NEW MEXICO OIL CONSERVATION COMMISSION

COMMISSION HEARING

SANTA FE, NEW MEXICO

Hearing Date FEBRUARY 20, 1985 Time: 9:00 A.M.

NAME	REPRESENTING	LOCATION
LORI KOMATAR	NORTHWEST PIPELINE	SALT LAKE
Joe Rush	Milestone/El Paso Exploration	Denver
Ted Baker	Gary-Williams Oil Producers	Aztec NM
Marty Burgs	Tenneco oil Co	Denver, Co
Randy Hicks	GEOscience Consultants Ltd	Alby
N T Kellahin	Kellahin & Kellahin	Santa Fe
John Evans	BLM	Craig, Colo
Dale Ballard	El Paso Natural Gas	Farmington
W.D. Hall	" " " "	"
Greg Kardos	" " " "	"
Don, Read	El Paso Exploration Co.	Farmington, NM,
A.R. Kendrick	4 Corners Gas Prod. Assn.	Aztec
Dale H. Shoemaker	Amoco	Farmington
Gary Paulson	Amoco	Denver
Charles Boyce	Amoco	Denver
Paul Ogbaker	Westwater	Denver
Phil Henson	Texaco Inc	Farmington
Alvin R. Marx	Texaco Inc	Cortez, CO
Masud Zaman	Navajo Tribe	Wl/Rock, AZ.

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NAME	REPRESENTING	LOCATION
Wayne Wise	Petro-Lewis	Denver
Red Walsh	Walsh Engineering	Farmington
William L. Carr	Campbell & Black, P.A.	Santa Fe
C Terry Hobbs	Southland Royalty Co	FARMINGTON
Bill Fiant	Energy Reserves Group	Casper
Chris Shuey	Southwest Research & Information Ctr.	ALBQ
Mike Richardson	Consolidated Oil & Gas	Farmington
Wayne T. Conway	Consolidated Oil & Gas	Farmington
Nmocd	Geoscience Consultants Ltd	Albuq.
	Grant Industries	
Carlos A. Guerra	Giant Industries, Inc	Phoenix, Az
Charles Gholson	NMOCD	Aztec
Charles Sponberg	Union Texas Petroleum	Farmington
Ernie Busch	NMOCD	Aztec
David C Boyer	NMOCD	Santa Fe
Bob Fulton	Byram	Santa Fe
Phil Baca	NMOCD	Santa Fe

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NAME	REPRESENTING	LOCATION
Quincy Cornelius	San Juan County	
Robert A. Smith	" " "	
Louis MARTINEZ	State Land Office	S.F.
~~Michael Stogner~~	NMOCC	Santa Fe
Mike Davies	Southern Union Exp	Farm.
J.L. Calder	ARCO Oil + Gas Co	Denver
John F. Eichelmann	El Paso Natural Gas Co	Santa Fe
HUGH INGRAM	CONOCO INC.	HOBBS
TOM WRIGHT	EL PASO NATURAL GAS	EL PASO
Douglas Exp	NMED	Santa Fe
R.E. Karlin	San Juan County	Aztec
Paul + Myrtha Rouse	Farmington	Cedar Hill
B Leeper	" "	Cedar Hill
E. Chavez	OCD	Aztec

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

20 February 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

A P P E A R A N C E S

For the Oil Conservation Division: Charles E. Roybal
Attorney at Law
Legal Counsel to the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

A P P E A R A N C E S CONT'D

For the Water Study Committee:	Jeff Taylor Attorney at Law Oil Conservation Division State Land Office Bldg. Santa Fe, New Mexico 87501
For Tenneco:	W. Thomas Kellahin Attorney at Law KELLAHIN & KELLAHIN P. O. Box 2265 Santa Fe, New Mexico 87501
For Amoco Production Co.:	Gary L. Paulson Attorney at Law Amoco Production Company Amoco Bldg. 17th & Broadway Denver, Colorado 80202
For Northwest Pipeline & Amoco Production Co.:	William F. Carr Attorney at Law CAMPBELL & BLACK P.A. P. O. Box 2208 Santa Fe, New Mexico 87501
For El Paso Natural Gas Co.:	Tom Wright Attorney at Law El Paso Natural Gas Co. P. O. Box 1492 El Paso, Texas 79978

I N D E X

I N D E X CONT'D

E X H I B I T S

MR. STAMETS: We'll call next Case 8224, 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.

Before we start this case today I'd kind of like to go over some of the -- some of the ground rules.

Based on a 1958 Attorney General's opinion, anyone who is here attempting to represent a corporation or another person must be represented by a New Mexico attorney.

Any person may represent himself as an individual.

Any person may testify. All testimony, though, will be subject to cross examination.

Any person may make a statement and the statements are not subject to cross examination.

The intent today is to hear the report of the committee which has been studying this issue. We'll be hearing from the committee chairman. Also, I'd like to hear from any committee member who might like to make a statement or has anything to say relative to the

committee report or the committee activities.

We will be hearing from the Division's Environmental Bureau Chief and the Division's Environmental Engineering Specialist.

I would hope today that we can get everything out on the table that would sort of set out where we might wind up in this case; anything from, say, total abolition of -- of disposal of produced water on the surface, to twenty barrels a day being allowed.

We will allow cross examination of the witnesses today. They will also be available at the second session of this hearing for additional cross examination. The second session of the hearing is currently scheduled for this same time, same place, on March the 20th.

I would ask that at the conclusion of the day, if at all possible, that participants could identify those issues they will be addressing at the hearing twenty days from now.

We will also accept proposed orders in this case at the conclusion of the hearing.

At this time I would like to call for appearances in this case and any attorney who doesn't practice here on a regular basis or any other person that's going to make an appearance, if you've got a card that you could give the reporter, that would certainly help.

At this time we will call for appearances.

MR. TAYLOR: Mr. Chairman, I'm Jeff Taylor and I'll be representing the Produced Water Study Committee.

We'll have three witnesses.

MR. KELLAHIN: Mr. Chairman, I'm Tom Kellahin of Kellahin and Kellahin in Santa Fe, New Mexico, appearing on behalf of Tenneco Oil Company.

MR. CARR: Mr. Chairman, my name is William F. Carr with the law firm Campbell and Black, P. A., in Santa Fe. l

I'm appearing on behalf of Northwest Pipeline Corporation.

I'd also like to enter my appearance for Amoco Production Company.

MR. WRIGHT: Mr. Chairman, I'm Tom Wright with El Paso Natural Gas Company. I'm associated today for purposes of this hearing with the firm of Montgomery and Andrews.

We don't expect at this time to have anything to say. At the appropriate time I wish to make a statement.

MR. SHUEY: Mr. Chairman, my name is Chris Shuey and I'm appearing for myself.

I don't anticipate having anything to say in the way of testimony; however, there may be a procedural matter that I would like to bring up at the appropriate time.

MR. PAULSON: Gary Paulson, appearing in association with Mr. Carr for Amoco Production Company.

MR. STAMETS: Any other appearances in this case?

Mr. Taylor, you may proceed.

MR. TAYLOR: Do you want to swear the witnesses at this time?

MR. STAMETS: Oh, yes, that's a good idea.

How many witnesses will you have today, three? Okay.

Are there any other persons planning to put on testimony today?

(Witnesses sworn.)

MR. TAYLOR: We'd first like to call Mr. Marty Buys.

MARTIN BUYS,

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

DIRECT EXAMINATION

BY MR. TAYLOR:

Q Mr. Buys, for the record would you state

your name, by whom you're employed, and in what capacity?

A My name is Martin Buys. I'm employed by Tenneco Oil Company in their Western Rocky Mountain Division in Denver, and our largest producing area in that division is the San Juan Basin, northwest New Mexico.

Q You're appearing here today in your capacity as the Chairman of the Produced Water Study Committee?

A That's right, I am.

Q Have you ever testified before the Oil Conservation Commission and had your qualifications as an expert accepted?

A I've never testified before them, no.

Q Would you please then state for the Commission your educational and professional background, please?

A Sure, fine. I have a Bachelor of Science degree in environmental chemistry from Rutgers University in New Jersey.

I've been a director of a Public Health Water Quality Lab for two and a half years.

I have a Master's degree in environmental engineering, also from Rutgers University, and I've conducted several hazardous waste ground water contamination studies for the State of New Mexico -- for the State of New Jersey as a hazardous waste inspector, and as the Hazardous Waste Coordinator of Tenneco Chemicals, have also conducted several ground water studies and closures of landfills.

MR. TAYLOR: Are the witness' qualifications acceptable?

MR. STAMETS: They are.

Q Mr. Buys, could you just for the record explain the purpose of the Produced Water Study Committee, its make-up, and how it functioned?

A Well, the Study Committee was put together at an OCD meeting in this room last July 18th to try to attempt to identify any problems that might exist with the disposal of produced water from oil and gas operations in the four-county area of northwest New Mexico.

The committee is composed -- the total committee is composed of approximately fifty people. Of that, about half, a little bit more than half, worked on the -- were actively involved in this short term study group.

At the time of the July 18th meeting I was asked to be chairman in that, and that afternoon everybody who wanted to be on the committee sat down and we divided the committee into two study groups, short term and long term.

The long term has not -- has not done anything at this point; it's all been short term work, although members who are officially on the long term have done short term work.

Q Could you briefly explain how the committee arrived at its recommendations, what process they went through?

A I can do it, but I don't know how -- brief, I don't know, but yes, we can, certainly.

One thing I'd like to give out is the recommendations of the committee to the -- oh, you have to stamp them?

As I said, the committee was formed on the afternoon of July 18th, this past summer, and essentially the committee consists of people from the oil and gas industry, the Oil Conservation Division, the Environmental Improvement Division, several environmental groups that I think you could say for the State of New Mexico and the League of Women Voters from Santa Fe, and I was asked to be chairman.

To facilitate the work of the committee on what our charges were, we tried to divide up into two groups, long and short term study groups.

As I said, the long term group has been on hold until -- I would assume that fairly soon it would start up with some tasks.

By consensus we agreed within the committee that there would be four goals.

One was to determine what constitutes a vulnerable aquifer.

The second was map the vulnerable aquifers.

The third was attempt to determine the probability unlined pits may have in contaminating the vul

nerable aquifers.

And the fourth was prepare a recommandation to the OCD for an order which will address the problems identified by the committee.

Of the four tasks, I believe we've completed three of them. I don't really think that we ever determined the probability of unlined pits as a pollution source, or at least came to a consensus.

We were given six months, essentially six months, to complete the work.

General meetings were held on August 2nd, October 17th, November 29th, and January 9th.

In addition, a small mapping group was put together with people from the short term group, and they met on August 20th, September 10th, and November 1st and 2nd.

On top of all of that we had a field trip to the San Juan Basin, which was held on October 16th, 1984.

The mapping group, which was sort of a sub set-up of the short term committee, used various sources to list water wells in the San Juan Basin in preparation for mapping the vulnerable areas.

The following criteria was used to determine what data would be included in the water well maps. Also they had a good amount of literature that within it had listings of various water wells, and they went through this large list to narrow it down to wells that would be relevant

to what we were looking at.

And the first thing that they said was they'd record all springs that showed up.

Second, record all wells whose principal water-bearing unit was listed as Quaternary alluvium; record all wells whose depth to water was reportedly between zero and 400 feet; and when no other information was available, record all wells whose producing interval was reported to be between zero and 400 feet.

When only the perforation intervals were listed, they assumed that the top interval was the depth of the ground water.

This was really a very large task and took a lot of work on several people's part.

The water well information was put onto Northwest Pipeline's computer mapping program. The program was then used to generate two sets of maps; the one map, which could be overlaid on topographic maps for the four-county area; the one map listed zero to 50-foot, wells that feel in the zero to 50-foot range, and the other map was 51 to 400 feet.

We then used produced water maps and the water supply maps, or I should say we used production maps that listed oil and gas wells in the Basin, and water supply maps that were generated from this computer program, to divide the Basin into long and short term study areas.

If a township had no production, they

were eliminated from the short term study.

Q You're talking about water well production?

A No, I mean oil and gas production.

Q Okay.

A Secondly, if a township has only isolated oil and gas wells, it was eliminated for short term study, with provision that this would be looked at longer, or be looked at when the long term committee started its work.

This exercise delineated the area for the short term study group; essentially, it eliminated about 60 percent of the surface area of the four-county -- surface area within the four counties.

Using production maps, the oil and gas production maps; water hazard maps, which are from a Federal agency; topographic maps; and the water well maps that were developed, we're now able to -- already to try to map the vulnerable areas in the Basin.

Various attempts were made to try to do this and in the beginning weren't very successful.

They tried to use definitions and that didn't work very well in the beginning; contour lines of equal elevation, and there was difficulty with that; and approaches in section, township and -- section, township and range delineations, and nothing really seemed to work well.

The mapping group met in El Paso, Texas, on November 1st and 2nd. At that time it was determined

that by overlying a water well map on a topo map and tracing 100-foot contour lines perpendicular to the river flow, about 90 percent of the 50-foot water wells were covered.

If you then -- and that was -- that was very important because now we had taken in the better part of the water wells that we cared about.

If you then designated the sections that contained the remaining 50-foot wells as special areas, you essentially, then, took in all the area that we knew about that contained water wells that were producing from 50-foot or less.

Let me read that definition to you now.

We came up with several definitions in the committee and that were agreed upon.

One was for vulnerable aquifer, and it says:

For the purpose of this order the following are defined as vulnerable aquifers:

Unconfined aquifers that are less than 40 -- 50 foot from the surface, or unconfined aquifers in floodplain areas, or aquifers in unconsolidated materials. That's where we got the 50-foot, or cared about 50-foot water wells.

From that, then, we said the vulnerable area is an area which lies over or adjacent to a vulnerable aquifer and is defined as an area within the river valleys of the San Juan, Animas, and La Plata Rivers, which is

bounded by the topographic line on either side of the river that is 100 vertical feet above the river channel measured perpendicularly to the river channel.

That's a map -- we have a map to show what that looks like.

The second thing we then defined was the special areas, areas which were areas outside the vulnerable area in which ground water is subsequently found to be within 50-foot of ground surface.

Special areas presently identified are listed below, and that's in the recommendations. It lists all those sections that were not in the continuous area, or the vulnerable area.

We also then listed those areas which lie between the rivers and irrigation ditches in this area, in the river valley areas of the San Juan Basin, and there's about one, two, three, four, seven of those listed.

I'd like to now run through the map.

Q For the record, also, let us point out that the special areas the definition is referring to, are listed on your -- the recommendations of the Produced Water Study Committee, dated January 21st, 1985, which we'll denominate as Exhibit One.

A Okay. So, anyhow, using those definitions, the water wells maps, we came up with a vulnerable area, which we've listed on the map that I have here as, I think it's Exhibit Two. The other one is Exhibit One.

Q So, essentially what you're saying here is that in trying to determine vulnerable areas you came to certain areas, which essentially, from the map look like they lie along water courses, and your other areas, which you defined as special areas, are really contiguous to those.

A They're noncontiguous but they meet the same criteria, which, essentially, in this case would be 50-foot -- water wells producing from 50-foot or less.

Q So they're all vulnerable areas and the only difference between special areas is that they're not contiguous with the rest of them.

A That's right. They are -- they are exactly the same, and would be treated the same.

The second thing that these definitions allowed us to do was the vulnerable area and the special areas are not absolute in that if some -- at some future time we find, by whatever means, we find that water is being produced, we find water that is -- we know to be at least than 50 foot, and then it would be considered to be -- the Commission, we believe, would then consider to add that into the vulnerable or special areas, depending on whether it was continuous or not.

The other thing that this did, it reduced the area of study for the short term committee and for an order from approximately 15,000 square miles to 350 square miles.

The other thing it does, within that area there's contained approximately, we calculated, 1200 oil and gas wells, where in the very beginning a complete order would have covered -- an order for the whole area would have covered approximately 17,000 oil and gas wells.

Now, the second thing that we worked on was various definitions for different type pits at a typical oil and gas well, and then some prohibitioin exemptions and permits, and I'd like to use the easel to draw something right now.

MR. TAYLOR: Would anybody in the audience like copies of these maps?

A We worked on various definitions and I'm using this to represent an average oil -- an average gas well in the San Juan Basin. This does not by any means represent every well, or every configuration in the San Juan Basin.

Various definitions of the work line were the produced water pit, and that is the pit which received produced water from the primary separation in conjunction with the production of oil and gas, and that would be this pit here.

On average this is the pit that receives the most water in any day on that site, on an average.

Secondly, there's the dehydrator pit, which would only receive produced water, only from the dehydration, and that is this pit here.

The third pit is the blowdown pit, which receives liquid only when a well is blown down. That would be this one here.

The fourth one is the tank drain pit, which is the pit receives water when the production stock tank is drained.

And two other definitions, which I haven't drawn in the line here, are pipeline drip collector pit, which is the pit which receives liquids when accumulated in gas pipelines, and a compressor scrubber pit, which, you know, usually -- I won't say usually -- can be on the site. Many times it is, and that's a pit that receives liquids when the compressor suction is receiving water because of primary separator failure.

One section in the order, or in our recommendations, is entitled PROHIBITIONS AND EXEMPTIONS, and it clarifies what is covered by the order, specifically, disposal of produced water or fluids produced in conjunction with the production of oil and natural gas, or both, in unlined pits is prohibited, except for the disposal of produced water as described herein.

And the first thing it clarifies is that pits that lie outside the vulnerable area or special areas at this time are not covered by the order.

The other three things it covers are -- or the other thing it covers is pits, ponds, lagoons, or impoundments that are covered by other regulatory programs,

whether it be State or Federal, as an example, EID regulations, RCRA regulations, NPDES permits, Coal Mining, Surface Mining, Land Reclamation, various acts that are in force or recognized by the State.

And the one -- the other thing that it attempted to address were the ancillary pit, which is any pit on a site that is not routinely receiving water, but specifically the compressor scrubber pit, pipeline drip pit, tank drain pit, blowdown pit, and dehydrator pit, and the committee, I mean, it has to be said that the committee agreed not to agree on allowing any small item exemptions within the order as we -- within the recommendations of the committee.

And so then on the recommendations, these areas where you see blanks were meant to be blank, because of this agreement.

The Commission will have to decide if a small item exemption, small volume discharges are to be allowed in the vulnerable area.

The second section I'm talking about now is permits and the purpose of that section is to allow for disposal of a certain amount of water into unlined pits based on depth to ground water beneath such pits and provided such pits meet certain criteria specifically demonstrating the quality of the produced water to go in the pit and the quality of the ground water underneath the pit, and the quality of soil and geologic conditions adjacent to and

underlying the pits.

The committee, I think it's fair to say, agreed on a concept of a permit; however, they couldn't agree on the volume of produced water or the depth to groundwater that would be acceptable, so in that case, also, there are blanks left which were meant to be blank.

The other thing in the compliance schedule was it allowed for eighteen months, and I'll read it. After eighteen months of the date of the order, the use of unlined pits for the treatment, storage, and disposal of produced water within vulnerable or special areas defined herein is prohibited except by permit as defined above, and any pits or tanks that are installed after that time, I'm going to say after the time to be installed, shall be -- meet New Mexico Oil and Gas Conservation Division specifications.

And then we have the conclusion and it says, and I'm going to read this verbatim, very simply because this was worked out over a period of time and various people have various feelings about certain sentences:

The committee feels that these recommendations will provide the basis -- basic structure for an order from the OCD which will provide some immediate protection to vulnerable ground and surface waters in northwest New Mexico.

It should be understood that the committee worked essentially with limited data available in the

records of various agencies, and to date only limited evidence of contamination of these waters was found.

Hydrologic mechanisms exist for transporting contaminants into the ground water. These mechanisms also provide some attenuation of such contaminants before reaching the ground water.

The ultimate disposition of various liquids deposited to unlined pits and a determination of the probability an unlined pit may have in contaminating vulnerable aquifers depend on the hydrological, geological, and soil and geochemical conditions at the individual pit sites.

Shallow ground water conditions and permeable surface materials present at these vulnerable areas provide a contamination risk from discharges of produced water. Until and unless quantifications of such risks become possible, protection of ground water for uses defined herein must be based on a rational but conservative methodology, keeping in mind the need to apply limited resources to address the potentially serious problems first.

Q Okay. Now just for a moment if I could try to summarize what you're saying and then maybe you can tell me if I understand it.

What you're saying is that the committee, in looking at solutions for potential pollution from produced water, decided that, the short term committee, what they would do is look at the most vulnerable areas, and on Exhibit Two those have been shaded in in the San Juan Basin,

and those areas are the ones to which a proposed order would be applicable, and this order would prohibit disposal of produced water to unlined pits in those areas, unless an exemption is granted.

But the committee was unable to reach a consensus on any guidelines for granting exceptions.

A Yes, I think that's --

Q Is that more or less correct?

A That's a fair summary, yes.

Q And the committee recommends that a compliance schedule of approximately eighteen months be set up so that after that period of time these requirements would have to be met by all producers in any of the vulnerable areas in the San Juan Basin.

A Yes, that's right.

Q Okay.

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

MR. STAMETS: Are there any questions of this witness? Mr. Kellahin.

MR. KELLAHIN: Thank you, Mr. Chairman.

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Buys, when you referred to Exhibit Number One, which is the final recommendations of the Water

Study Committee, I have received over the last several months various drafts of this.

May we know what exact date you're referring to in this exhibit?

A Yes. There's been problems with -- we redrafted several times and the last time we did, and I thought we had it right, the word processor ate part of it, and I figured that they clarified.

So this would be dated 1-18-85:1410a. That would be on the last page.

The title of it is Recommendations of the Water Study Committee.

Q All right, sir, I have picked up one off the table in the back that's dated February 20th, '85. Am I looking at the same one?

A No, to make sure you -- it's handwritten or is it typed?

Q Handwritten.

A The proper date would be on the very last page about one-third of the way down the page.

Q All right, sir.

Mr. Buys, I'm interested in whether or not there was a consensus by the Study Committee with regards to the mapping of a vulnerable area.

For purposes of my question can I assume that the committee came to consensus that the area contained, or described, in the vulnerable area is one that is

being contaminated? Is that correct?

A Ask me that question again.

Q All right.

A Within the vulnerable area the committee --

Q All right, I'm interested in the methodology and the explanations of the definitions you've used to describe a vulnerable area.

Am I correct in understanding that the vulnerable area does not mean that the Committee has come to a conclusion that within that area they established evidence of contamination by allowing produced water to be deposited in unlined surface pits.

A I think you can say that the vulnerable area represents that area within the study area, the whole study area, that we believe is most likely to be polluted, but I don't know that the committee as a whole agrees that this is an area that has been polluted.

Q All right, there is no consensus by the committee that this area has been polluted but it's one that is at high risk, or at risk, within the San Juan Basin.

A That's right.

Q Would you describe for me again, sir, what the difference is when we talk about a definition for the vulnerable area as opposed to those areas outside a vulnerable area?

How do I distinguish between the two?

A That are special areas, you mean?

Q No, sir, between an area that's a vulnerable area and one that is not, excluding for a moment the special areas.

A The vulnerable areas have been -- have been, you know, the work has been done, the definitions have been arrived at and agreed to by the committee, consensus by the committee, and a map has been prepared and presented as an exhibit.

Any area outside of the vulnerable area at this time is not part of the short term study group's responsibility. That's not to say it will not be studied later on by the long term committee.

Q Using the definition agreed upon by the study committee, how do you exclude the nonvulnerable area?

A From the short term study group's work?

Q Yes, sir.

A We had just so much time and so much energy and we had to put it where best we thought, and that's how we worked it going after that, the -- the vulnerable area.

Q Does -- does the area outside the vulnerable area fail to meet the definition agreed upon by the study committee in that you had ground water deeper than the agreed upon definition, or an absence of ground water that had been documented?

A There's various reasons why an area

that's not in the vulnerable area is not.

One is, I guess you'd say one is that there is no known pollution in -- in areas outside the vulnerable area.

Secondly, there is no -- we don't know that there's shallow ground water there; shallow, 50-foot or shallower.

In some of the areas there's no production; there might have been ground water, just was no production, oil and gas production.

I think many of the people on the committee, I will say people on the mapping committee were aware that a lot of the area that is not in the vulnerable area is also underlaid by geologic conditions that make it -- you would -- you would think it would be a lot harder for pollution to -- to have an effect on ground water there, or to have -- oil and gas to have an effect on ground water there. I'm not saying it won't, but a lot less difficult.

Q Is it fair to characterize the committee's consensus about the vulnerable area as one that has a rational basis upon which the Commission could then enter an order?

A I think it is a rational, logical approach there. That is, I think we've done enough work to show why they came about, and why this is the area that should be first looked at by the Commission for some sort of no pit order.

Q When we look at the map, which I think is Exhibit Number Two --

A That's it, yeah.

Q -- is that intended to be simply an illustration of the area affected by the definition?

A That's exactly right, the way the committee envisioned the program, an order would require each operator to determine, using the definition of a vulnerable area, whether his well's in that area or not, so that map is -- is just an illustration of what we think the vulnerable area is with our going through it with a couple of maps.

It, itself, would not be -- you would not use that to determine if your well is in or out of the program. The Commission would want to have definition and some sort of certification from the operator that his wells are or aren't in that area.

Q Is there a consensus by the committee that the definition as agreed upon is one that is convenient to administer and to understand, not only by the Commission but by operators faced with drilling wells in the vulnerable area?

A I think that's -- do think that's the case.

Specifically with new operations you determine, when you do your survey of your site, the information would come about at that time to determine if this is a site within this vulnerable area or not.

Within that vulnerable area I believe you've told us that there are identified some 1200 oil and gas wells that currently exist and approximately 300 water wells in this area.

A That's right.

Q When we look at the committee report on the page that shows the compliance schedule, second to last page, it has a paragraph that begins, "After eighteen months", if you'll look at the third line of that paragraph and find the phrase "prohibited except by permit", would it be fair, Mr. Buys, to insert after the word "permit" the words "or exemption" in the event the Commission approves some small volume exemption on a blanket basis in the unlined pits?

A That would -- that would seem logical to me to include there. Yes.

Q Let me discuss with you what was the thinking of the committee in terms of providing an eighteen month compliance schedule. Could you give us a little more detail about whether the committee thought that was reasonable, how that was arrived at, and what the committee was trying to accomplish?

A Well, I feel -- I feel that the committee agreed, my feeling is that the committee agreed that eighteen months was a reasonable time period.

The way it came about, I think, is we originally said a year, or a year was said, and we said that

represents a couple problems to the industry.

One is planning for budgets for the capital expense that this would require; and secondly, while a year sounds good, most of the kind of work that we're talking about here, or we envision would have to be done, would not be able -- would not lend itself to being done in winter months. So a year would, in fact, not be a true year of working.

So that's how we came out with eighteen months.

Q I'd like to go through with you, Mr. Buys, the conclusion section of the report and have you explain for us the basis upon which various statements have been made in the conclusion section.

A Okay.

Q All right, let me find the ones that were of interest to me.

To return to an earlier discussion we've had in terms of what the vulnerable area means, it is simply an area where there is shallow ground water that is potentially at risk from contamination.

A That's right.

Q When we discuss the committee's work essential -- working essentially with limited data available in the records of various agencies, could you describe for us what is meant when we've added that portion of the next sentence?

A Well, the first thing that comes to mind is a lot of the data reported would not really be considered complete information about that water well. As an example, you might know how deep the well is, where the perforations, but it doesn't list exactly where the table, water table is. That's where we made some assumptions.

It's information like that we're saying is not -- was limited.

On the other hand, some people's opinion was that there are more water wells in this area, or in the Basin, than we had records of; therefore, we didn't -- if we didn't have a record of it we couldn't include it in our preliminary review to decide whether it would be applicable to this study or not.

And I guess that's what we're saying. There could be more water wells out there and some of the information that we did have could have been more complete. What we had is, I think, you know, gave us a pretty good shot at defining the vulnerable area.

Q The last portion of that sentence says that to date only limited evidence of contamination of these waters was found.

Could you amplify upon what evidence or basis that statement is made in the conclusions?

A Well, that particular statement was -- there was a lot of discussion in the committee, and I guess the only thing to say is that at this time there is one in-

cidence of ground water contamination that is being -- is attributed to oil and gas production, and that that, the way I understand it, is that we don't know that that's exact -- that that is a true statement or not.

We know there is some pollution at one well in that vulnerable area but we don't know that it's been proven proof positive that that is linked to an unlined pit or produced water pit.

Q Can you identify for us in some descriptive words what well or area was involved when the committee identified one well within the vulnerable area that might be a source of contamination?

A This -- this well is in the Flora Vista area and I believe it's Mary Willer (sic) -- I forget the number on it.

Q It's the Manana Gas Well in Flora --

A Gas well --

Q -- Vista?

A -- right, and we did see this well on our -- on the field trip that we had in October of '84.

Q Has the committee attempted to make any type of calculations or other studies with regards to the hydrologic conditions around these unlined pits?

A No, we haven't, and that refers back to one of the four goals, was to attempt to determine the probability unlined pits have in contaminating the vulnerable aquifers, and that was something we did not have time to get

to.

Q Can you describe for us, Mr. Buys, what your understanding is of those items that you anticipate would be the subject of a long term study?

A The first thing, I believe, would be some sort of approach to what impacts small volumes of produced water would have going into unlined pits in the vulnerable area.

The second thing on a long term committee would be look at other areas in the Basin to determine if any of these conditions we've described in the short term exist other places in the four county area.

Other than that I don't really have any other tasks for them right at this point in time.

Q Let me go through with you and see if I understand those major elements upon which there was consensus by the Water Study Committee.

When I use the word "consensus" I mean unanimous agreement by the various members of the study committee, so that the end product came to a resolution that everyone agreed upon.

With regards to mapping and defining and identifying the vulnerable area was there consensus on that point?

A Yes, there was.

Q When it came to the issue within the vulnerable area of providing a recommendation to the Division

on precluding high volume discharges into unlined pits, was there any consensus on that point?

A High volume discharges.

Q Yes, volumes in excess of, say, twenty barrels a day.

A Yes, I think there's -- you can say there's consensus on that.

Q And what is that consensus?

A Pits, using the Federal standard, pits of five barrels or higher a day in all likelihood should not be allowed to go into -- pits that receive five barrels or greater, unlined pits in that vulnerable area, probably shouldn't be allowed to exist after the order is -- should be handled by the order; in other words, taken out of service.

Q Can you articulate for us the basis upon which the committee has a consensus about high volume discharges into unlined pits?

A Just that, I guess nothing more than logic. There's a certain amount of logic that I think most people can see that a large volume of water going into a pit day in and day out could have an effect in this small -- in this vulnerable area, and so I think from that most people are willing to concede that these large volumes going into these unlined pits probably shouldn't happen in a vulnerable area.

Q And that again is based upon the opinions

of the study committee, their analysis, calculations, what not, but it is not based upon documented evidence of contamination by unlined pits, even at large volumes.

A Not in the San -- not in the vulnerable area, no, and not by calculation or any study. It was just, you know, certain -- certain definitions and certain logic, it seems like they should not exist any longer.

Q When we look at whether or not the Commission should allow a small volume exemption, which I have understood to be five barrels a day or less, then there was no consensus by the committee about that issue.

A That's right. There was a consensus to not agree to it.

Q When we talk about the pits, and with your permission, I'd like to mark the drawing as Study Committee's Exhibit Number Three, Mr. Buys, when we talk about the pits around a wellsite that are unlined, you've identified for us those pits.

Was there any consensus or agreement by the committee with regards to how to handle the unlined pits?

A By that do you mean how -- should they be lined or should be taken out of service, or --

Q Yes. Let's start with each one of the pits. When we look at the blowdown pit, was there a consensus about whether that pit ought to be lined or taken out of service?

A I don't think that there's any consensus on how it should be handled because we really didn't address that, other than we identified several pits that are common to operations in the San Juan Basin, and looked at -- had a consensus on definition to describe that pit.

But how a pit should be taken out of service was never -- I won't say it wasn't discussed, but it was never -- it was never made a goal of the short term committee.

Q Would you describe for the record, Mr. Buys, the understanding of you and the committee with regards to the order or frequency in which the various pits that you would commonly see at a wellsite are subject to having water placed in them?

I realize that you've gone through that earlier, but I'd like to have you do it again so that I'm clear on what the committee had available to it and its understanding of the pits that were subject to having water placed in them.

A Just that the primary -- the produced water pit, that water that receives -- that pit that receives water from primary separation is a pit that any given day when the well's on would in all likelihood receive water.

The other pits that are on the diagram do not routinely receive water every day, on average.

Q Where is the dehy pit in relation to the

produced water pit on a typical well, sir? Is that the same pit or is that different?

A On average it's a different pit. Generally it's a different pit in the San Juan Basin.

MR. KELLAHIN: Thank you, Mr. Chairman.

MR. STAMETS: Are there any other questions of the witness? Mr. Shuey.

QUESTIONS BY MR. SHUEY:

Q Just a couple questions, Mr. Buys.

You said that there were approximately 1200 oil and gas wells in the vulnerable area that the committee described, and then you -- you've got your drawing here and you discussed some of the pits.

Is it safe to say that at each oil and gas well there are at least two and sometimes three pits?

A At a gas -- at a gas well there's -- there's, on average, there's -- will be the produced water pit and the dehydrator pit.

Q Okay, by the "produced water pit" you mean what?

A That pit that primarily receives water and any day would probably receive some water from the primary separation.

Q Okay. The pit that's associated with a condensate tank, does that sometimes receive water from the

tank?

A Yes, it does, yes. No, not all wells in the San Juan Basin have condensate tanks. The San Juan -- many of the formations of the San Juan basin are very dry, both from water and from hydrocarbons.

Q Okay. When you discussed the Flora Vista case, you said that, if I can be accurate in describing what you said, that was a case in which a water well had been contaminated and that the possible culprit was a nearby pitted gas well.

A That's the way it's been described to me.

Q Okay. If we do some multiplication and find that at the 1200 oil and gas, or gas sites, in this vulnerable area, there's approximately 2400 pits, of the 2399 other pits besides this one in Flora Vista, have you or has anyone else evolved any information on that in terms of their -- in terms of whether they had contaminated ground water or not?

A I, well, from working on the committee, I don't know. I don't know that they have, and I have not seen any information. I'm trying to think -- I don't think we've seen any information.

Q In your capacity as the committee chairman, is it your opinion that the committee would have had time to go and get that information?

A Get --

Q To do some other site specific studies on

other pits outside of that in Flora Vista?

A Not in a six months time frame.

Q Okay. Thank you.

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

MR. WRIGHT: Mr. Chairman, I'm Tom Wright, representing El Paso Natural Gas Company. I just have a few questions.

CROSS EXAMINATION

BY MR. WRIGHT:

Q Mr. Buys, during the committee deliberations, what were the ranges of small volume exemptions that the committee -- committee considered?

A A range of volumes anywhere from zero to five barrels.

Q So generally everyone on the committee agreed that there probably should not be exemption in the vulnerable area for more than five barrels.

A I think that's a fair statement.

Q But there was some support for both ends of the range on the short term committee, is that correct? Both for no exemption and for exemption of five barrels.

A Within the committee itself, yes, there was disagreement and some people believed both ends of that zero and five barrel range, right.

Q In the -- from what -- from the evidence

that the committee considered, is there evidence that there are at well locations some pits that are normally dry?

A From the -- I believe that the committee would agree with that, yes.

Q And from what the -- from the evidence that the committee -- committee considered, there is some evidence that there are -- are pits that receive less than five barrels of produced water per day.

A Yes, I think that there's agreement on that, too.

Q And some of these numbers we've gone over before, but I'm not still clear on it, how many wells are we talking about in the vulnerable area?

A We've counted the wells as best we could off of -- using a particular listing system available in the San Juan Basin, and we feel that 1200 is a good representative number of how many wells are in that vulnerable and special areas.

Q In the vulnerable and --

A Oil and gas wells that are in production today.

Q And did the committee -- from the evidence the committee considered, do you have any idea about how many pits there are per well?

A I don't -- the committee did not -- I don't think it's -- I can't say the committee has an opinion on how many pits there are, but I think most people agreed,

I think it's agreed, that the diagram on average is a fair representation.

Many wells will not have the blowdown pits.

Q So some wells have one pit and some wells have as many pits as there on this diagram?

A That's right, and some might even have another pit, but --

Q But the average would be about five pits per well?

A No. The average -- now, in my opinion the average will be about three pits per well.

Q Three pits per well and 1200 wells?

A Right.

Q Does the committee have any idea how much it would cost to line each pit?

A No. There's no consensus on the committee about that. That really wasn't discussed.

It was discussed at times but there was not any agreement and we had no need for an agreement from what we decided were our tasks.

Q Is there a list of the committee members, the short term committee members, entered into the record yet?

A No, but I -- I intended to do that.

Q That will be done.

A That will be done before I leave testi-

fying.

Q Thank you, Mr. Buys.

MR. STAMETS: Mr. Paulson.

MR. PAULSON: Mr. Chairman, may I ask one question from here without going out?

MR. STAMETS: Only if the reporter can hear you.

MR. PAULSON: I'll speak loudly. Thank you.

Gary Paulson with Amoco Production Company.

CROSS EXAMINATION

BY MR. PAULSON:

Q Mr. Buys, the vulnerable area includes, according to your report, areas where the depth of ground water is less than 50 feet, and where the water is presently being used, or could reasonably be presumed to be used for certain purposes.

Did the committee attempt to investigate the quality of the water existing within the vulnerable area?

A The committee as a whole did not. Now, OCD has done some analysis and they will testify, they will be talking about that in a little while.

Q But the designation of the vulnerable area didn't take into account the quality of the water,

ground water, that exists presently.

A No, it didn't.

Q So that it might be possible that if the recommendation that the committee is adopted, that under, I guess it's Section C-a), their quality permit, it's indicated that if the operator can demonstrate that the quality of the existing uncontaminated ground water is such that the introduction of produced water will not cause degradation of ground water, that you would then be able to get a permit.

It's certainly possible, is it not, that some of the water in there, within the vulnerable area, would facilitate --

A Be below quality; that's possible.

Q No, further questions.

MR. PAULSON: Thank you, Mr. Stamets.

MR. STAMETS: Are there other questions?

MR. KELLAHIN: Mr. Chairman, I have one last question based upon what Mr. Paulson asked.

RECROSS EXAMINATION

BY MR. KELLAHIN:

Q I think it's very clear, Mr. Buys, but let me ask you again to make sure I know, pollution was not a criteria to distinguish between the vulnerable and the nonvulnerable area.

A No, it was not.

Q The distinction is that the vulnerable area is an area that's at greater risk than the nonvulnerable area.

A That's right.

MR. STAMETS: Mr. Buys, I've got a --

MR. TAYLOR: Mr. Chairman, if I could just have one more question.

MR. STAMETS: Okay.

MR. TAYLOR: I just want to have Mr. Buys clarify the exemption they're talking about.

REDIRECT EXAMINATION

BY MR. TAYLOR:

Q Mr. Buys, you stated that there was no consensus on the committee about granting exemption for small -- what do I want to say -- for small water production, and that there is a feeling by some that zero was -- was what it should be, and others thought there should be an exemption for up to five wells.

A Five barrels.

Q Five barrels, excuse me.

A Yes.

Q Was the -- was the feeling of the committee, other than those people who thought there should be no exemption at all, that the exemption should be on a well by

well basis where they would have to apply for that, or was there some other method by which they thought these exemptions could be granted?

A Well, the way -- the way we wrote this document, there would -- the way it was written, and I said it has not been agreed to in volume or in depth of ground water, that there be two ways to go at it.

One would be certain types of pits would essentially get a carte blanche exemption, which would allow them to dispose of small volumes of water into unlined pits.

Then the other way of going about it was if an operator on a well to well basis could demonstrate certain things, which are, you know, the quality of the water being produced, or the quality of the ground water underneath the pit, or soil and geologic and other considerations, which would show that it would be unlikely for water in the pit to get to ground water, then they could get a permit to dispose of, you know, an unstated volume of water at that pit, but that would be well to well, the way this is written now.

Q Well, I assume because there were some members of the committee that thought there should be no small volume of discharge exemption that there was not really consensus as to the fact that there shouldn't even be exemption to those, is that correct? The majority of the committee members felt there should be exemptions but there was no agreement because of the fact that some felt there

should be no exemptions granted.

A That's right. I believe if you go a little further, I believe you can say that there's -- I believe the people on the committee as a whole agreed that some sort of permitting -- if somebody could prove that they would not be impacting ground water, then there should be a mechanism for them to allow them to try to do that.

So I think as a whole the committee agreed that some sort of permitting process would be -- should be allowed.

Q So there more or less was a consensus on that issue if they could prove that there was no -- could be no harm to ground water.

A Yeah. What there was not a consensus on was how much water could go underground if you met these criteria.

Q You said you had a list of the members of the committee.

A Yeah, I was going to read that, yeah.

Q Okay, would you do that, please?

A Now, these are the -- these are the people on the committee, on the initial full committee, as I think that they participated in the short term, so here we go.

Chris Shuey of Southwest Research and Information Center.

Edith Pierpont from the League of Women

Voters here in Santa Fe.

Tom Chandler from Texaco.

Joe Rush from Milestone/El Paso.

Lori Komatar from Northwest Pipeline.

Dale Shoemaker of Amoco Production and Chuck Boyce of Amoco Production.

Masud Zaman of the Water Resources Division of the Navajo Indian Tribe.

Bill Lorang of El Paso Natural Gas.

Dave Boyer from the Oil Conservation Division.

A. R. Kendrick, representing Four Corners Gas Producers Association.

Anthony Drypolcher and other members of the Environmental Improvement Division.

John Calder of ARCO.

Mike Herrington of Union Texas.

And Albert Gutierrez of GeoScience Consultants, representing at the time Giant Industries, were probably the members as I -- as I remember who did the most work on the short term committee and had an impact on the results of the work.

Q Mr. Buys, our Exhibit One was the recommendations of the committee.

Exhibit Two is the map, and Exhibit Three are the drawings.

A The drawing.

Q Each of those were prepared under your supervision, was it not?

A Definitely, yes. Had to think about that. Yes.

MR. TAYLOR: I'd like to move the admission of Exhibits One, Two, and Three.

MR. STAMETS: These exhibits will be admitted.

CROSS EXAMINATION

BY MR. STAMETS:

Q Mr. Buys, I've got a few questions.

If the Commission prohibits the disposal of produced water in the vulnerable area, what will the operators do with the water?

A If there's a total prohibition, you're going to have a volume of water that no longer an go into an unlined pit.

There's verious options available, but the fact of the matter remains that there's going to be some water that has to be disposed of that is not going to evaporate, and at this time in the San Juan Basin, it is my opinion there is just no mechanism to handle that.

That's not to say that there couldn't be and there won't be, but at this time there isn't.

Q What would the options be, though?

A The options would be deep well injection

under the UIC program.

Another option would be building solar evaporation ponds either at each site or a central facility.

Various physical chemical treatments and then disposal. The disposal could be, you know, I'm not saying it would be, but through NPDS permits through a river or other water body if it was a high enough quality water used from any number of uses.

But those would be the general options.

MR. TAYLOR: Mr. Chairman, we'll have some testimony on options for disposal later on.

Q Your testimony was that none of these facilities are available at the present time to serve the volume of water which would be affected.

A To serve the volume of water, yes. I mean some of this is going on there but is not -- it does not exist to the scale that I think we'd need with a complete ban in the vulnerable area.

Q Okay. In Exhibit Number One, in Special Areas in Part b), you've identified the areas which lie between the rivers and the ditches mentioned below, and I presume that means that no pits or only the permitted pits would be allowed between that ditch and the appropriate river.

A That's right.

Q Now, are these ditches defined on your Exhibit Number Two or are they defined on the U. S. Coast and Geodetic Surveys? How would an operator determine

whether or not he lay between one of those ditches and the river?

A They are not on our map, that I know, at least not all of them are, and I don't really have an answer for you.

The ditches, the irrigation ditches, were -- that was worked out between other committee members and all I know was -- what I know I can talk about is just that they exist and we felt that artificial water levels might exist between these ditches close to the river and the river, and we thought that that would make those areas vulnerable, also.

But other committee members could answer that question better.

Q Okay. Before this hearing is concluded we do need to be able to tell people how they can determine whether or not they are affected.

Mr. Buys, if the Commission goes along with the recommendation of this vulnerable area and, let's say, that a new ditch is put in or new wells are drilled and find water less than 50 feet deep, do you believe that the area should be expanded, say, at a public hearing, like we do our nomenclature?

A If information became available that would further identify some, you know, areas that could be -- that would meet the definition of vulnerable, yes, I think that would be the way to go with it, then, make an announcement and have a hearing.

Q Okay. On the next page relative to the prohibitions and exemptions, I presume that the volumes of water which would be disposed of would vary from well to well in the area.

A Vary in what way?

Q In volume. You might have one well making five barrels of water; another well making two barrels; another well making half a barrel.

A That's what, you know, the wells -- the San Juan Basin in it's gas operations is a low water producer in the first place, and it varies within -- within the Basin, and the wells do vary, so you'd have to identify a well and decide what kind of water volume is being produced.

Q And even if each -- in each well you could have a different volume at a separator drain line, say, from the dehy drain line, you might have, what, two barrels a day at the separator, half a barrel, or less, at the dehy?

A Yes. You -- the only pit that continually receives water on average is that produced water primary pit, the produced water pit from the primary separation.

Dehydrator pit does not receive water routinely at all, and as a matter of fact, the water that it does handle through its dehydration, much of it leaves as water vapor; it never does drop down into the pit, although I'm not saying -- why would you want a pit?

Q Based on water volumes alone, then, would

you believe that there would be different levels of hazard in the vulnerable area from well to well and from pit to pit at individual wells?

A Yeah, in theory, yes.

Q Is it possible that the Commission should consider some sort of a phase-out by volume? Let's just say, for example, everything over five barrels a day would have to be phased out in twelve months, and everything from five barrels down to a half a barrel, in eighteen months and everything from, well, half a barrel and lower, in twenty-four months, would that be a logical way to phase out the produced water and provide protection in local areas?

A That, to me that seems like a logical way. I'm not necessarily agreeing to the compliance time but the concept, yes.

MR. STAMETS: Any other questions of this witness?

He may be excused.

We'll take about a fifteen minute recess.

(Thereupon a recess was taken.)

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

Mr. Taylor, you have some other witnesses?

MR. TAYLOR: Mr. Chairman, our next witness will be Mr. David Boyer.

DAVID BOYER,

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

DIRECT EXAMINATION

BY MR. TAYLOR:

Q Would you please state your name, by whom you're employed, and your position for the record?

A Yes. My name is David Boyer. I'm employed the New Mexico Oil Conservation Division. I'm Chief of the Environmental Bureau and my position with the agency is a Geologist 4.

Q And you're appearing here today on behalf of the Division, is that right?

A Yes, that's correct.

Q Did you sit in on the meetings of the produced water committee? Were you a member of that committee?

A Yes, I was.

Q Have you ever appeared before the New Mexico Oil Conservation Commission before?

A No, I have not.

Q Would you then please state your educational experience and your work background for the Commis-

sion?

A Yes. I have a Bachelor of Science in hydrology and water resources from the University of Arizona.

I also have a Master of Science in hydrology from the University Arizona at Tucson.

My work experience, prior to New Mexico, was involved with various water resources development studies on Arizona Indian reservations through the Office of Arid Land Studies.

In 1978 I came to New Mexico and took a position as a geohydrologist with the New Mexico Environmental Improvement Division.

In that capacity I was in charge of the New Mexico Surface Impoundment Assessment and the New Mexico -- development of the non-oil and gas portion of the Underground Injection Control Program.

I also reviewed and made recommendations for approval and disapproval of ground water discharge plans under the Water Quality Control Commission regulations.

Last July I came to work for the Oil Conservation Commission.

Q And as part of your employment with the Oil Conservation Commission, you have been studying produced water for some time?

A Yes, that's correct.

MR. TAYLOR: Mr. Chairman, are the witness' credentials acceptable?

MR. STAMETS: They are.

Q Mr. Boyer, would you explain to us why the Commission proposed a rule prohibiting unlined pits, or proposed a study of this matter?

A Yes. The Commission is charged by New Mexico Legislative Statutes to protect fresh waters in the state as designated by the State Engineer. The reference to this statute is 70-2-12 B(15) of the New Mexico Code.

As part of that study we wanted to take a look at some of the different types of produced waters in the San Juan Basin and determine their characteristics and the potential for vulnerable -- for contamination, for aquifer contamination.

I have several exhibits that I would like to introduce and at this time I'd like to introduce Figure 1, or have Figure 1 introduced.

Q Let's see.

A Figure 1 is simply a schematic drawn by one of the OCD staff people of the possible sources of produced water in the field.

Now earlier Mr. Buys talked about a number of pits associated with individual wells and production facilities.

This shows quite a few different pits that -- at different facilities, both at the wellsite and further on down the pipeline.

These names are defined in the committee

recommendations, ancillary pits, primary pits, the definitions are in there.

But this is the type of pit that we are talking about regulating in the San Juan Basin.

If we go to the areas that we're talking about today, Lee Wilson in a 1979 report, he listed that area as a highly vulnerable area to contamination and his reasons for listing the -- listing this area up in the San Juan Basin was because of the shallow water table and none, or very limited, protection from discharges to the vadose zone.

The soils up in that area are generally permeable and generally have no caliche in the valleys to overlie and protect them; therefore, there's a high potential to contaminate ground water from improper disposal practices in this area.

We need to take a look at, besides the vulnerable areas, which Mr. -- besides the definitions of vulnerable areas which Mr. Buys has already described in his testimony, we have to take a look at some of the characteristics of what we're talking about as far as the waste products that may go into these produced water pits, and these are products that are produced along with the oil and gas and it's usually called produced water.

Now, this water has a number of characteristics that we have looked at over the past -- over the past year.

I have some sampling results and I would like to introduce a table listing those sampling results and it's at the back there. This was a table that was compiled by the EID.

This, this table shows the results of sampling that were conducted in September of 1984 by this Division, myself, and David Catanach. An earlier sampling that was conducted back in April of 1984 of these particular, of several selected wells.

Additionally, sampling was conducted in January of this year and those analyses came in last night and they haven't been -- not all of them were complete and so I didn't try to compile them; however, that data will be available in the next few days and includes about another fifteen wells and pits.

Based on what I've seen in preliminary data, the hydrocarbon content of those samples is quite high. The TDS, or the total dissolved solids, is lower, but those will be available in a few days and I will gladly make them available to whoever wishes to make -- make copies.

In any event, I want to discuss some of the -- what we looked -- what we found with regards to some of the characteristics of these produced waters and why we believe that it is important that they be regulated to protect ground water.

First off the table shows that you have a wide variation of total dissolved solids. You have a varia-

tion from about 50 milligrams per liter at one particular well, the Florence 37 A, to over 24,000 at a Chacra -- Chacra well up in the San Juan Basin.

The average for the sample, these nine samples, was about 10,900. The limit which we protect ground water according to the statute that I referenced earlier, is 10,000 milligrams per liter, so these waters are at least on the average, are quite poor quality with total dissolved solids-wise.

Some of the other inorganic constituents that exceed standards that have been promulgated under the New Mexico Water Quality Control Commission regulations, just for an example, of standards in ground water, some of these other constituents include chloride, sulfate, some heavy metals, arsenic, barium, boron, iron, manganese, cadmium, chromium, lead, selenium. All of these inorganic materials that I've mentioned, especially the arsenic and selenium and lead, cadmium, have health effects that are toxic to humans at concentrations, at excessive concentrations.

These concentrations that I'm comparing them against were set after regulatory hearing by the New Mexico -- before the New Mexico Water Quality Commission several years ago when ground water standards were adopted based on health effects at that time.

If so desired, I can go into individual health effects from every -- from every parameter, if you

wish, but I think that it's -- that at least right now I would just like to sum up as far as inorganic constituents are concerned by saying that the produced waters exceed those -- those numbers in a number of cases, and therefore that these waters should be -- should be disposed of in a proper way so as to prevent ground water pollution.

I also want to discuss what I think is the more important constituent now, is benzene and other associated hydrocarbons which are found dissolved in the waters that are released as the well -- as the water is -- as the natural gas comes up the water comes up and there is natural gas in those waters -- excuse me, there is dissolved hydrocarbon gas in that -- in those waters and that goes onto the surface of the ground.

To give you some idea of the comparisons, again with just using benzene, the health limit for benzene set in the regulations is .01 milligrams per liter.

The nine samples that are on this table have a range from 3.2 milligrams per liter to almost 30 milligrams per liter, and so there is, let's see, that would be ten, hundred, thousand, about a 10,000 difference, exceeding over the health standards. Is that right? Between 1000 and 10,000 exceeding over the health standards.

So benzene is an extremely important constituent and one that needs to be looked at in any type of a discharge to these unlined pits.

I'd like to just mention some of the

toxic effects of benzene.

It has been documented that benzene causes leukemias, in other words, cancer. There is good data indicating that health levels, that show that good health levels can be determined. It isn't a type of parameter where you've doing a lot of guesswork. There's a lot of good health data.

So benzene is probably the most important of -- of the constituents that we know of right now that we want to protect from getting into the ground water. There may be additional constituents that we haven't looked at. I've heard about them but I haven't looked at them, such things as polynuclear aromatic hydrocarbons and other exotic type names like that, but for purposes of this hearing I'm just mainly concentrating on the benzene and toluene and some of the other numbers that are in the -- that we have ground water standards, State ground water standards set for, and based on my review of this information, the produced waters exceed that -- those standards.

Now there are a number of things that are found in ground water naturally; benzene, however, is not one of them.

A lot of the inorganic constituents that I mentioned are found at different concentrations but benzene is not found in ground water naturally.

The State EID last summer published a study of volatile organic sampling results for statewide but

I'm going to concentrate on the system, on the San Juan County systems. I'm just going to concentrate on the ground water systems because of the surface water systems get it from the river and treat it.

The City of Aztec, they had no volatile organic hydrocarbons detected.

Flora Vista Water Users, none, none detected.

Lee Acres Water Users, none detected.

The West Hammond Water Users, none detected.

The ground waters, ones that were sampled, didn't detect any of these and earlier reference was made to Flora Vista. There was contamination detected several years ago in one well and that well was shut off line, but today none of the wells tested by the -- community wells tested by the State Environmental Improvement Division showed any detectable levels of these type of chemicals, so these are not normal constituents of ground water, at least not in the type of ground water we're looking at. They may be associated with oil and gas deposits.

Regarding the inorganic constituents, the one that is used most rapidly for comparison is total dissolved solids.

In 1980 the State EID made a -- compiled a list of chemical quality of New Mexico community water supplies. The total dissolved solids for the San Juan

Basin, wells, the ground water areas were from about 300 TDS up to about 7-or-800 TDS. There may be some individual variations beyond that but there are -- most of the water is of good quality. The State limit for total dissolved solids is 1000 milligrams per liter, so that is below that for the ground water standard.

So here again, the types of waters that are introduced do have characteristics that are -- that are both health effects and esthetic effects that need to be avoided in any type of disposal.

The one documented case we do have, again, was that of contamination in a well, is the Flora Vista, and as Mr. Buys said, the exact cause of that has not been proven, which -- which -- what might have been the cause. There was an oil and gas well in the neighborhood that was producing those types of hydrocarbons, but that's -- right now it hasn't been proven one way or the other.

Q So if I could summarize what you've said there, the Commission is delegated the responsibility of, under the Water Quality Control Commission, of prohibiting pollution of water or protecting fresh water resources.

A Well, that is not a delegation. That is a separate prohibition or separate charge that is given in the statutes under the Oil and Gas Act.

I was just using the Water Quality Control Commission regulations or not regulations but standards as examples, because those standards were set for New Mexico

conditions and they differ a little bit from the Public Health standars for drinking water, for example, in a couple of constituents.

Again, it's useful to look at those as a comparison against what -- as some sort of a number to start from to compare how bad the discharges are.

Q And essentially the Commission's determination to study produced water flows from its duty to protect the fresh water resources.

A Yes, that is correct.

Q Okay. Could you please explain for us, Mr. Buys was talking about the fact that the committee had decided that the immediate vulnerable areas in the northwest part of the state were those aquifers or areas along rivers where there is water at less than -- at 50 feet or less. Could you explain the rationale for that determination?

A Yes. As I was getting to a little bit further in my techinal testimony a little bit later, the reason for this is that the shallower water is clearly at risk in -- from this disposal. I'm going to elaborate on some of these, but it goes back to what I mentioned before in the Lee Wilson report, too, that this area has shallow water which means that travel times are shortened for the materials getting to water. It has a characteristic, it does not have in general low permeability materials. It doesn't have the caliche like you see down in the southeastern corner of the state. It has sands and gravels in the

vadose zone, or the unsaturated zone, as it's also called.

All of these give -- give rise to having a --looking at that area first. Many of the wells in the San Juan Basin are at that depth, or thereabouts, so this first cut at protecting these vulnerable aquifers used -- used 50 feet as a working number so that we could look at these wells individually, and again, that was based on the fact that it is the most vulnerable, area most vulnerable to contamination from percolation downward.

Q So essentially there's been no determination that water deeper than that is not vulnerable, but in the short term for the committee to work on, 50 feet or less was most vulnerable --

A Yes.

Q -- and something needed to be done?

A Yes, and I think that it's important to emphasize that in the definition of vulnerable aquifer, the definition of 50 feet was -- was also followed by a definition of unconsolidated, or aquifers existing in unconsolidated materials.

So there are additional safeguards, but again, 50 feet is a good number for working from this information.

Q Okay. Mr. Buys stated that the committee had been unable to come to a consensus as to small volume discharges; that generally many people on the committee felt that small volume discharges should be allowed but they were

unable to agree on the amount of discharge or specifically how they might be handled other than on a well-by-well basis.

Does the Division have any recommendations to make in this regard?

A Yes. I feel, as Chief of the Environmental Bureau, that -- that there should be no small blanket exemption for small volume discharges, and I'm going to present some technical testimony as to why I feel that way.

In general you may have -- there are a number of problems, and I'll just discuss some of those briefly, but -- and then I'll discuss the technical reasons.

Aside from technical reasons, the type of discharge that goes from both the primary separator and the dehydrator contains hydrocarbons that are -- that have high levels of toxic materials, as I testified just a few minutes ago, arsenic and benzene, and so on and so forth.

The difference is mainly in volume but you still may have a drip that comes out a relatively small volume but it has very high concentrations.

So small volume along does not provide for much protection.

There are also some administrative reasons. If we wanted to do a permitting program from a standpoint of taking a look at individual unlined pits within the vulnerable area, I think that it would take a large quantity of staff time and also it would take a -- it would

take a lot more information from the operator to give us the type of information as to how much is actually going into the pit, what is the quality, and so on and so forth.

Those are briefly my views, and I'd like to go on to the technical testimony, give you some technical back-up for why I believe that small quantity discharges pose a risk, as well as large quantity discharges.

I'd like to introduce another figure. It's labeled Figure 2. It's a general soil map of the San Juan Basin and it -- Figure 2 is from the Soil Conservation Service, the Department of Agriculture Soil Survey, and I just want to briefly discuss that the figure, if you take a look at the area labeled 2, you'll see it goes along the river areas from Farmington up towards Bloomfield and Blanco and up to Aztec and up to Cedar Hill.

If you take a look at the map units down below, you will take a look at the association, the soil associations that are called the Fruitland-Riverwash-Stumble. Deep, nearly level to moderately steep, well drained to somewhat excessively drained soils that formed in alluvium and Riverwash, on fans and in valleys.

The next page of Figure 2 gives a little bit better explanation of what is meant by that definition.

I think the key word there is -- is drained and excessively drained. In that particular case it gives a rather qualitative indication of permeability. In other words, if you add water to the soil it moves into the

soil. It doesn't stand and pond like you'd have if you had a clay -- clay layer or something like that. It actually moves into it.

And they say it's deep and well drained, which means that it's well developed and throughout that well developed stage it is drained and is drainable.

That is sort of a general soils map and I have additional discussion that I'd like to get into that will discuss the individual characteristics within the area.

The area shown on that soil map, that Area 2, follows very closely along with the area, the vulnerable area that we're talking about in this exhibit over here. Which exhibit is that?

Q Two.

A That's Committee Exhibit Number Two.

So I feel that it's very good justification to discuss in detail the individual soils within this particular area, and the general statement I made is that the vadose zone, or unsaturated zone, provides little protection for small quantities or large quantities, for that matter, of discharge to the subsurface.

Consequently, I'd like to enter into the record Table 1, which is entitled Properties of Soils in the San Juan River Valleys.

Q Okay, and let's list this as Exhibit Four.

A I will discuss briefly this table. It is

five pages of different types of soils on it, and the sixth page is interpretive information. The soil name and map symbol are given and the acreage in the soil survey area, and that's the entire soil survey area, so it's possible there are additional areas outside the vulnerable area that are included in this numbers of acreages, but generally my review of the San Juan Basin, or San Juan County Soil Survey Manual, shows that most of this acreage is indeed inside the vulnerable area.

A listing of the depth and the texture, and I see one mistake right up at the top there, that should be zero to 5 inches for the Ap soil instead of zero of 51.

The texture in that particular soil is a clayloam.

The permeabilities are given from the tests that the Soil Conservation made and are listed in tabular form in the manual, so those are the vertical permeabilities and it also can be called the infiltration rate of those particular soils.

And as a hydrologic soil group, C, which is defined on page six of the table, and it tells what the infiltration rate is, or qualitatively describes the infiltration rate, and some other qualitative information about the particular soil.

The soil location is also given on that page six, and that's listed, for example, that first soil, it's a floodplain and low river terrace, and there are some

limitations listed in the soil survey for the particular use of different things.

Now in this case unlined pit suitability, meaning unlined sewage pits, but it wouldn't matter, it has a severe limitation to the wetness and floods. In other words, it has a real shallow water table, 24 to 60 inches seasonal water table.

If you go through and take a look at these individual soils, you'll see that for the most part once you get below the top, what's called the A horizon, you get into more permeable materials, sand, loamy sands, gravelly sands, I can just go through, sandy loams, but permeabilities are -- increase also, 4-to-12 feet per day permeabilities and they have severe limitation because of seepage. Unlined pits have severe limitations because of seepage.

So what the bottom line of the summary of this particular table shows is that the soild in the vulnerable area are indeed, for the most part, coarse grained and do have limitations for controlling infiltration into the subsurface; in other words, infiltration is very rapid.

At this time I'd like to introduce this Table 2.

Q Let's designate that as Exhibit Five.

A Table 2 is entitled Application Rates for Pits of Various Diameters and Variable Discharge Rates.

What I did here was, it's time to explain

how -- what my thought process is -- was on making some of these calculations.

Based on what I've seen up in the San Juan Basin, a lot of the fluid that comes out of the separators, before -- it just doesn't go into the pit from the end of the pipe. It has something called a swirl pot that decreases the amount of pressure and essentially sprays the fluids over a certain area.

It depends on -- I'm sure it depends on the pressure and the design of the swirl pot as to how far it goes, what that area is.

So I took a diameter under the swirl pot of 2 feet, 3 feet, and 4 feet, for purposes of calculations.

Then I also took estimations of the rate of discharge into the pit. In other words, it dumps 5 barrels per day, 1 barrel per day, 1/2 barrel per day, or maybe 2-1/2 barrel -- gallons once a day and that might be based on the volume inside the separator and only dumps once a day, so it dumps 2-1/2 gallons.

If you make a calculation over that volume over that area, it tells you, if you had an impermeable pit, what the depth of the water would be on that -- on that area; in other words, how much water at the end of a day would you have.

If it dumps 5 barrels per day to an area of 2 square -- to an area with a diameter of 2 feet, you'd have a depth of 8.9 feet if you had no -- if you had a liner

or something like that.

Now, you can compare that rate of application to the permeability rates that I gave in Table 1, and the conclusion I draw from doing that is that at depths beneath 6 to 24 inches most permeabilities or most infiltration rates exceed, and in some cases greatly exceed, the application rates; therefore ponding will not occur under natural conditions, and I'm just talking here about the reason why you see pits so dry is one, you may indeed have a lack of water, but two, your infiltration rates are so -- so large that the water soaks right in, and this is -- I'm just talking about the water phase here and if you get oil you can have other -- other complications, but if we just talk about the separator is working properly and you're disposing of your disposed water.

So that's why you see dry pits, is those two reasons. One, small volumes. Two, high infiltration rates.

I'd like to introduce another table and that's Table Number 3.

Q Which we'll designate as Exhibit Number Six.

A Before I read the title I just want to make one additional comment about Table 3.

There was some speculation aboaut evaporation and flash-off playing a role in removing some of these materials before it reaches into the -- gets into the

ground, and Phil Baca, the Environmental Engineer for the Division will address some of those issues in his own testimony later on.

Anyway, getting back to Table 3, the title of Table 3 is Days to Complete Saturation of Material Beneath Pits (Assuming storage and No Movement.)

Now, this is sort of just a table that I put together just to -- in one way it a rule because we know that ground water is moving downward, we know that ground water isn't being stored at the bottom of this pit, at the top of the water table, and so on and so forth, but just to get an idea of how long it would take to complete some saturation beneath the pit at the rates we're talking about.

And given some basic information I made a little table using these different diameters, again 2, 3, and 4 feet; depth of the water table, H, is 10, 25, and 50 feet; the volume of the discharge, or the volume of the actual -- the volume of the storage area, in this case it's the volume, cylindrical volume of material times the depth of material times your velocity, and in this type of materials we're assuming a porosity of .25. You could assume .20 or .30 and it wouldn't make much of a difference.

Your porosities in this type of material range right around 15 to 35 percent and so it's ballpark figures, anyway.

But what it shows is if you had no movement out of this imaginary cylinder that goes from the bot-

tom of your pit to the top of the water table, at 5 barrels per day you fill up that cylinder in .3 days for a 2-foot diameter pit.

Even for small quantities over a small diameter, if you had one dump per day and you had no movement out of the -- that imaginary cylinder, it was take 117 days to fill up.

My conclusion on all of this is that even if you did have some sort of storage in the vadose zone due to capillary storage and so on and so forth, it would fill up, and it's just -- this table is more an illustrative table to show that this storage is very finite in this unsaturated zone.

I have three more tables and they're all stapled together so I don't know if you want to label them one exhibit or not.

Q Yeah, we'll label that next exhibit, Exhibit Seven, and why don't you explain those for us and what's contained in them?

A All right. Tables 4, 5, and 6 give some basic hydrology, or hydrogeology for the river valleys up here and the reason for that is once it moves to the water table, you've got to know something about the hydrology to make some estimates of where it will be moving, and so on.

Table 4 is entitled Ranges of K for Alluvial Material in River Valleys, and it's just a straightforward compilation of different permeabilities and I got it

out of several textbooks.

One of the interesting things was that there was a pump test done that was reported in a recent publication, Hydrologica Report 6 by the Bureau of Mines, and it was done in the vicinity of the Farmington on a coarse-grained portion of the Animas, and it had a very high permeability, permeability on the order of 2500 feet per day of -- of movement.

The actual values of permeability can range from 25 to about 2500, so for purposes of illustration in the next couple of tables, as I discussed, I used a permeability of 25, permeability of 250, and a permeability of 2500 feet per day.

To actually get the actual water movement you have to multiply the permeability times your hydraulic gradient, and hydraulic gradients are given in Table 5, which is entitled Examples of River Gradients, Farmington and Vicinity. This is all a part of the same exhibit.

And in the absence of additional information, you would just -- you just make an assumption that ground water flow gradient is the same as the river gradient in the shallow ground water area near the river. In other words, the ground water flow will be sub-parallel to the -- to the river bottom and you will end up with a gradient that is approximate to the ground -- to the river gradient.

And I just made some calculations from some topo maps and came up with a gradient of about .0023

average for the San Juan and about .0041 average for the Animas and .059 for the La Plata. That was only one measurement, only had one map.

And Table 6 just shows you some of the rates of ground water movement, the average linear velocity in some of these river valleys based on the information that I've just -- just mentioned, and again the actual average linear velocity is your permeability times your gradient divided by your porosity.

If you just wanted the average flux or the average volume going through it, you wouldn't use porosity, but the -- you use porosity to get an average linear velocity of your -- of your travel.

And using those values of permeability that I mentioned, 25, 250, and 2500, you come up with average linear velocities of .24 feet per day, 2.4 feet per day, and 24 feet per day.

So if you use a range from .24 feet per day to 24 feet per day, you can probably come up with some idea of ground water, rate of flow of ground water movement in the San Juan River.

For the Animas River it's a little higher, .41 feet per day to 41 feet per day.

And those values are as good a ballpark estimates as you're going to get based on the available hydrological data and certainly their order of magnitude, and when you're dealing with the different composition of the

subsurface down there, it -- it certainly is well within the reported literature values for this type of material.

In other words, you have three orders of magnitude that you have to take a look at just to get a range of what happens with this stuff.

Anyway, that's Table 6.

The last table -- the last table is Table 7 and it's titled Estimation of Ground Water Concentrations.

Q And for the record we'll denominate this as Exhibit Eight.

A Now, just to get a quantitative estimate of concentrations of this stuff might be in ground water, you had to make some assumptions, and some of them we can discuss later. I will discuss later some of the assumptions, but I'll just lay them out to start with.

First off, you have this imaginary cylinder going from the bottom of this pit, whatever diameter you choose, 2 to 4 feet, going down to the top of the water table.

At the bottom of the water table this imaginary cylinder discharges into the ground water.

Now, for purposes of , again for very simplistic model, you assume that the ground water mixes with the pollutants that are coming down and comes up with -- you come up with final, some final rate of concentration, some final dilution. You're just talking about dilution here. It's called a mixing model. You're not addressing

some of the other types of character -- attenuations that the subsurface may undergo. It's a simple -- just a simple mixing model giving you a firsthand glance as to what may be happening down there.

And the first page of the table shows you the basic mixing equation. I won't go through all the terms except that the first term, the $C_i Q_i$, C_i is the initial concentration of your contaminant. In this case it is zero in the ground water for benzene. In other words, I'm assuming benzene is not an actual constituent, so therefore you have zero concentraton for that particular term.

The other types of things are self-explained in the table.

I used an average effluent of -- concentration for benzene of 14 milligrams per liter based on the average of the nine produced water samples.

I used an estimated concentration of 10,900 milligrams per liter total dissolved solids for the estimated concentration of TDS.

I ran the simple model at 5 barrels per day discharged to ground water, 1 barrel per day, 1/2 barrel per day, and 2.5 gallons per day.

And the results are given on pages two and three of this table.

For different pit diameters of 2, 3, and 4 feet, different permeabilities that I already mentioned of the ground water of 25, 250, and 2500 feet per day, the bot-

tom line is that the concentration of benzene in the ground water for a pit of 2 feet in diameter in a -- discharging into a ground water having a permeability of 2500 feet per day, still exceeds the ground water standard, not by much, but it still exceeds the standard.

So you -- this -- this shows that at least using the simple mixing model, which is the best data I have to date, as little -- to discharge as little as 2.5 gallons per day of -- of fluid containing benzene at 13 milligrams per liter will cause ground water to exceed ground water standard at -- at the boundary of this imaginary cylinder.

By the way, for purposes of calculation, I used a depth of 25 feet of contaminated -- for mixing of the contaminated zone. That 25 feet is based on information from the Environmental Improvement Division that indicates that on some recent product spills they have found gasoline contamination, and I'm talking about dissolved constituents in the ground water at depths up to 25 feet.

Even though hydrocarbons are quite light and usually float on top of the water, dissolved hydrocarbons move with the ground water and mixing and dispersion can occur.

For total dissolved solids it's a little better, little better situation.

I used an average of 740 TDS and that was based on the samples of the ground water on a study done on

the Aztec area, and in any event smaller quantity discharges or larger quantity discharges do not appreciably affect the total dissolved solids in some of these areas.

Again you can take a look at your numbers for your different effluent concentrations in gallons per day and you can come up with some numbers here.

The same holds true for pits of 3 feet diameter and 4 feet in diameter. That 4 feet in diameter discharging 2.5 gallons per day, in other words one separator dump per day, using this imaginary model, even at a very high conductivity of the aquifer, you -- you just come under the ground water standard. You come down to 0.008 milligrams per liter benzene.

So the bottom line, as far as I'm concerned, is that small quantity discharges have the potential to pollute ground water using this -- this -- these assumptions that I have made here.

I think that you could go out and do studies elsewhere and maybe come up with some harder numbers and use some more sophisticated models. This committee did not have time to do all that. I think if you did do a site specific study you'd probably end up with a site specific number, which may or may not be applicable to a site a mile away or even a half mile away.

I'd like to make a few points here, a few additional points, before I close this -- this portion of my technical testimony, and one o the things that was mentioned

or was asked earlier of Marty was what contamination have we seen. What has -- what's out there? And we have the one case where there's a limited case and we suspect it could be from this particular gas well out in the area.

And while there are a number of characteristics of the unsaturated and saturated zones that could delay seeing some of this stuff, and I'd like to introduce at this time Figure Number 3.

Q Which wse'll call, refer to, as Exhibit Number Nine.

A Figure Number 3 is from an API publication, Number 4149, and it just talks about oil spills, in this particular case they're actually talking about spills, but it's illustrative in a couple of ways.

If you have -- if you have a combination of water and oil coming out of the dehydrator and going into a pit, it will theoretically form sort of a type of a diagram or type of a characteristic shape as shown in the top part of that Figure Number 3, where you have some fluid hydrocarbon floating on the water table. This is especially true if your separator or whatever, it may not be working at top efficiency and you are getting some oil spill over into the pit.

The dissolved or soluble materials, the soluble materials will dissolve into the ground water and that is illustrated by the cross hatched or the shaded area beneath the water table showing the zone of ground water

contaminated by soluble compounds, and that more or less goes along with what I was saying that -- about EID finding 25 feet or contamination at 25 feet beneath a spill or product leak.

Beneath the top figure you can see the effect of stratified soil with varying permeabilities, what sort of effect that has on your -- on your waste. If you have a fine grained material you're going to have it spread further out before it starts moving down. If you have a coarse grained, it's going to go down.

The imaginary cylinder I talked about just had one homogeneous material in it and you didn't have any stratification; however, if you look at Table No. 1 you'll see that some of the soils do have stratification at depth and stratified layers, so you can expect that there will be some movement aside from straight downward.

Well, given all that, you know, why didn't we see more contamination. I've already said that you've got, at least by just strict mathematics, you should have lots of contamination down there.

You know, why not? And the questions is that we may not have looked for it enough. We have -- we have a case here in Flora Vista that we're going to try to go out and do some work here in a couple weeks and do a little more looking around that particular well area.

But, you know, there may be -- this is a case of where you have a water supply system with a large

drawdown or a large flow, and a cone of depression intersecting a flume of contamination. You may have -- you may have domestic water wells out there that are close by a contamination flume but the flume may not have reached it because you don't have a pumping rate that's great enough to expand your cone of depression and draw the contaminants into your water.

So that may be one reason we haven't seen any.

Another reason is that the model I was talking about assumed complete mixing and this occurs only after some distance traveled and after some time. It depends on the various types of -- of geologic material before you can actually make the determination.

But you may actually have areas, very localized areas of higher contamination that -- that you wouldn't be able to pick up using such a -- such a method.

The contaminant flume could be moving faster or slower due to the geology. I mentioned that you have some -- may have some high rates of movement. The stuff may be moved out away from a particular zone and even though you may put monitor wells around it you may -- you may not catch some of the dissolved constituents, especially if you're out of the influence of the -- of any residual hydrocarbon areas.

There are some mechanisms in the subsurface for containment and attenuation of these things. I'm

going to discuss those briefly and -- and give you my view as to why they are not important in this particular area, but they need to be mentioned because I think that, again, people need to know what type of things are going to be acting on this stuff to try to make it less toxic once it gets into the waste environment.

And by the way, a good reference for this, in case anybody's interested is Groundwater Monitoring Review, Fall, 1983, an article entitled Organic Compounds and Groundwater Pollution. It talks not only about hydrocarbons but also about organic, other types of organics.

Anyway, the major mechanisms for attenuation of this -- of these contaminants are sorption, volatilization, degradation and dilution.

Now, in sorption your subsurface solids of organic matter, your clay materials and amorphous hydroxides absorb your organic solutes.

As some examples, PCB's and DDT, and those type of nasty stuff, are absorbed a lot quicker than the type of thing that we're looking at as far as benzene. So benzene has a relatively low absorption compared to some of the other typs of toxic organics that you sometimes worry about in the subsurface; however, in addition to that, especially in a sandy oil -- sany soil with low organic matter, you would even have less absorption than you would have normally.

Now the area that we're talking about

here, especially on the Animas River, is a high -- is an area where there's been high energy deposition of boulders and a lot of stuff like that from the San Juan Mountains, and you may not have as much of a developed clay and other types of materials as you might, say, along some parts of the San Juan River, where you have the washes dumping in from the south.

In any event, yeah, how this all affects absorption is unknown, except that in the sandy zones you have less absorption than where you have high clay and high organic matter; therefore, based on what I've seen on some of this area, I would expect less sorption than I would in other areas, say, in the southern part of the San Juan Basin.

The statement we were talking about, the second one is volatilization. This particular article mentions that loss due to volatilization is considered insignificant in ground water, so if there's any volatilization loss, it's lost before it gets into the ground water rather than after and Phil's going to discuss some of that a little later on regarding the volatilization of the stuff.

Degradation, bugs, in other words, usually, bacteria can act on this stuff in an aerobic environment. Some of the oil companies are using land farming as -- to break down some of these organics.

In an anaerobic environment it's a different story and degradation only occurs slowly in anaerobic

environments.

So if you have an anaerobic environment down there you probably don't have very much in the way of degradation.

And that really leaves the last one, which is dilution. If you have a generally low ground water velocity mixing and dust dilution is not very common, and where you have areas of coarse material and higher velocities of ground water flow, then dilution can be an important constituent towards removing these materials to below levels that are toxic, but again, you can't always count on it because of the wide range of permeabilities you may have. Indeed, high permeabilities but you go over a short distance away and you get low permeabilities.

I'd like to conclude this portion of the technical testimony by reading a statement into the record from a textbook, Freeze and Cherry's Grondwater, and it states here:

Problems of groundwater quality degradation are difficult to overcome. Because of the heterogeneities inherent in subsurface systems, zones of degraded groundwater can be very difficult to detect.

The United States Environmental Protection Agency has reported that almost every known instance of aquifer contamination has been discovered only after a water supply well has been affected. Often by the time subsurface pollution is conclusively identified, it is too late to ap-

ply remedial measures that would be of much benefit.

From a water quality viewpoint, degradation of ground water often requires long periods of time before the true extent of the problem is readily detectable. Long periods of groundwater flow are often required for pollutants to be flushed from contaminated aquifers. Groundwater pollution often results in aquifers or parts of aquifers being damaged beyond repair.

And I think that that will conclude that technical portion.

Q Okay, thank you, Mr. Boyer.

You testified that you recommend that no small volume exemption would be permitted at this time.

Could you explain for us, if the Commission would decide that some small volume exemption is needed, what guidelines you would recommend for such exemptions, even though you've stated yourself that you're not in favor os such exemptions?

A Well, I believe that a small quantity blanket exemption wouldn't work, just based on the fact that the conclusions itself of the committee is that you have the -- site specific conditions must be looked at. Let me get that conclusion.

It says a determination of the probability an unlined pit may have in contaminating vulnerable aquifers depend on the hydrological, geological, soil and geochemical conditions at individual pit sites, and I stres-

sed the words "individual pit sites" there.

So as far as a blanket exemption, I wouldn't, you know, again that -- I feel that is not the way to go.

However, if they are to be considered by the Commission, we want to look at the same things that we looked at in the permitting aspects.

We want to take a look at the soil and geologic characteristics, texture infiltration, soil types, drainage, so on and so forth. We want to take a look at water quality of both the receiving water and the discharged water, and we want to take a look at the TDS and the organics, as I've discussed here.

I think that we need to know what types of things go into the pit and how often they go into the pit. In other words, the information we have now may not be adequate. In fact, I'd say I don't think those figures are adequate to base a small volume on; just saying zero on the report when there may be actually a very small quantity dumped. I think we need to know what that quantity is and how often it occurs.

So I think that that means any type of a blanket exemption, we need to have some sort of an accurate methodology for measuring flow and how often. What is it going to be based on, a month or a maximum daily discharge or how is it going to be measured and how frequently. I don't have answers for that right now but they're considerations

that need to be addressed in any blanket exemption.

I think you also need to ask your -- if you get a blanket exemption, I think there would have to be some demonstration that you're right in giving the demonstration -- in giving the exemption. Would they have to perform groundwater monitoring, as an example? I don't have an answer for that, but I mean how do we know if we're right or wrong in giving a small quantity blanket exemption?

Groundwater monitoring is one way of doing it. You put in a monitoring well and take a sample and on some sort of routine basis have it analyzed; submit the reports to the Division for analysis.

I'm not recommending that one way or the other. I'm just saying that is one way to make sure that if you give an exemption, that you actually don't screw up the groundwater.

I think we're talking about things that are going to need increased staff consideration. You're going to need people to review what's -- what's happening out there. You're going to need inspectors, these type of things, and I think that staff constraints and time and budget constraints are pretty thin right now, so the Commission would have to take a look at, you know, how much more money would they want to put into this type of -- of program to make sure that we actually did the right thing by giving a small quantity blanket exemption.

Q So essentially you're saying that if an

exemption procedure is set up, that it has to be balanced against the amount of staff time that would be needed to monitor it.

A Right, that's one of the things that would have to be balanced, right.

Q Okay, thank you.

I just have one other question to clarify what you said earlier.

At the beginning of your testimony you stated the Oil Conservation Commission was obligated to protect fresh water sources. I assume from the fact that the committee has recommended that for the time being, at least, only the so-called vulnerable areas would be subject to the no-pit rules, that in reality this is not a recommendation which would absolutely protect fresh water resources, but it is one meant to protect those resources which are being used most by communities and by individuals and that if they pollute it, it would cause the most damage in the sense of having to come up with alternative sources.

It's not a blanket method of protecting fresh water resources.

A Right. It is not the end of it. One of the things that we want to take a look at is the, you know, the disposal in the other areas of the Basin; that's what the long term committee is going to do and maybe the long term committee should also be charged with taking a look at some of the alternatives, too, to this type of thing. Do

you want me to discuss some of those?

MR. TAYLOR: Would the Committee like to hear that?

MR. STAMETS: I'm not sure we'd like to hear that before lunch.

A Well, actually, it's relatively short and not too, you know, five minutes at the most.

MR. STAMETS: Let me ask a question at this point.

Are there going to be questions of this witness?

MR. KELLAHIN: Are you suggesting we should let him go?

MR. STAMETS: Just trying to be certain that there are going to be questions.

I think at this --

MR. KELLAHIN: Mr. Chairman, I think we might take a break so we can decide in the lunch hour to what extent we need to ask Mr. Boyer additional questions.

MR. STAMETS: This would be an outstanding time to take a break. Do you think 1:15 will do it today?

MR. TAYLOR: Could I get my exhibits submitted first?

MR. STAMETS: Yes, before we take the break, the exhibits will be admitted.

(Thereupon the noon recess was taken.)

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

I believe your witness had a few more things he wanted to say.

Q Mr. Boyer, you said you wanted to talk for a moment, I believe, about the alternatives to --

A To the unlined pits.

Q -- the unlined pits.

A Yes. Just wanted to let you briefly go over the types of things that the Division has been looking at as alternatives.

Number one is the, when you talk about unlined pits, you can only think of lined pits and that type of installation. We do have some current specifications for lined pits and current specs are used mainly down in the southeastern part of the state for any lined pits in the area that's under Rule 3221.

In general those pit specifications aren't going to be changed much with the revision, but the significant thing about that is there will need to be some sort of a leak detection system so that we can make sure that the pit actually is not leaking and is actually performing as designed.

Phil is going to talk a little bit more

about some of the pits later on.

Another alternative that some of the companies are already using up there is -- is tanks of one type or another. I know Amoco has been putting in some fiberglass reinforced tanks and some of the other folks have other types of installations.

The tanks will have to demonstrate integrity to -- to the satisfaction of the Division and the Division hasn't set up standards as of yet for that, but the type of thing we're looking at is some sort of test, integrity test, dipstick test, I suppose it could also include a double liner, double lined tank, and stuff like that.

Careful metering for in or out flow is another possibility.

One of the questions that I was a little worried about regarding any of the tanks up in that area, buried tanks, was an inclusion under the new, what's called by EPA the LUST program, Leaky Underground Storage Tank Program, and EPA has just promulgated some initial regulations and one of the exemptions listed in the regulations is as follows. Quote:

> Exemptions. Liquid trap or associated gathering lines directly related to oil and gas production or gathering operations. Unquote.

I don't represent myself as a lawyer, but common sense indicates to me that that would possibly -- that would likely put those type of tanks we're talking

about under the LUST program.

That's all the comments I have on it and all the testimony I have.

Q Okay.

MR. TAYLOR: And that's all the questions I have.

MR. STAMETS: Are there questions of this witness?

Mr. Carr.

CROSS EXAMINATION

BY MR. CARR:

Q Mr. Boyer, I don't know what exhibit this is. It's the exhibit that has the water analysis on six wells.

A Yes, sir.

Q Could you tell me on each of these wells where the sample was actually taken? Is it from a separator or a pit, and if so, what kind of pit?

A Okay. I have those notes. I have those notes in my field book and up in the office. I don't have them right with me, but I can provide you with that information.

Q And we'd like to know not only where the sample was taken but as to a pit, if it is other than a produced water pit, you might note that.

A Right.

Q I suspect they all are.

A Right. I think that what I want to do before the next hearing, hopefully in the next week when I get the samples from the January sample analyses back, I want to put it all together and that would be in part of it, including where the sample was taken and the situations.

Q If we go to the second page of this exhibit, does that depict sampling from four individual wells? Is that what that's intended to indicate, or a common site from another well?

The sampling station, I don't know if you meant an individual well or what.

A Right. Based on -- based on what I read, it would be individual -- locations at individual wells because each one of the sections is different.

Again, I can get that information --

Q Now, on the fifteen wells that you've just recently received the data on --

A Right.

Q -- again would you be able to give us information on whether or not those -- where those samples were taken?

A Certainly.

Q Do you happen to know offhand whether any of the samples were taken from pits other than produced water pits?

A They were pits which produced water went

into. There were some other samples taken up there that wouldn't be included with this that I was -- that I took -- took a sample from one of the landfills up in that area.

Q Have you any samples on, you know, in-line drips, pits at that type of location?

A Yes, I have one sample up there.

Q Can you make that available also?

A Yes.

Q Will we have those prior to the next hearing?

A Yes. Again, I would hope to get them to you within the next week, as soon as I receive the remainder of the data from the Scientific Laboratory Division.

Q As to this exhibit, could you tell us how these individual wells were selected?

A Well, the -- I was not involved in the April 6th, 1984, sampling; however, the other wells were selected in September and the ones in January, what I wanted to do, my methodology here was to get different wells from different formations and compare the different formation water so that we've have the characteristics of the different types of waters that would be expected to be produced with the oil and gas.

To that extent we worked with the company and with our District Supervisor in Aztec in trying to identify some of those wells.

Q Did you individually select these?

A Did I individually select them? No. I had the opportunity as we visited wells to sample, the first sampling in September I didn't have enough bottles, so I didn't sample every single well we visited.

I tried to get a wide range of formations.

Q If we looked at the first page of this exhibit and look at the Valdez A-1-E Well, you have the Chacra formation under that.

A Yeah.

Q Is that the only sample that you have studied so far on the Chacra formation?

A I'm not -- don't recall whether one of the ones we got in January was from that formation also or not. Up until that time this is the only information I have.

Q If we go back to the samples that were taken in April, you indicated that you did not -- it was not your decision to -- you did not select the individual wells, is that correct?

A In April, right.

Q Do you in fact know who made that selection?

A I believe the representative of the OCD at that time did.

Q And who would that have been?

A That would have been Oscar Simpson.

Q Now on the fifteen samples that you're going to make available to us, the data for which you've just received, did you witness the taking of the samples on each of those wells?

A Yes, I took them myself in each one of those wells.

Q All of the fifteen?

A Yes.

Q Thank you.

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

MR. KELLAHIN: Yes, Mr. Chairman.

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Boyer, I'd like to ask you some questions following up on Mr. Carr's questions on the Exhibit Three document.

I guess I was confused earlier this morning. I thought these samples represented on Exhibit Three were samples that were taken under your direction or specifically by you, and I guess only those on the first page --

A That's right.

Q -- were samples under your control. All right, sir.

When we look at the samples from the six wells on the first page, am I correct in understanding that those samples were all taken directly from the separator flow?

A Again, I would have to get my notes. That was my intention.

There may have been one, and I think it was the Amoco Gallegos one that we actually either took it from the pit or had to somehow get it out from the end of the swirl pot, whereas Tenneco ones we actually were able to open a little stopcock on the -- on the separator itself.

Q On the Gallegos Well, if it was taken from the production pit, it was taken from the pit immediately after we dumped the separator into that pit.

A Right. My recollection is that we were struggling to get a barrel or a bucket under it so we could get a sample. In fact, it may have been just -- just above the pit.

Q When we look at the tabulation on that page one and we look at the station, am I correct in understanding that the "D" refers to a Dakota producer?

A Yes.

Q And the Chacra is obvious. The Kmv is a Mesaverde producer?

A Uh-huh, that's correct.

Q Would you describe for the record, Mr. Boyer, what is the process of taking an acceptable sample as

a hydrologist?

A Okay. When we are taking a water sample we have several steps that we have to go through.

First off is that you have separate sampling containers for organic and inorganic materials, and in fact in the inorganics you actually have additional separate containers.

The items of interest that we sampled here were general water chemistry and your heavy metals and your purgeable aromatic hydrocarbons.

The process used for the general water chemistry was to take a clean cubitainer, about a quart size, rinse it out, rinse out the cap, take the sample, cap the sample. No preservatives are added at that point. The sample is labeled and shipped to the laboratory with a data sheet so that they can make the appropriate analyses.

The heavy metals are preserved, taken the same way with a separate cubitainer and preserved with 5 milliliters of nitric acid, concentrated nitric acid to prevent precipitation of the metals into the -- into the cubitainer.

The third item we're looking at is the hydrocarbon concentrations. We use duplicate 40 milliliter glass vials with Teflon caps. The glass vials are cleaned in between sampling by the State Laboratory Division and also they throw away the Teflon caps and put new ones on.

Those are filled up to the top as -- as

close as possible so there's no head space and cap is screwed down so you don't have any air bubbles. There may be some air entrapment that comes out later that does produce an air bubble, but when we close the sample we make sure that there's no air entrapment.

Now, the different -- there are different -- we take these, we keep the hydrocarbon samples cooled down to about 4 degrees Centigrade with ice bath, or something like that, and ship it to the lab.

The other samples we generally try to keep cool but there's -- the general water chemistry is not very sensitive to temperature changes at those concentrations we're looking at, several thousand TDS, and the other one we try to keep cool, but most of the stuff comes out of -- stays in solution by the addition of the -- of the acid.

So that is the general procedure for taking these samples.

Q Once the -- and were all the six samples depicted on the first page of Exhibit Three taken in the acceptable manner you've just described?

A Yes.

Q After the samples are taken, then, what then did you do with those samples?

A I hand carried them to the laboratory in Albuquerque.

Q All right, which laboratory would that have been?

A I should say that's the Scientific Laboratory Division of the State Health and Environment Department.

Q And in your opinion as an expert, is that an acceptable laboratory from which to obtain accurate and reliable analysis of those waters?

A Yes, it is.

Q With regards to the fifteen samples that you took in January of this year, did you follow the same procedure that you've outlined for us that you conducted in September of '84 on the first six samples?

A Yes, I did.

Q Is the sampling of the next fifteen in January samples that were taken from the separator or from the production pit directly after the separator was dumped?

A I tried to get a sample from the pit and a sample from the separator to compare what changes may be between the pit and the separator.

Q And you will give us indications of which ones --

A Again, all the data, right.

Q All right.

A And I will try to get indications of this on this Table 21b also, what the situation was with those samples, because I have some notes on that.

Q When we turn to the second page of Exhibit Three, these, as I understand, are samples that were not

taken under your control or direction. They were taken by Mr. Simpson?

A Right.

Q Are you able, sir, to testify based upon your experience as an expert that the samples taken by Mr. Simpson were subject to the same kind of stringent controls that you took the first samples?

A I do not know the controls or conditions under which Mr. Simpson sampled. I would, if I may add, however, he was -- he had been trained in the particular -- particulars of sampling, so I presume he would have done it correctly, but I have no direct knowledge of that.

Q None of those samples on Mr. Simpson's list were taken under your direction and control?

A That's correct.

Q All right. When we look at Exhibit Number Seven --

A Okay.

Q --halfway down on the page on the left side of the diagram you've shown for the average benzene value that you've taken nine San Juan Basin produced water samples.

A Uh-huh.

Q Which of the nine from Exhibit Three go into the calculation?

A All of the -- all of the benzene samples listed for produced waters, the one that was excluded is the

benzene that's listed for condensate, 20 North, 12 West, Section 29.

The other nine were included.

Q All right. On the first page under the benzene for the Cornell Well there was no test for benzene.

A There was no test because I ran out of sampling vials. That was the last one we tested.

Q All right, so we've got five on the first page and then we have four of Mr. Simpson's on the second page.

A Right.

Q To make the nine.

A Uh-huh.

MR. STAMETS: Mr. Kellahin, in your last question you were referring to Table 7?

MR. KELLAHIN: I'm sorry, Exhibit Three is the samples. Table 7 is Exhibit --

MR. STAMETS: Eight?

MR. KELLAHIN: Yes, sir.

Q When we look at the average value used in the calculation on Exhibit Eight, which is Table 7, the average value of seven San Juan Basin produced water samples for the TDS value, which seven were used to make the average?

A All of the samples on the first page of that exhibit plus the one that is listed on the second page.

Q All right, sir.

A I would like to emphasize that any number could be put in the equation as far as -- to come up with a final concentration. These were just a methodology to take a look at some averages and that's why I averaged them all together, realizing that I have one that is quite high, one that is quite low.

Q I understand. When we look at the calculation, then, the K value, which is the permeability value --

A Right.

Q You have for purposes of the calculation used a K value of 25 feet, another one of 250 feet, and a last one of 2500 feet.

A Right.

Q You gave us a reference, I think, in Exhibit Seven, which is Table 4, about how you came up with the K value or the permeability value.

A Uh-huh.

Q And if I --

A The range.

Q Say again?

A The range of values.

Q The range of values, yes, sir.

And when I -- when I look at Table 4, am I correct in understanding that the only aquifer test we have from a well is this pump test on the McMahon No. 1 Well.

A That is correct.

Q Based upon the only actual aquifer test value from this McMahon Well, which of the values on the tables for Exhibit Eight represents those that closely approximate the reality of that permeability value?

A Well, I would have to say that I chose a range because based on my experience in hydrology, you would have a range, depending on the particular fluvial depositional patterns in the -- in the Basin area.

I think the range of 2500 feet per day is adequate for a well that is probably very close to the river. In fact, one of the notations on the aquifer test was that after several hours the boundary effect of recharge from the river was noted in the aquifer test, which indicates that it had a very direct connection with the river.

So that K is probably very representative of that area.

Q Could you tell us where the McMahon Well is, Mr. Boyer?

A The township and range and location is on there. I'm -- I didn't have the quadrangle for the Farmington section when I put this up and I wasn't able to plot, you know, whether it's two miles east of town or north of town or whatever.

Q Your note on the exhibit shows somewhere in the vicinity of Farmington?

A Right.

Q Have you actually visited that well?

A Oh, no.

Q All right.

A That was reported in Hydrologic Report Number Six.

Q You gave us a reference earlier this morning to, I believe, an EID study or some data about analyzing water well samples to see if there was benzene present in those water samples.

Could you give us a more complete reference to that source?

A Well, unfortunately the thing I have from EID says simply Volatile Organic Sampling Results, and I know the thing that -- about it is that even though there is no specific date on it, I know it was done last spring, the results published last summer, and what they did was they went out and tested all the water systems in the State, all the community water systems in the state, to take a look for trihalomethanes (sic) and also for volatile organic hydrocarbons.

Q I wonder, sir, if you could also make a copy of that available to us so that we'll be using the same reference material that you are.

A Certainly.

Q Apart from that EID study are you aware, sir, of any other studies or surveys that have been made in the San Juan Basin about hydrocarbon contamination of ground

water?

A The Environmental Improvement Division has been doing two different types of hydrocarbon studies.

One is the study of petroleum product contamination of groundwater by petroleum product hydrocarbons, and the other one is organic contamination other than hydrocarbon contamination.

Q Do either of those studies include the examination or study of produced water into unlined surface pits?

A That would be in the organic contamination study and that is not available yet. It's still undergoing in-house review.

Q In looking at Exhibit Eight and calculation, does the calculation take into consideration the diameter of the pit?

A Just a second let me get my -- yes, it does.

Q And for purposes of making the calculation, then, you assumed a pit diameter of 2, 3, or 4 feet.

A That's correct.

Q I assume, sir, that you're estimating that area of an unlined pit that would be saturated by the dumping of the produced water from the separator.

A That's correct.

Q All right. Have you measured the area that you would believe to be effected in the pits when you

went around and took your samples?

A Not specifically measured. I did notice which of the -- how much of the area was wetted or appeared to be wetted and it appeared to me that the -- dependent on where the position of the swirl pot is, but it appeared to me that the area that was wetted was directly beneath this swirl pot and that would probably on a diameter of several feet.

Q I'm trying to understand the basis of using 2, 3, or 4 feet, and what is that?

A That is just essentially, if you have a separator that dumps into a swirl pot to reduce the pressure and the stuff sort of sprays out over the area, wets an area, it doesn't, you know, wets more than six inches and it probably doesn't go much more than 4 feet across, and so in between there you have a range of values that may be wet, depending on how much water is coming out, the pressure, and how far off the ground the swirl pot is.

Q In taking your samples did you develop data by measuring the area of saturation on the surface for each of those pits?

A No, we did not.

Q We were talking, or you were talking this morning about the rate at which water would flow vertically into the ground.

Could you explain, sir, the relationship, if any, with the rate that water will flow vertically in the

ground as opposed to the horizontal migration?

A All right. Yes. The vertical rates that I talked about here were from the soil survey. They -- they developed them, they presented them, and I'm not sure of all the specifics of how they -- how they got them. I presume they did them through some sort of percolation test or infiltration test, and that may be buried somewhere in the report, but I'm not sure about that.

However, in general, your horizontal permeability of your unconsolidates sediments like this are an order of magnitude or about ten times higher than your vertical permeabilities, so your groundwater flow would be faster horizontally than downward.

Q What portion of your calculation takes that fact into consideration?

A That is not taken into consideration in the -- in the calculation because I used the figures given by the Soil Conservation Service, and again, those figures were actually numerical numbers that they developed and I would presume that would be the actual rate, or the range of actual rates of permeabilities, vertical permeabilities.

Q You told me earlier that we have the EID samples of water from water wells that have not shown benzene levels in excess of the standard.

A In excess -- they have not shown benzene levels at all from the water levels -- I mean from the water wells. Not detected.

Q Based upon your experience, what or how many samples would you consider representative with respect to analyzing the existence of quality of the groundwater when we're looking at a vulnerable area that has approximately 300 water wells in it?

A I think you want to look at what you're analyzing for. I think that -- I think that in this particular case as far as to hydrocarbons is concerned, benzene is not a natural constituent that is found in ground water.

The -- so I think that it should be enough to demonstrate that point.

Regarding TDS and some of the other --

Q Excuse me, but I didn't understand your answer. If I'm interested in hydrocarbon contamination or benzene levels, how many wells would I sample to have a representative group in a vulnerable area?

A I don't know if you would actually need to sample any wells, because it is not a natural constituent of groundwater.

Q All right, let's take that one step further. If I wanted to have a representative sampling of the water wells to see if they were contaminated, or subject --

A Okay.

Q -- to contamination from unlined pit use, what would be a representative sampling?

A I can't answer that right off the top of my head.

Q How would you go about arriving at a number? You said you couldn't do it off the top of your head. What method would you use to come up with a percentage?

A Oh, I think you'd probably want to decide what sort of a confidence interval you'd want to choose; maybe do some statistical testing, some (not clearly understood) testing, to see if you have -- take a control sample, or something, and maybe compare that with the number of wells that you might have to sample to make some sort of a statistical determination.

That is something that I'd have to look into. It's been a little while since I've done any statistical stuff like that.

Q Let's talk about a period of time. If we're going to sample water wells to see if they've been contaminated for hydrocarbons, can you give us the length of time it would take, approximately, to come up with a plan?

A Come up with a plan of sampling?

Q Yes, sir.

A Statistical, that would be statistically valid?

Q Yes, sir.

A Oh, several weeks, thirty days. I mean it wouldn't take too long, I don't think, to come up with -- formulate a plan based on the information. There's literature information as to what is -- what sort of statistical samples, statistically valid sample you'd want to choose,

and all that type of stuff.

Q Once we came up with a plan within, say, thirty days, for that process, how long then would it take to actually conduct the sampling so that you were comfortable that you would have representative samples?

A Depend on the sample size you chose, obviously. It would depend on that and the access that you'd be able to get, whether you could get to all those wells, and everything else.

I presume it would probably take some -- some time and staff effort.

Q Have you gone through that process yourself?

A No, I have not statistically gone through that process.

Q In order to have a representative sampling from the oil and gas wells in the vulnerable area, we've got 1200 of them, I guess, is an approximation.

A Uh-huh.

Q What would, in your opinion, be a representative sample for the chemical analysis of water produced from those wells in order to have a representative group of -- for those well?

A More than one. I am not --

Q Would you need all 20 -- there's 12, 1200 wells?

A No, we wouldn't need all 1200 wells.

It's the same type of statistical calculations that you would make. What are you trying to determine, at what confidence limit -- intervals, and then you can come up with some sort of a number N that you want to use; random selection, and so on and so forth.

Q We tried to talk about a representative sampling for hydrocarbons or benzene levels. Are your answers the same if we're testing for TDS? Or can you give us what you think would be representative samplings for TDS?

A I think that we already have a large number of TDS samples from individual wells at water supply systems. They're on record.

We would have to do less of an effort to get TDS than the other type of constituents because they have already been documented.

We'd probably want to hit domestic wells and so you'd be reducing by some percentage the total number of wells that actually would have to be sampled.

Q Can you give us some estimate of a range of numbers of wells or percentages that you would want to have in your data base?

A Not, not right off the top of my head. I feel that as far as TDS is concerned we do have quite a few representative, you know, several dozen analyses in this Chemical Quality of New Mexico Community Water Supplies for the San Juan County and around the Farmington area.

You could go through this and make a, you

know, an analysis as far as average and standard deviation and see. You may already have enough information there after you look through that.

Q Okay. You have not yet done that, have you, sir?

A No, I have not. I did not attempt to go through and try to make a determination of how many wells I would need to determine on, to get TDS. I do know that of all the wells that I have seen in the shallow alluvium, it is -- the TDS is less than 1000, and that is the ground water standard.

If you wanted to use 1000 as a limit, as an upper limit, then you could -- could proceed from there and you wouldn't have to test any more wells.

Q You indicated this morning that you were going to undertake further study and testing at the Flora Vista well. Would you describe for us what you propose to do?

A Well, the actual, specific details aren't all in place yet, but we would like to try to delineate the extent of contamination, existing contamination, out there; put in some monitor wells, if possible, to get some sample values, and somehow try to get an estimate of not only chemical quality but also the hydraulic gradient; pump the existing contaminated well, the well that is thought to be contaminated, to see if it is still contaminated. If we can get some aquifer parameters we can do some time of travel

type things, and generally do a hydrologica investigation that might tell us whether or not either the remainder of the water supply wells are in danger or whether any nearby domestic wells are in danger.

Q Do you know, sir, what the current status is of the Manana Gas Well?

A I don't know what the current status is, no.

Q When do you propose to undertake that additional study of the Flora Vista well?

A The best tentative date that I have now is the last week in March.

Q That is not information, then, that we will have available either to you or us prior to the next hearing in this case?

A Yes, that is correct, it will not be available.

Q To make sure I'm clear on the Flora Vista study, is that a project that you are undertaking by the Oil Division or is that to be made a part of the study of the Commission's Water Study Committee?

A No, this is a joint cooperative project that the Division's going to undertake with the Environmental Improvement Division.

Q All right, sir.

A And it is separate from the Committee's Water Study Group; however, the results of any study will

be, of course, made available.

Q Apart from the EPA and the OCD, who else will participate in that study?

A The EID.

Q I'm sorry, the EID. Who else?

A The Water Users Association.

Q Could you describe for us what type of contaminants were found in that Flora Vista well?

A The information I have is a copy of a table that I received from the Environmental Improvement Division listing a sample date of August, 1983, and at that time the biggest contamination was 32 milligrams per liter, almost 33 milligrams per liter, of oil and grease.

It had a concentration of 0.4 phenols and a detected aromatic purgeables, but there's no quantification limit given. It's less than .01 for aromatics.

Q Did they analyze for oil or grease or phenols in any of those water samples?

A In the other samples?

Q Yes.

A No, they just --

Q Produced water samples?

A Oh, in the produced water samples. No, phenols were not analyzed for and neither was oil and grease.

The oil and grease, usually when to took the sample there was a -- it could come out as sort of a two

phase, and we tried to distill off the two phase part of it, and the lab, when they took their samples, went and got the actual dissolved phase versus any residual oil that may have been in the top of the area, the top part of the water vial.

Q One final question, Mr. Boyer. Were two phases visible in the samples in the produced water data?

A Were two phases visible?

Q Yes, sir.

A No. As I said, there was -- we tried to keep them, we tried to keep them separate. There may be a little, a little oil globule entrapped in the -- in the 40 milliliter vial, but we try to keep -- get the water phase and discard the condensate or any -- or any oil phase. In fact they have a name for that type of oil phase, and to the -- we did our best to eliminate that, and most of the samples that we got, with the exception of a little bit that may have been entrained were free of any two phase, distinct two phase separation.

Q All right, sir. Thank you very much.

MR. STAMETS: Are there other questions of the witness? Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q Mr. Boyer, were company representatives available and present or allowed, invited to be present, for samplings that were taken in September and in January?

A Yes.

Q Did any of them object to the sampling procedure that was used?

A No. They were all very cooperative.

Q Was there water standing in any of the pits that were sampled?

A Yes, there was.

Q Could we then presume that water that was standing was not pit water that had been freshly dumped but perhaps had accumulated over a certain period of time?

A Yes.

Q From the previous question, was there free oil, then, that you got in your samples that you took out of the separators initially?

A Initially there was free oil. If we gather from the separator we attempted to make sure that the water would overflow and the oil would go out and we still had some little globules, but we tried to get as much oil as possible away from any sampling that we did, and in fact, to that end, something I might want to mention about the sampling itself, is that for each one of the wells that we sampled in, in January, we took a clean Mason jar, a clean glass jar, and used that to actually collect a sample from the end of the swirl pot or if need be, from the pit itself, so that we didn't have any cross contamination between a sample from one pit and another; each sampling device was cleaned individually.

Q And therefore you analyzed only the

hydrocarbons that were dissolved in the water.

A Yes.

Q That would seem to indicate that the hydrocarbons that were actually dumped in the pit were in a larger quantity than the amount that was sampled because of the free oil that was removed from the sample, is that correct?

A You want to run that by one more time? I'm not sure I understand it.

Q Would that indicate, then, that there was more free oil, or more oil dumped with the water that went to the pit than was indicated by the sample?

A Oh, yes, the samples, again, were designed to sample produced water and not the -- not the oil, and there was -- there was oil, free oil, standing in some of the pits.

Q Would that then indicate that there was more benzene in the fluid that was in the pits than was contained by the dissolved -- that was contained in the water?

A It would depend. It would depend to some extent. One of the things that I mentioned earlier is volatilization. It doesn't occur in the groundwater, as such, but there may be some movement of benzene and such out of that oil scum at some time.

If you just have pure drip, though, it is -- it is very high in benzene and it would be higher than the water, but as far as what the composition of the scum

itself is, I am not real sure.

Q Are you familiar with any other instances of groundwater pollution in the San Juan Basin, aside from probably oil and gas? This would be from any processes, mining, or whatever?

A There's a whole slew of potential and existing problems up there from different types of waste disposal, improper waste disposal. It goes everywhere from septic tanks and nitrate problems to uranium tailings and improper disposal of those types of waste, and there's a lot of -- there's a lot of different types of improper waste disposal.

Q Therefore we're addressing only pollution that might occur from oil and gas activities as a preventative measure, is that correct?

A That is right.

MR. CHAVEZ: That's all the questions I have.

MR. STAMETS: Any other questions of Mr. Boyer?

Mr. Shuey.

MR. SHUEY: Thank you, Mr. Chairman.

QUESTIONS BY MR. SHUEY:

Q Mr. Boyer, in reference to sampling procedure for the hydrocarbons on January 11th, you talked

about 40 milliliter glass vials.

A Uh-huh.

Q Could you explain to the hearing record precisely what, how you put the sample into those vials, starting with the water that you took from the separator into the Mason jar and then into the vial?

A All right. It's easiest when it comes directly from the separator, when you have a little stopcock that, at least on some of the Tenneco ones that we used, you can just open it up like a little valve and just let it drain into the vial.

What you do is you let it drain into the 40 milliliter vial until it overflows, and then just turn it down to essentially just to a drip and that lets the air that's in the sample that went in first sort of come to the surface, and you let that just sort of sit there for about 30 seconds, or so, until most of the air has -- has popped out, the entrapped air, and then you just let another drip or two go and put -- put the top on so you don't have any -- so you won't introduce any air bubbles, screw it down and put it in the bag.

Q Why is it important in these particular samples not to have any air in it?

A We don't have any free -- you don't want to have any free spaced because then one of the things that can happen is that you can get movement out of the sample into the free space of some of the dissolved constituents in

other words. If you let something on the surface equalibriate (sic) with the air that doesn't contain it, it will tend to move from that surface into the air.

Q Does that have to do with why we call some of these hydrocarbons volatile?

A Uh-huh.

Q When you took these samples in the 40 milliliter glass vials, and -- well, did you notice at any point in time that you had what appeared to be an oil/water or a hydrocarbon and water phase in the vial, and if you did notice that, what did you do with that particular sample?

A Well, to the extent possible, and it happened a couple of times when we tried -- especially when you get it out of the swirl pot, or something, we just kept pouring the sample, say, from the Mason jar into the vial and very slowly, and what happens is that the -- the stuff that's flowed in on top of the oil is sitting on top and will eventually just sort of flow over the side of the bottle and you're left mostly with your produced water versus any scum or anything like that.

As I said, there was always a little bit that may be stuck to the bottom of the, just little droplets here and there, but to the extent possible, we tried to remove all of that.

Q Thank you. Those little droplets that might have clung to the side of the bottle, do those significantly affect the hydro -- the dissolved hydrocarbon or

purgeable aromatic content of that particular sample, or a particular sample?

A I have not seen any data on that.

Q To the best of your knowledge?

A To the best of my knowledge it would not significantly affect it. We are dealing with numbers here that are in the range of 8 to 20, or so, milligrams per liter benzene and that would -- I would find it hard to believe that a little droplet would have that much of a significant effect on it.

And I'm not sure we're dealing with -- we're not dealing with droplets that drip here, we're dealing with some droplets of paraffin and other types of things that have longer and different types of organic molecules than the volatiles.

Q Okay. Thank you. To then summarize that, correct if I'm wrong, but to summarize that, what you're saying is that in these 40 milliliter glass vials for the hydrocarbon samples, you try your best to get nothing but produced water in this vial, correct?

A That is correct.

Q Okay, thank you. In your Exhibit Number Three, the produced water sample table, (not clearly audible) you'll notice in the column, the last column, for the Florence 37A, on the first page --

A Uh-huh.

Q -- there's a value of 50 across from the

parameter TDS.

A Uh-huh.

Q TDS is total dissolved solids, is that correct?

A Right.

Q Is the measurement of total dissolved solids supposed to be representative of all the dissolved constituents that are in a given water sample?

Well, what does TDS mean? What does total dissolved solids mean?

A All right. The actual -- TDS is sort of a misnomer these days. It's actually total filterable residue. Okay, and the way they do that is they evaporate off the water, or liquid, and then they weigh the residue and that, they calculate from that what is the -- what is the residue, and in this particular case, in this particular case, if they heat it up to, oh, I think 180 degrees Centigrade, you'll lose your organic fraction, so what you're left with, your inorganic things, your heavy metals, your major cations and anions and salts, as your TDS.

Q Okay, your cations and anions and salts.

A Right.

Q Calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, fluoride, those are what you would describe as major ions?

A Right.

Q Okay. Is it -- if you had not done these

tests, okay, or even if you had done them, which you said you have, to verify the reliability of them, would you simply add together some of the dissolved -- some of the milligrams per liter values for the individual parameters and see if they come close to equaling the TDS?

A Right. You can -- you can get TDS from two -- two methods. You can add the major constituents, as you just labeled, or else you can do it by the evaporation and residue method. Okay.

Now, there's another check you'd make and you just -- you do your actual mole fractions or equivalent fractions and balance those plus or minus.

Q Okay, thank you, and just looking at this column, if you were to add up the parameters bicarbonate, lead, benzene, toluene, already would those not equal more than 50 parts per million or milligrams per liter?

A Yes. But I've already said that the TDS is not representative of your benzene and toluene, because they would -- they would go off.

Q They would go off. Okay.

A The measured value of TDS.

Q Right. Did you have that particular sample analyzed once or more than once?

A Well, it was only analyzed once but there were two different determinations of calcium and magnesium and both of them were extremely low, which indicates that the sample as a whole, the number as a whole is correct.

Q Okay, so then given all that, do you have any reason to believe that there is anything wrong with -- with the data or the values there were given for any of those parameters in that particular sample?

A I have no reason to doubt any of the numbers.

Q Well, good thinking. We've heard you testify, I think you used the word "suspected" in this Flora Vista water well problem.

A Uh-huh.

Q We heard you testify that you and the Environmental Improvement Division and the Flora Vista Water Users Association would be conducting a hydrologic study of the site in a month or so. I'm interested in knowing why -- what basis you and the EID have had throughout this time to call this, the contamination of this one water well "suspect", or even remotely related to any of the facilities related to the Manana Gas Well next door.

Could you explain that for the record, why is it that -- why is that gas well even remotely connected to the contamination of that water?

A Well, I'll make several comments and I would possibly ask that you direct some questions to our District people, because they're more familiar with the particular situation up there; however, to my knowledge, that's the only oil and gas well, or natural gas well that close by the system. In fact, it's only yards from that particular

well, I forget exactly how many, and the unlined pits were even closer than the wells, and, of course, the fact that they found oil and grease on top of the -- on top of the water in an area where there's no other activity, there's no dumping, there's no landfills, there's no illegal type of disposal out in that area.

Q By activity you mean not only general waste level activity but hydrocarbon activity --

A Well, that's --

Q -- or what?

A They are the only well close by. I don't know what the next well is, how close the next well, but I didn't see another well when I was out there, just that one.

Again, I'd suggest that if you need something more specific you might want to talk to the Aztec field people.

Q Okay, I think there is one more question that you may have personal knowledge of.

Do you know, based on either conversation with the folks in Flora Vista who use that well or through conversations with other people who are familiar with the case, how this particular contamination incidence of the water well first came to light?

MR. KELLAHIN: We object, Mr. Chairman. That calls for a hearsay answer from this witness as to what he's been told by others.

MR. SHUEY: Well, I asked him

from his personal knowledge. Isn't that okay?

MR. STAMETS: Mr. Boyer, do you have any personal knowledge of how the contamination problem was first observed in Flora Vista?

A No, sir.

Q Fine. Now, Mr. Boyer, you testified that the Flora Vista water well that was contaminated had 33 milligrams per liter oil and gas --

A Oil and grease.

Q -- or oil and grease; .4 milligrams per liter phenols, and aromatic hydrocarbons were detected but there was no value given.

A It was less than .01 milligrams per liter given.

Q Less than .01 milligrams. That particular data that you have, where are you citing those from?

A This is an attachment to a letter from Anthony Drypolcher, Bureau Chief of the Groundwater Hazardous Waste Bureau, to -- oh, before I speak any further here -- it's a cc on a letter from Tony Drypolcher, Bureau Chief of the Groundwater Hazardous Waste Bureau at the Environmental Improvement Division, to Mr. Marty Buys. The date of the letter is December 7, 1984.

Q In that letter are there data for other parameters besides phenols, oil and grease, aromatics, on that piece of paper you're looking at?

A Yes, there are.

Q What would -- are there a parameter for arsenic, for instance?

A Yes, there is.

Q What would that result have been?

A 1.56 milligrams per liter.

Q Do you know what the State standard for arsenic in groundwater is, the health standard under the Water Quality Control Commission regulations?

A It's in the standard over there. I'm not sure which one it is, exhibit.

MR. KELLAHIN: Mr. Chairman, I'm going to object to that question. There's no proper foundation to establish arsenic contamination has any relationship based upon hydrocarbon contamination. It's irrelevant in this case.

MR. SHUEY: Mr. Chairmam, Mr. Boyer has testified this morning and earlier that he has sampled for numerous constituents in produced water. He has -- including all heavy metals. He has testified that -- that there are wide ranges of those kinds of constituents in produced water, and we have asked him questions about why this Flora Vista case is even being brought up, and it's precisely because of the presence of the gas well nearby.

Okay, and you know --

MR. STAMETS: Was your question as to what is the State standard for arsenic in produced water?

MR. SHUEY: Yes.

MR. STAMETS: I think that the witness can and should answer that question.

MR. SHUEY: May I hand him a copy of this?

MR. STAMETS: Yes.

A I'm impressed. My answer is that this is the groundwater standard under the -- State standard for groundwater. I believe it's the same as the drinking water standard by -- published by the USPE and adopted by the State.

Anyway, the standard is 0.1 milligrams per liter arsenic dissolved.

Q How many -- is that less -- is that less than 1.56 parts per million that you quoted from the sample for the water well?

A Well, the sample is, let's see what that was, the sample is about 15 times higher than the standard.

Q Thank you. In your -- continuing in your column of parameters from the water well, do you see a parameter for mercury?

A Yes, I do.

Q And what is -- what is its value?

A 0.63.

Q 0.63 what?

A Milligrams per liter.

Q Milligrams per liter. Again could you

tell us what the State standard is for milligrams -- for mercury?

A The State standard for total mercury is 0.002 milligrams per liter.

And the reported value is about 300 times the State standard.

Q Mr. Boyer, in your experience and longevity as a geohydrologist, have you had to deal extensively with the chemistry of various waste products, such as produced water, and generally chemistry of groundwater, both that which we drink and that which can be used for other sources?

A General water chemistry, yes.

Q General water chemistry. Have you in your experience seen drinking water with a concentration of 1.656 parts per million arsenic that was of natural causes? Or naturally occurring in the groundwater?

A Drinking water?

Q Yes.

A Or other types of water?

Q Drinking water?

A I can't recall any. This doesn't mean I haven't seen any or there might not be some in the literature, but I can't recall any.

Q Okay. Mr. Boyer, you -- I may not have heard quite correctly, but did you state in your response to a question Mr. Kellahin stated, there were or were -- that

there were phenols and oil and grease in the gas well separator pit nearby?

A I didn't. I didn't speak to that at all. I said there were oil and grease and phenols in the samples that had been collected on August, 1983.

Q Okay. Well, I'll ask you the question then.

Do you know if there were phenols and oil and grease detected in waters in a pit next to the separator on the same date of that August, 1983, sample?

A I think there were some analyses made of that but I don't have them before me.

MR. SHUEY: Mr. Chairman, I'd like to show the witness a copy of a data sheet that I believe has that information. I believe that it has that information because the numbers that are -- that he has been quoting from his sheet supplied to him -- or supplied to Mr. Buys by Mr. Drypolcher, those numbers for the water well are identical to the numbers on this sheet here, and there is a column next to the column I'm reading from on the water well that is identified as oil/water separator next to the gas well.

Would you like to see this?

MR. STAMETS: I will wait for Mr. Kellahin to speak.

MR. KELLAHIN: Mr. Chairman, I am going to object to this line of questioning.

If I recall correctly, this witness has concluded if not once, on several occasions today that he cannot reach any conclusion about the source of contamination for the Flora Vista well because the data is not available to him, and that is the purpose of the continuing study.

It is pointless to ask this question to this witness about what is the status of the data when he's already concluded he's examined it and can reach no conclusion.

I think we're wasting our time.

MR. SHUEY: Well I, Mr. Chairman, I didn't ask him to make a conclusion on whether he thought the water well was contaminated by the oil and gas well or pit.

I'm just asking him some questions about the data on which he's been qualified to speak.

MR. STAMETS: What's the purpose of this line of questions, Mr. Shuey?

MR. SHUEY: Well, unless I'm mistaken, I thought that I heard in questioning by Mr. Kellahin that Mr. Boyer said that he either did not know or in fact stated that there were no parameters such as phenols, oil and grease, detected in a pit at the oil -- at the oil and gas well.

I stand corrected if that's not what I heard correctly.

MR. KELLAHIN: Mr. Chairman, what I'd asked the witness and what he'd answered earlier is those standards on produced water samples, and we shifted gears rather quickly awhile ago and maybe I lost everyone but Mr. Boyer and myself. But we shifted gears and talked about the produced water samples, if that's not correct.

MR. STAMETS: I certainly don't remember the question Mr. Shuey remembers.

MR. SHUEY: All right, well, are you saying I can't show him this?

MR. STAMETS: We will sustain the objection.

A Mr. Chairman, I would, if I had an opportunity, I would address some of the problems with analyses and comparisons between analyses, and that might help or clarify some of this, what Mr. Shuey's trying to get at, if that is so the Chairman's wish.

MR. STAMETS: Well, let's just let Mr. Shuey continue.

Q You were asked a series of questions, Mr. Boyer, about the second page of Exhibit Three and you testified that Mr. Oscar Simpson had actually taken those samples.

Do you have any reason to believe -- and then you then testified that to your knowledge he had had the same training as you, or the proper training to take those samples.

Do you have any reason to believe that the data on that second page was improperly gathered or is inaccurate in any way?

A I don't know the circumstances surrounding how it was gathered. I don't have any opinion that would indicate that it would be inaccurate.

Q Thank you.

A Or any knowledge that it would be inaccurate.

Q Thank you. And then a couple of -- you -- you participated in the Produced Water Study Committee --

A Yes.

Q -- is that correct?

A Yes.

Q And you, if my memory serves me correctly, were -- I believe attended at least two of the subcommittee on mapping sessions, correct?

A At least two.

Q Okay, and then -- so therefore you participated directly in -- in the -- arriving at the method by which the committee derives the so-called vulnerable area, correct?

A Did you say directly or indirectly?

Q Directly.

A Yes.

Q Okay. We heard Mr. Buys testify this morning that there was a considerable amount of work that

had led up to the production of that map that's hanging on the wall, which is the committee's Exhibit Two, I believe, and that included in that was a series of investigations based on published literature of known water supply wells in the San Juan Basin.

Do you -- could you describe for the Commission and the record where some of that information came from, specific documents and who they were offered by?

A The two major documents we used were Hydrologic Report Number Six, which is Dr. Stone's publication from the New Mexico Bureau of Mines in Socorro. That was published, I believe, in 1983.

The second document is a brand new open file report by the U. S. Geological Survey Water Resources Division in Albuquerque, and that tries to pick up where Bill Stone left off as far as putting together a compilation of water wells, mainly domestic wells, in the portion of the San Juan Basin in the vicinity of the Farmington San Juan-Animas River Valley, that area.

The two together have an immense amount of data.

Q In your judgment is there any other data, more recent data, than those two compilations that the committee could have relied upon to determine where known water wells and groundwater use are in the San Juan Basin?

A There may be one additional source, and that would have been the State Engineer's Office. That,

that would have picked up anything more recent than the open file report I just mentioned, and also may have -- may have picked up some additional information on well types and completions, and so on and so forth.

I also believe that the Navajo Tribe probably has some additional -- had some additional information and through the representative of the tribe on the committee that was provided to us.

In general, however, I believe that the committee used the most up-to-date data available for its work.

Q Thank you.

MR. SHUEY: I have nothing further. Thank you.

MR. STAMETS: Are there any other questions of Mr. Boyer? Mr. Paulson.

MR. PAULSON: Thank you, Mr. Chairman, I'll try and speak up.

CROSS EXAMINATION

BY MR. PAULSON:

Q Mr. Boyer, you made reference several times in response to your questions by counsel concerning your sampling of produced water to your field notes. I assume those are notes that you took at the time of this?

A Yes.

Q Could you also make those available,

copies of those, to the parties, as well, at the time you furnish the other data?

A Yes, certainly.

Q Thank you. My understanding is that the report that you've rendered did not -- the report that you've rendered makes no reference to analysis of water from water wells in the vulnerable area, is that correct?

A The report, you mean the committee report?

Q Well, all of the data that you've furnished today has a volume of data from produced water samples --

A Okay.

Q -- but my understanding is that there's no data in your report that discusses or concerns analyses of water from water wells.

A All right. There are, there are two sources here as I answered earlier. One is the volatile, organic hydrocarbon samples that the Environmental Improvement, the listing of the Environmental Improvement, which I'll make available to anybody as a copy.

The second one I referenced earlier is the Chemical Quality of New Mexico Community Water Supplies in 1980. If it is necessary, this could be introduced, or both these documents could be introduced into the record, and especially this one, I'd be able to Xerox the pertinent tables and include them in the record.

Q And are there water wells from within the vulnerable area that are identified in that document?

A Yes, there are community water systems.

Q And those would give some indication of the presence of some of the contaminants that you've discussed, such as benzene?

A Well, benzene is not, to my knowledge, is given in this 1980 report.

The benzene and the volatile organic hydrocarbons are given in this particular Environmental Improvement Division report, and additionally, there is a hydrologic sheet for the Aztec area that gives some additional information on alluvial wells in the area.

Q Where would that be available? The Aztec office?

A Well, I have -- no, no, that's available from the Bureau of Mines, but I'll be willing to Xerox the table and stick that in here too, yeah.

Q If you would, please.

Does the Division plan any further testing of water wells within the vulnerable area between the time of this hearing and the next hearing?

A The Division does not plan any testing at this time; however, it has responded here in the past several weeks and will continue to respond to individual requests when there may be a suspicion that problem in a well may have been caused by oil and gas related activities.

Q So if I understand your response, there wouldn't be any further testing done on the water wells within that area unless there were further complaints filed?

A Right, right.

Q How about beyond the time envisioned for the next hearing, do you know if the Division plans any further testing of water wells either within the vulnerable area or any place else in the San Juan Basin on some sort of systematic basis?

A No, this Division is not -- does not plan any systematic water well testing.

Q Thank you. How many complaints have been received to which you have responded in the past?

A Well, in the past two months I've received two complaints.

Q Complaints from the San Juan Basin?

A Yes.

Q Could you make copies of those complaints available to us, as well?

A I don't know their status as far as confidentiality. If they are not, I don't have any problem with that. I haven't received -- I haven't received all the data back yet.

Q Were the complaints from within this vulnerable area?

A Yes.

Q And did the complaints relate to conta-

minated water?

A Possibility of such contaminated water.

Q And does the Division plan on investigating those complaints?

A It plans on -- it plans on taking samples of the water to first off indicate if there's a problem and then we'll make a decision based on what we find.

Q Okay, and what's the timetable for that procedure?

A The timetable, unfortunately, is limited by the turn-around time at the State Laboratory. I would hope that I could get some samples back quicker than I have been.

We're talking here thirty days turn-around time.

Q Thirty days to get the samples back and to analyze them?

A No, no. Thirty days to -- thirty days from the time the samples were taken to get them back with analyses from the State Lab.

Q And what about a timetable for taking the samples?

A The samples, one of them -- one set of samples is already taken and the other set should be taken in the next day or two.

Q And I assume the results of those studies when they're available would be --

A We are not planning a full scale study. What we are planning to do is take a look at the samples and see if there's a problem.

By taking a look at what is in the samples, then we can try to decide whether we have a problem with a casing leak or a pit or whatever, and I can't speak on either one of them right now.

Q Referring to Exhibit Three, I think it's Exhibit Three, at the top it says Table 21a, Northwest New Mexico Produced Waters.

A Yes.

Q There are six wells represented across the top. The second well there is denominated the Gallegos Com #94E.

A Uh-huh.

Q Do you know who operates that well?

A I think that's the Amoco well we sampled that day.

Q And we can't find that well. Is it possible that that number is in error?

A Right, I --

Q Could you make a check on that?

A Okay.

Q I wonder if it could be the 194E or something like that?

A Possibly. The table was introduced here as mainly a convenience as a compilation.

I'll double check the numbers on that one.

Q Good. Thank you very much.

Lastly, Mr. Boyer, in selecting wells for the purpose of testing produced water, was the quantity of water that was produced from such wells considered?

A Not generally. Generally we wanted to get a representative sample of the different types of water produced by the different formations.

Towards the end of the last sampling trip we went down towards Kirtland area and took some wells from the Gallup that actually produced more water than some of the other wells up near the Bloomfield area produced.

Other than that we -- we just went strictly trying to get several samples from each formation.

Q Have you since the samples were taken, checked to determine whether the samples were in fact taken from wells that produced more than a nominal amount of water or less? Have you made that determination?

A Well, I don't know what you mean by nominal amount of water.

Q Well, let's say five barrels. Do you know whether these samples were drawn from wells that produced more than five barrels or less?

A I can -- I can get such information, if you so, you know, if you want to come up or made -- have it made part of the record. Such information could be pro-

vided.

MR. PAULSON: That's all I have, Mr. Chairman.

Thank you very much, Mr. Boyer.

MR. STAMETS: Any other questions of Mr. Boyer?

MR. WRIGHT: Mr. Chairman, Mr. Boyer, has mentioned some document that he had in his possession. (Next several words not understood.)

I'd just like to suggest that he make several copies of those documents (inaudible.)

MR. STAMETS: Any other questions of Mr. Boyer?

Mr. Boyer may be excused.

And, Mr. Taylor, probably at the next hearing Mr. Boyer ought to introduce the data sheets which were the subject of the final questioning as, what, Exhibit Number Nine or Ten?

We'll take a ten minute recess.

(Thereupon a recess was taken.)

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

Mr. Taylor, you have one final witness.

MR. TAYLOR: Mr. Phil Baca.

PHILIP BACA,

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

DIRECT EXAMINATION

BY MR. TAYLOR:

Q For the record could you please state your name, by whom you're employed and in what capacity?

A My name is Philip Baca. I'm an Environmental Engineer with the New Mexico Oil Conservation Division.

Q And in the course of your employment have you had occasion to -- to study produced water and look at the findings of the committee that's been looking after this?

A Yes. My particular concern was to look at a study of evaporation rates in the San Juan County area.

I prepared a model to look at the amount of surface area that would be required to evaporate a certain amount of water given the evaporation rate data for that area.

What I did for my model is I assumed that you were going to be dumping 20 gallons a day into an unlined pit and or for that matter, you could assume it to be lined, whatever you wish.

My goal was to look at how much of that

water over a period of time would be evaporated if the water was evenly distributed throughout the bottom of the pit, and I'd like to at this time submit exhibits.

Q Okay, let's see, that's your evaporation data?

A Yes.

Q Okay, and we're going to designate that as Exhibit Eleven.

Q Okay, would you please explain for the Commission the study you did and the findings?

A Yes. The important part of this exhibit is illustrated on page seven in graphical form and I've made several copies of that graph for those who desire to take a look at it.

I took evaporation data for the months of January through December. I obtained that data from the New Mexico Climatological Data compiled by W. K. Summers and Associates, and I used the evaporation rates from this book.

I also used the precipitation rates on a monthly basis from this book.

What I did is I took 20 gallons a day being deposited into a pit of a specific surface area. I took that volume, multiplied by the appropriate factor to get the cubic feet per day and then multiplied that by the number of days in a month.

Then I subtracted the monthly evaporation rate data and I added the monthly precipitation rate data.

And if you take a look a the graph, you'll see that if you have a pit with a surface area of 100 square feet, after one year's time your pit, assuming no seepage and assuming that all of your mechanisms for mass transfer are due to evaporation, you'll see that your pit would have an accumulation of water seven feet deep.

That means that if you're depositing 20 gallons per day into the pit, that translates into 7300 gallons per year.

At the end of the year, if you have seven feet of depth inside your pit full of water, that's 5200 gallons. That means that only 29 percent of your water from that pit has evaporated.

I went a little further ahead because I wanted to see at what point you would create a non-gaining situation in a pit and I finally created a non-gaining situation if I had a pit with a surface area of 400 square feet.

Non-gaining means that if my pit did not lose any water dues to seepage or anything else and my only mechanism was evaporation, non-gaining means that I would never have to worry about that pit overflowing through the course of time.

This calculation does not take into account the appearances of any hydrocarbon-like or oil films on the top of the pond. In that case, the evaporation rate would be greatly diminished because there is only a certain

amount of water per period of time that is allowed to equalibriate into this film on top of the pit.

Q I assume just from a layman's point of view listening to what you have to say, if you had an unlined pit, what you're saying is that unless you have a very large pit, evaporation is not going to take care of the produced water, it's going to go into the ground, and if you have a lined pit, it's going to take a very large one in order to keep from building up more and more water every year.

A That's correct.

Q What other methods did you look at as alternatives to unlined pits?

A Well, I've been workin on revising the specifications for lined pits and our primary revision will entail the addition of a leak detection system and the addition of a second liner underneath the primary liner. Of course the upper liner will also have to be resistant to ultra violet light or else it will have to be covered in such a manner that ultra violet light will not degrade the polymer or membrane-like substance that's being applied.

I have also looked at some costs associated with the installation of pit liners and the cost based on some of the things I've seen, varies from $2.50 a square foot to $4.00 a square foot. $4.00 a square foot seems to give you a real Cadillac-type of design, too, so you could use $3.00 a square foot as an average.

Q What's -- there's another method of getting rid of these produced waters other than unlined pits. It could be flashing off. Have you looked at this potential for flashing off the organics in the water?

A Yes, I did, and at this time I'd like to submit another exhibit.

Q Would you please explain Exhibit Twelve for us?

A In this exhibit I tried to model a situation in which a highly volatile mixture would come out of a pipe and flash. Flashing means that part of your liquid is going to vaporize and go off into the atmosphere and the remainder of the liquid would fall on into the pit or whatever collection media you have.

What I did for my model was I tried to take a look at a situation where the greatest amount of flashing would occur. So I took a mixture of 50 mole percent benzene, 25 mole percent toluene, and 25 mole percent ortho-xylene.

I didn't add any water to that because that would just lower the potential for flashing. So I took the maximum situation.

I also took a temperature of 100 degrees Centigrade, which is slightly lower than the normal operating values that are experienced inside of a glycol reboiler.

So I took a very extreme condition. I

took highly volatile substances and I took a high temperature.

I went ahead and went through the calculations for flash evaporation, which are based on Raoult's Law. It's a pretty fundamental law in which you can calculate the mole fraction that will go off into the vapor form, giving certain parameters such as temperature and the pressure. This is a classical calculation that can be found in any chemical engineering mass transfer textbook.

After going through the calculation, I found that the ratio in terms of weight of liquid to vapor after it is flashed out would be one to one. That is, if two pounds of hot liquid that I have just described were to come out of the pipe, one pound would vaporize and go out to the atmosphere and another pound would fall into the pit in the liquid form and from there either seep into the ground, puddle, or evaporate due to the natural evaporation, or any combination of the above.

Q Okay. So could you briefly summarize what you think the findings are from the studies you've done as far as the committee's analysis of a no-pit order?

A With respect to evaporation of water, quantities as small as 20 gallons a day being deposited into a pit could not be evaporated without a sufficient amount of surface area, and in other words, a pit that's 10 x 10, has dimensions of 10 x 10 feet, would not be sufficient to evaporate a half a barrel a day of water being deposited into a

pit.

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

MR. CARR: Could we get a copy of Exhibit Twelve? Thank you.

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

MR. KELLAHIN: Not at this time, Mr. Stamets.

MR. STAMETS: Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q Mr. Baca, based on your analysis of an extreme condition, what conclusions would you draw based on a large amount of water coming off a reboiler containing small amounts of these lighter hydrocarbons?

A The amounts of liquid would increase; that is, you would be flashing off less in the form of vapor and you would have more residual liquid leftover. It's all dependent on the vapor pressures of the substances that you're dealing with, and water, for example, has a lower vapor pressure at that temperature than benzene.

So your overall amount of fluid would increase.

MR. CHAVEZ: That's all.

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

MR. KELLAHIN: Is Mr. Baca going to be available to us at the next hearing for examination?

MR. STAMETS: Yes, he will be.

MR. KELLAHIN: We'll reserve the right to have some questions at the next hearing.

MR. STAMETS: Mr. Shuey.

MR. SHUEY: I would also reserve the right to ask Mr. Baca some questions.

MR. STAMETS: All right.

MR. SHUEY: Mr. Chairman, would this be a proper time to bring up a procedural matter or two?

MR. STAMETS: Yes, I think it is. I believe we have concluded the direct testimony for the day and unless someone out there has something they feel compelled to say at this time.

I presume you have a procedural matter you want to bring up.

MR. SHUEY: Yes, Mr. Chairman. I'd like to propose, and I don't know if it's proper for a motion or just a proposal, that the time between this hearing and the next be expanded. I"m flexible to the amount of time that is.

The hearing notice says thirty days. Knowing that, at least myself and I imagine any of the other interested parties here, will want to review the

transcript of this part of the hearing. My experience is that transcripts for approximately six hours testimony, five hours of testimony, will probably take two weeks to prepare and be available.

We're looking for approximately two to three weeks additional time after March 20th for the second part of the hearing to be about the middle of April. The exact date is again flexible.

The reason being is Mr. Boyer did testify that the joint EID/OCD study of the Flora Vista would be going on and there was quite a number of questions being put to him about that study.

The Navajo Tribe will be conducting a similar investigation on tribal lands that would -- by people who were on the committee -- that would direct bearing and help to support the record or at least add to the record of the hearing.

We want to be able to have a record that puts all the available data in and unless there would be a hardship caused to any of the parties by an initial two to three weeks after March 20th, I think that the -- the additional benefits for the record would support an additional time of about two or three weeks.

That's what I'm proposing and again, I'm not proposing six months.

MR. STAMETS: You propose at least two weeks.

MR. SHUEY: Yes, sir. That's my --

MR. STAMETS: That's up to April the 3rd.

MR. KELLAHIN: Mr. Chairman, I wonder, for a point of clarification, I thought Mr. Shuey was representing himself today and he's referred to himself as "we".

Might I inquire as to whether there is more than one Mr. Shuey?

MR. SHUEY: I, Mr. Shuey, I am representing myself and I used the term "we" but it is I that I'm talking about.

MR. KELLAHIN: Mr. Chairman, the need to review the transcript, I think, is a reasonable request; however, there were no surprises here today for anyone that has participated in the last ten months of studying this process.

We have in a limbo state some 1200 wells in this vulnerable area that signify a substantial investment for a number of operators. They do not know the future of those wells and those pits within that area, and we are faced with a predicament of facing potential rules without data to show us that we pose of risk of contamination to the fresh water sources.

To say that those wells are going to be held in limbo pending the study of a Flora Vista

contamination case that's been in existence for years, seems to me to get the situation backwards.

It's my understanding the study committee has virtually resolved every issue there is to resolve with the entrance of an order, except for the small question of whether or not there is small volume exemptions or not. As I said, I don't think that is a terribly complex and difficult issue. It is one that I think we can resolve quickly and that we ought to go forward as expediently as we can, realizing that we've been at this for some ten months.

My point is, I don't have any trouble with a continuance that puts this into late March or early April but I would not want to continue this case much beyond that for my client, waiting for future studies and data that continues to evolve and develop as we learn more about this area.

MR. STAMETS: Are there any other comments relative to potential continuance to, say, April the 3rd?

MR. WRIGHT: Mr. Chairman, El Paso Natural Gas Company can live with a continuance or not, basically for the same reasons that Mr. Kellahin expressed, and for the additional reason that if some of these pits are going to have to be closed, the summertime is the best time to work on that sort of thing and every time you continue this thing it's going to be pushing into that summertime period, and we might need another, instead of eighteen

months, another two years to do all this.

MR. STAMETS: Any other comments?

(There followed a discussion off the record.)

MR. STAMETS: Mr. Shuey, would you represent yourself as an environmentalist?

MR. SHUEY: I would hope that several people do.

MR. STAMETS: In any event, I had personally wanted to stick to the thirty day time schedule to avoid any potential criticism of this Commission for delaying implementation of -- of this action if it is needed.

Since the identified environmentalist has requested a two week continuance, I certainly don't feel that we'd be criticized if we granted a two week continuance.

Also with any luck we can write the order two weeks quicker than we might otherwise.

So on that basis, we will grant a continuance of this hearing until April the 3rd and it will be, I am assuming, at the same location. If there's any change in the location it will posted on the doors out here.

Is there anything further.

MR. TAYLOR: Mr. Examiner, I moved to move the admission of our Exhibits Eleven and Twelve.

MR. STAMETS: Those exhibits will be admitted.

If there is nothing further today, then we will --

MR. KELLAHIN: Mr. Chairman, I wonder, just a point of inquiry, if the Chairman would want to request of those individuals that have set in the hearing today whether or not there are any unsworn statements that they might want to make.

MR. STAMETS: Yes, that's a good idea.

I have already had some representatives of the Cedar Hill area indicate that they are going to request that some expansion of the vulnerable area be made and they plan to present some testimony on that at the next hearing, to take in Amoco's big water pits out there in the Cedar Hill area.

Is there anybody here at this time who does not plan to be back next time who wishes to make a statement?

I see no such person.

With that, then, we will continue the hearing until April 3rd.

MR. KELLAHIN: Mr. Chairman,

this morning in your introductory comments you suggested that you might want the participants to try to identify those issues that they think will be the subject of discussion at the next hearing, and I remind you of that issue and ask you if you want to have us try to frame what we're going to do the next time.

MR. STAMETS: If anyone feels that they can do that, it certainly could be useful, but I'm not going to bind anybody on that.

MR. WRIGHT: Mr. Chairman, El Paso Natural Gas has a written statement that it would like to put in the record, but it's getting late so I'm not going to read it.

MR. STAMETS: All right, I'll just let you give that to the reporter.

Anyone or anything else?

The hearing then will be continued until April 3rd.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR

Statement of Qualifications

Name William F. Lorang

Employer: El Paso Natural Gas Company
P. O. Box 1492
El Paso, Texas 79978

Education: BSCE 1969 NMSU
MSCE 1972 NMSU

Subject of Thesis: The Hydraulics of Unconfined Aquifer Recharge, November, 1971.

Professional Registration: Registered by the New Mexico State Board of Registration for Professional Engineers and Land Surveyors and authorized to practice Professional Engineering; Certificate #5668.

Related Work Experience: Mr. Lorang was employed by EPNG June 15, 1969 and since then has worked on various water resource problems related to natural gas transmission, preparation of coal mining plans and environmental statements in the states of Oklahoma, Texas, New Mexico, Wyoming, North Dakota, Arizona and Utah. During this time, numerous monitoring facilities for ground and surface water were designed and operated and aquifer tests were performed and evaluated.

Disposition of Produced Waters

This is a statement for the record of the hearing called by the New Mexico Oil Conservation Commission to define the 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. The Oil Conservation Commission seeks to define such areas and prohibit and/or limit the disposition of such produced waters on the surface of the ground.

This statement is intended as testimony to be presented at a hearing February 20, 1985 in Santa Fe, New Mexico. The statement provides information in support of continued use of certain unlined pits in the area. The statement also urges the Commission to consider exemptions to any forthcoming order which would provide for the continued use of certain unlined earthen pits.

El Paso Natural Gas Company (EPNG) has been in business in the San Juan Basin of northwest New Mexico for some 33 years. Gas reserves have been developed through our own exploration and development, and through the purchase of gas from many other operators. EPNG operates some 5000 wells in the Basin and has tied literally thousands of others into its gathering system.

We feel that we have operated these many years in a prudent manner as good citizens and good neighbors. There are some 1966 EPNG employees in New Mexico generating about $54,000,000 combined annual income. We also pay our taxes as a good citizen must. EPNG paid in excess of $61,000,000 in taxes to New Mexico last year.

In all our 33 years of operation, we have never had a complaint of groundwater contamination from landowners or groundwater users in the San Juan Basin. This record strongly suggests that a large problem of groundwater contamination simply does not exist. If there were a problem, surely in the last three decades evidence would have appeared in one of the 300 shallow water wells in the area.

The Short Term Water Study Committee has delineated a vulnerable area which, in the committee's opinion, includes the bulk of the area now being used for shallow water supply. This vulnerable area lies principally along the river bottoms of the San Juan, Animas and La Plata Rivers. The committee also identified other "special" areas which should be protected much like the vulnerable area.

Within the vulnerable and special areas, EPNG has 547 earthen pits. These pits vary in size and purpose. Some are used for disposal of water from primary separation of water from produced hydrocarbons, others are used only for disposal of water separated and/or dehydrated from the gas stream. To replace all these pits with tankage would cost EPNG in the neighborhood of $1.8 million.

The amount of water discharged to these various pits is generally not measured. Thus, we are uncertain of the volumes of water that, over a period of time, are discharged to them. We do know, however, that many pits are normally dry while others normally contain produced water. Of the 547 pits EPNG has in the vulnerable areas, 421 of them are normally dry. We offer that if a pit has water discharged to it less than 10 days in any calendar month, it can be considered normally dry.

We feel that we have a very large stake in the protection of the State's environment and that each incident of probable contamination of the groundwwater should be checked. However, to line normally dry pits would not provide any additional protection to the State's groundwaters, but would reduce the economic benefits to our stockholders, our employees, and the State of New Mexico. Therefore, we feel that we must have a small volume exemption to the pit control order from OCD.

If water is discharged onto soil, we have all observed that the soil is wetted but after a time again dries to its original condition by evapotranspiration. Soils will dry to depths of several feet due to the high evaporation and low precipitation rates common to the San Juan Basin. If water is discharged to a pit at a frequency to allow drying between discharges, then saturated soil conditions will not exist thereby precluding the transport of contaminants.

It is our understanding that many pits in which occasional discharges containing small amounts of crude oil have been made tend to be relatively impervious due to the sealing of pit bottom and sides. In such cases, the only means available for water to leave the pit is evaporation, thus further reducing any threat to the groundwater. It is also our understanding that water in a pit must have a driving force - a hydraulic head - before significant infiltration takes place. Absence of a hydraulic head - such as in the case of a normally dry pit - would indicate that there is no threat to groundwater.

Once the water infiltrates, native soils have an affinity to adsorb various substances - crude oil being one - thus providing an attenuation of contaminant transport. If the pit lies substantially above the water table, the infiltrating water passes through a column of soil thus providing the contact for adsorption of contaminants.

In short, at least two conditions are necessary in order for a pit to be a threat to the local groundwater. First, the pit must contain enough water to maintain a hydraulic head sufficient to act as the driving force of infiltration and overcome any sealing of surface pores. Second, it must be near the groundwater table for otherwise contaminants percolating downward would be adsorbed on soil particles before reaching the water table.

We would offer that there are many pits that don't meet the aforementioned criteria for being a threat. If they lie substantially above the water table and are normally dry - receiving discharges of water less than 10 days in a calendar month, they would not contain sufficient water to effect the transport of contaminants into the groundwater. Indeed, of EPNG's 547 pits, 421 - more than 3/4 - are normally dry. Such normally dry pits should be exempt from any order of regulation.

I repeat that EPNG believes each incident of probable contamination should be checked. And, EPNG is presently inspecting all of its pits with or without a pit control order from OCD. I believe that EPNG may have pits in use today which should be lined, or replaced with a tank. But, there is the continuing problem of determining which pits are a threat and which are not. We are aware of at least three laboratories, Sandia National Laboratory, Woodward Clyde Consultants, and the Southwest Research Institute, which are working on technology to determine the leaking potential of a particular pit at a cost which the government and industry could afford. EPNG is planning to provide Sandia National Laboratories in Albuquerque with several site locations for field testing of such technologies to verify its commercial applicability.

In summary, we urge the Commission to consider the fact that there are many pits, both in the vulnerable areas and elsewhere, that are doing no harm. Those pits should be allowed to continue unlined because they meet one of two critical criteria: 1) they are substantially above the groundwater table or 2) they are normally dry.

EPNG urges the Commission to adopt as a part of any order for control of unlined pits an exemption for those pits which meet the criteria of minimal threat. By providing for such exemptions, the resources available can be utilized to address those situations where there is a real threat to groundwater and to try new technologies in detecting those situations where the threat to groundwater is not clear.

EPNG, therefore recommends that any requirement of an order to prohibit and/or limit the disposition of produced waters should contain the following language:

Exemptions: The following earthen pits are exempt from the requirements of this order.

1) Pits lying outside vulnerable or special areas;
2) Pits to which no more than 5 barrels of produced water are discharged per day except where the depth to groundwater is less than 10 feet; and
3) Pits which are normally dry, i.e. to which produced water is discharged less than 10 days in any calendar month.

Thank you for this opportunity to express our concerns with respect to the pending order.

William F. Lorang, P.E.
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