn't been demon-
8 strated in this hearing. But, as I say, the industry is
9 willing to accept that because of its consistency with other
10 regulatory agencies.

11 I submit that the record in
12 this proceeding contains no substantial evidence on which
13 this Commission can enter an order requiring the lining of
14 those pits with the resultant expenditure and waste of
15 natural resource, which is appropriate.

16 Thank you.

17 MR. STAMETS: Mr. Carr.

18 MR. CARR: Mr. Stamets, first I
19 have a written statement from ARCO Oil and Gas Company.
20 ARCO has participated in the preparation and financing of
21 certain technical testimony presented here today.

22 I do not intend to read this
23 statement. I would ask it be included with the record as an
24 unsworn statement and I have copies for anyone who's inter-
25 ested in that.

I also have a statement, a
brief statement that will less than five minutes for North-
west Pipeline Corporation.

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2 This case, as you are aware,
3 was called by the Oil Conservation Commission to define the
4 vertical and areal extent of the aquifers potentially vul-
5 nerable to contamination by the surface disposition of water
6 produced in conjunction with the production of oil and gas
7 in certain counties in northwest New Mexico.

8 Even though this is the Commis-
9 sion's case, and in view of the way the case has been
10 called, I presume that it as not been prejudged and that
11 when we come before you in a proceeding of this nature, we
12 can expect you to render a decision based on the evidence
13 which is presented to you.

14 That being the case, the next
15 point which must be addressed in a proceeding of this
16 nature, who bears the burden of proof? In this case , as in
17 all cases, that burden falls on the applicant, on the staff
18 of the Oil Conservation Division and those who have joined
19 with them.

20 And we submit to you, on the
21 record before you in this matter, they have failed to meet
22 that burden of proof, for they have simply shown no contami-
23 nation.

24 Talk as they will about Flora
25 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

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2 today was particularly interesting on this point. He talked
3 about weighin the problems that this situation could pose to
4 various people in the area, and he stated, it will be, and I
5 quote, a hardship for those whose well is contaminated. And
6 then he said, if that happens.

7 I think right there you have an
8 admission that they cannot and have not shown that there is
9 any contamination which they can connect with surface dispo-
10 sal of produced waters in the San Juan Basin. They have
11 failed to carry their burden of proof.

12 Their effort to prove a poten-
13 tial problem was been feeble, indeed. They've used inade-
14 quate sampling techniques, outdaed concepts, and incomplete
15 information.

16 They've used models which they
17 have not calibrated to consider field data. In fact, they
18 have shown no real world problem.

19 The evidence of their failure
20 to carry the burden I think is underscored by today's last
21 ditch effort to shift from benzene and toluene to chlorides
22 and total dissolved solids.

23 They're asking you to take the
24 most conservative case. Well, the most conservative case
25 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.

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2 On this record you should dis-
3 miss this case.

4 Following the February 20, 1985
5 hearing some of us met and concluded that no matter what the
6 inadequacies of the other case might be, we were being asked
7 to come before you and prove the negative. We sat down and
8 got to work and we think that we have done a pretty good
9 job.

10 We've presented testimony which
11 we submit is scientifically sound. We've given you a com-
12 plete explanation of what's happening in the San Juan Basin.
13 We've reviewed six mechanisms of attenuation that work to
14 abate, in fact, to eliminate, the very thing that they're
15 concerned about. We've used laboratory work. We've used
16 the most sophisticated laboratory work available. We've
17 called the most respected experts around and they have tes-
18 tified that their conclusions do work in the field and that
19 they have confirmed this with field samples.

20 The other side, of course,
21 wants to scoff at biodegradation but when they do that, I
22 think they should come forward with an explanation of what's
23 happening in the real world, and they've failed to do that.

24 Recently the environmental
25 function of the Oil Conservation Commission has been empha-
sized and it now stands on an equal footing with the tradi-
tional functions of waste prevention and protection of cor-
relative rights. I assume these still are equal functions

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2 and that environmental advocates will be expected when they
3 come before you to make the same showing as those who repre-
4 sent the industry. If they are, we submit there's only one
5 case before you which is factually and technically adequate,
6 and that's the case presented by Tom Schultz, Gary Miller,
7 Randy Hicks, Al Kendrick, and Alberto Gutierrez.

8 On the record before you, you
9 should not enter an order defining any area as vulnerable
10 and susceptible to contamination in the San Juan Basin, but
11 if you must, on this record certainly you cannot fall below
12 the five barrel per day small barrel exemption. If you go
13 beyond this, we state that you've further elevated the envi-
14 ronmental function and that you've turned your back on the
15 traditional duties of this Commission.

16 MR. STAMETS: Mr. Kellahin.

17 MR. KELLAHIN: Thank you, Mr.
18 Chairman.

19 I have prepared for your con-
20 sideration a proposed order that is attached as Exhibit A to
21 a memorandum on legal issues we think are important in order
22 to frame the action the Oil Conservation Commission will
23 take on this issue, and if you'll give me a moment, sir,
24 I'll distribute those copies.

25 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

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2 have had the privilege and honor of appearing before the Oil
3 Conservation Commission and Division since early in 1972 and
4 this is the first case in which I have participated directly
5 or one in which I am aware in the last thirteen years in
6 which members of the industry have been placed in an adver-
sarial role with the staff members of the Division.

7 It is uncomfortable for me. I
8 assume it's uncomfortable for you. It's a difficult task
9 that you have to wear two hats and try to separate your
10 function as Director from your duties and responsibilities
11 as Chairman of the Commission. Were this the typical case
12 with competing operators fighting over an unorthodox well
13 location or some other issue to address, then it's easy to
14 sit back and be objective about the proof that's been sub-
mitted to you.

15 It's also difficult and a pro-
16 blem for me to discuss the quality of the Oil Conservation
17 Division's case today because I have the greatest respect
18 and admiration for Mr. Boyer. I knew of his reputation be-
19 fore the Environmental Improvement Division. I know his re-
20 putation as a competent and experienced hydrologist.

21 I also am an admirer of Mr.
22 Chavez. I am a supporter of his willingness to undertake
23 the responsibilities of administering the Oil Conservation
24 Division in Aztec and I have set back and watched him prac-
25 tice being a lawyer in the last four days of hearings and
for this case, and he's made some interesting points that I

1 think are important.

2
3 Setting aside those problems I
4 have about criticizing those people that I have to do busi-
5 ness with on a daily basis, and on which my livelihood re-
6 lies and my ability to pay the rent, I'm going to say some
7 things that I think need to be said.

8 It has been a great length of
9 time before the Oil Conservation since the Oil Conservation
10 Division has entered an order that has been reversed by the
11 New Mexico Supreme Court.

12 Mr. Carr at that time, I think,
13 was Staff Attorney. He well knows what it takes in order to
14 prove a case at the Oil Conservation Division and Mr. Carr
15 holds the unique standing in this community as being the
16 last Commission lawyer reversed by the Supreme Court.

17 That was the Faskin case and
18 you will remember it is a case very much like this case.
19 The Division Examiner and Mr. Carr can correct me any time I
20 mess this up, the Division Examiner and the staff sat back
21 and listened to Mr. Faskin present a case. It was uncon-
22 tested in terms of the record.

23 Mr. Faskin came in with his ex-
24 pert and advocated under sworn testimony a particular posi-
25 tion 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

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2 Supreme Court says, guys, you can't operate that way. If
3 you don't like what he's doing, if you don't believe it, put
4 the staff on, put some contrary evidence in the record, and
5 you judge the record as a whole.

6 That's not unlike the case we
7 have here today. I was thinking as I came back from lunch
8 and I crossed the Santa Fe River and was taking a moment to
9 look at water that is not frequently there. I found that
10 the Oil Conservation Division offices are directly up gra-
11 dient from the Supreme Court Building and I maintain to you,
12 sir, that if we enter an order based upon this record, we
13 are going to find contamination that goes downstream and is
14 going to be monitored and controlled and changed for you by
15 the New Mexico Supreme Court.

16 The problem with this case is
17 the burden of proof. There are numbers of instances in the
18 record in which the staff, either through Mr. Chavez, Mr.
19 Boyer, or Mr. Taylor, make references to a degree or stand-
20 ard that sets us far up and above any standard applied to
21 this type of situation by the Environmental Improvement Di-
22 vision.

23 The testimony has been that New
24 Mexico, through the Environmental Improvement Division sets
25 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

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2 ard of proof that's impossible to meet, and you should not
3 apply that standard to us.

4 It's typified on page 120 of
5 the transcript on January 20th. I'm sorry, February 20th.

6 Mr. Chavez' question: There-
7 fore we're addressing only pollution that might occur from
8 oil and gas activities as a preventative measure, is that
9 correct?

10 Mr. Boyer's answer: That is
11 right.

12 Now, that's not the degree of
13 proof required before the Division. That's not the standard
14 we have in our Supreme Court decisions on this type of hear-
15 ing. We are not required to prove the negative. We are not
16 required to take every possible means to prevent contamina-
17 tion because somebody suspects it might happen.

18 I think you remember how this
19 all started. I certainly remember it.

20 When it happened eighteen
21 months ago, sixteen months ago, I was reminded of the story
22 of Chicken Little running through the barnyard screaming,
23 the sky is falling.

24 Chicken Little's gone. He
25 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

1 not here and the sky didn't fall.

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3 Tenneco Oil Company has devoted
4 a considerable amount of time, money, and effort to this
5 problem because it's important, not only for the Commission
6 to understand that they were willing to devote resources to
7 an environmental question as opposed to how much oil and gas
8 we can get out fo the ground, it's important for our own
9 self-respect for you to know that we're environmentalists,
10 too.

11 Mr. Shuey and these others are
12 not the only environmentalists in New Mexico. Mr. Shuey
13 does not live in Farmington. We employ more than a hundred
14 people in this area. We spend millions of dollars every
15 year. We don't want our people contaminated, polluted
16 groundwater. We are good environmentalists. We're going to
17 stick here and we are going to study this problem until
18 you're tired of studying it. But I'm telling you now on
19 this record with what we have you have no other choice but
20 to let those unlined pits using small five barrel a day vol-
21 umes continue. There's no reason to go any further with
22 what we've done.

23 We have contributed Marty Buys
24 to the Short Term Study Committee. Marty has sat through
25 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

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2 a study committee composed of industry people, of people
3 that were concerned about the water, and study it from that
4 point of view.

5 It was early on in that process
6 that Mr. Buys and other industry people volunteered and sug-
7 gested to the other participants that they do the very study
8 that Mr. Hicks and Mr. Gutierrez have done. There were no
9 takers, sir, there were no takers.

10 Mr. Boyer and the OCD did not
11 take that offer. We could have kept this in the form of a
12 study committee. We could have studied it until you're hap-
13 py that we've examined every possible parameter. It did not
14 take that course of action. The study committee was stag-
15 nated on the issue of a small volume exemption. We have
16 turned this into an adversarial case and we've gone about it
17 in that fashion.

18 We have proved, we have under-
19 taken the task that the Short Term Study Committee was in-
20 vited to take. They refused, and we have spent the money,
21 our own dollars, we've studied the problem and we've proved
22 there is no contamination.

23 Let's enter the order and go
24 about something else.

25 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

1
2 proposing regulations for the Underground Injection Control
3 Program, I was probably accused of being Chicken Little at
4 the time, was beaten soundly about the head and shoulders,
5 and ultimately I think we arrived at some rules that are
6 workable and beneficial to the state.

7 Ms. Pruett, do you have a clos-
8 ing statement?

9 MS. PRUETT: Well, I do, but
10 frankly, I'd rather submit it in writing when I've got the
11 rest of the data in, if I may.

12 MR. STAMETS: You most certain-
13 ly may.

14 Mr. Taylor.

15 MR. TAYLOR: Thank you. I'd
16 like to on behalf of the Division reserve our statement on
17 the findings until we've had a time to review further infor-
18 mation from the industry.

19 I would, however, just like to
20 make a comment that, especially in response to the previous
21 comments, that although this case has been somewhat adver-
22 sarial, I think that it does not need to be either confron-
23 tational or unpleasant for those of us who are doing it.

24 The Commission is here to find
25 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-

1
2 lated dumping of produced water onto the ground or into un-
lined pits could affect the health of the citizens.

3 Industry disagrees. They have
4 a right to disagree. They have a right to either put on
5 their case or not put on a case and the burden of proof
6 doesn't change if they don't put on a case.

7 It's still up to the applicant
8 in these hearings to prove the case and we've either done
9 that or haven't and it's not -- it doesn't depend on whether
10 industry responds to our proposal as to whether that burden
11 is carried.

12 Money is a problem with OCD and
13 we have other problems in presenting these. Obviously we
14 couldn't run out and do a lot of testing but we are grateful
15 to industry for their cooperation in the Study Committee and
16 for their presentation of witnesses here, who we think tried
17 to show us to the best of their ability what they think the
18 true situation is. The Division has done its best in doing
the same thing.

19 We're only, as I said, we're
20 only here to protect the health and resources of the State,
21 to preserve fresh water resources, and I think we all need
22 to cooperate in doing that and not get off into whether the
staff is out to get industry or not.

23 Certainly I don't have that
24 feeling. We're all professionals here. We're trying to do
25 a good job and I think this hearing has proved that we can

1 do that very well and I just wish the Commission luck in
2 trying to come up with a conclusion.

3 Thank you.

4 MR. STAMETS: Perhaps wishing
5 us wisdom would be better than luck.

6 Before we conclude this case I
7 would like to publicly thank Marty Buys, who did chair the
8 Short Term Study Committee, and all of those persons within
9 industry, within government, private citizens, who partici-
10 pated in the valuable work of the committee.

11 Certainly this whole process,
12 even though it's gone on for four days would have been much
13 longer without the work of these people and we certainly
14 wish to thank all that participated.

15 Also before we conclude this,
16 I'd just like to announce that it is the intention of Com-
17 missioner Kelley and I to adopt an open meetings resolution
18 immediately after we take this case under advisement, which
19 would call for us to issue on a regular notice under Rule
20 1204, and by mailing copies of the dockets to any party who
21 chooses to be on the dockets list.

22 If there's nothing further,
23 then, in this case, one -- one final thing.

24 May the 7th is the date to have
25 all of the information together that's going to be
exchanged.

How long would everybody like

1 in addition to that for any final comments?

2 Another ten days? Two weeks?

3 Is that acceptable to everyone?

4 All right, it will --

5 MR. TAYLOR: We have until May
6 7th to exchange the information?

7 MR. STAMETS: Yes, and then it
8 will be May the 23rd for any final submittals, any comments
9 on the information to change hands.

10 With that, then the case will
11 be taken under advisement, and the hearing is adjourned.

12 (Hearing concluded.)
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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