STATE OF NEW MEXICO
ENERGY, MINERALS, AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION COMMISSION FOR THE PURPOSE OF CONSIDERING:

APPLICATION OF LIGHTNING DOCK GEOTHERMAL HI-01, LLC, FOR APPROVAL TO INJECT INTO A GEOTHERMAL AQUIFER THROUGH THREE PROPOSED GEOTHERMAL INJECTION WELLS AT THE SITE OF THE PROPOSED LIGHTNING DOCK GEOTHERMAL POWER PROJECT, HIDALGO COUNTY, NEW MEXICO. — Case No. 15357

and

APPLICATION OF LIGHTNING DOCK GEOTHERMAL HI-01, LLC, TO PLACE WELL NO. 63A-7 ON INJECTION-GEOTHERMAL RESOURCES AREA, HIDALGO COUNTY, NEW MEXICO — Case No. 15365

REPORTER'S TRANSCRIPT OF PROCEEDINGS
COMMISSION HEARING
September 10, 2015
Santa Fe, New Mexico

BEFORE: DAVID R. CATANACH, CHAIRPERSON
ROBERT S. BALCH, COMMISSIONER
PATRICK PADILLA, COMMISSIONER
BILL BRANCARD, ESQ.

This matter came on for hearing before the New Mexico Oil Conservation Commission on Thursday, September 10, 2015, at the New Mexico Energy, Minerals, and Natural Resources Department, Wendell Chino Building, 1220 South St. Francis Drive, Porter Hall, Room 102, Santa Fe, New Mexico.

REPORTED BY: ELLEN H. ALLANIC
NEW MEXICO CCR 100
CALIFORNIA CSR 8670
PAUL BACA COURT REPORTERS
500 Fourth Street, NW
Suite 105
Albuquerque, New Mexico 87102

APPEARANCES

FOR APPLICANT LIGHTNING DOCK GEOTHERMAL HI-01, LLC:

Michelle Henrie, Esq.
MHENRIE
225 E. De Vargas
Santa Fe, New Mexico 87501-2703
(505)842-1800
michelle@mhenrie.com

FOR PROTESTANT AMERICULTURE and DAMON SEAWRIGHT:

Charles N. Lakins, Esq.
Lakins Law Firm, P.C.
P.O. Box 91357
Albuquerque, New Mexico 87199
(505) 404-9377
charleslakins@gmail.com

FOR INTERVENOR HIDALGO SOIL AND WATER CONSERVATION DISTRICT:

PETE V. DOMENICI, JR.
Domenici Law Firm, P.C.
320 Gold Avenue, SW
Suite 1000
Albuquerque, New Mexico 87102
(505)883-6250
pdomenici@domenicilaw.com

FOR THE NEW MEXICO OIL CONSERVATION DIVISION:

ALLISON R. MARKS, Esq.
Oil Conservation Division
Assistant General Counsel
Energy, Minerals and Natural
Resources Department
1220 South St. Francis Drive
Santa Fe, New Mexico 87505
(505)476-3462
allisonr.marks@state.nm.us

Also Present:
Darr Shannon

HEARING INDEX

LIGHTNING DOCK GEOTHERMAL CASE-IN-CHIEF:

WITNESS DAVID W. JANNEY

WITNESS MONTE C. MORRISON

I N D E X (cont'd)

INDEX (cont'd)

E X H I B I T I N D E X

Lightning Dock Geothermal HI-01, LLC, Exhibits
Offered and Admitted

OCD EXHIBITS
Offered and Admitted

PROTESTANT AMERICULTURE EXHIBITS
Offered and Admitted

(Time noted 9:20 a.m.)

CHAIRPERSON CATANACH: At this time, I will call case 15357, which is the applications of Lightning Dock Geothermal H1-01, LLC, for approval to inject into a geothermal aquifer through three proposed geothermal injection wells at the site of the proposed Lightning Dock Geothermal Power Project, Hidalgo County, New Mexico.

Call for appearances in this case.

MS. HENRIE: Mr. Chairman, Commissioners, Michelle Henrie for Lightning Dock Geothermal.

MR. LAKINS: Mr. Chairman, Commissioners, Charles Lakins on behalf of Protestant AmeriCulture and Damon Seawright, and he is seated here to my left.

MS. MARKS: Allison Marks on behalf of the Oil Conservation Division, also making an appearance in case 15365.

MR. DOMINICI: Good morning, Commissioners. I am Pete Domenici, Jr., on behalf of the Hidalgo Soil and Water Conservation District, who are intervenors in this case.

And I am here with my client. This is Darr Shannon. She is the vice president of the Conservation District. She is also a county commissioner from Hidalgo County. And I have spoken with Counsel

Brancard. At some point she would like to make a non-technical public comment. I just wanted to let you know she was here.

CHAIRPERSON CATANACH: Are we going to consolidate this case at this time with the other case?

(Non-verbal response.)

CHAIRPERSON CATANACH: Let me call case 15365, which is also the application of Lightning Dock Geothermal HI-01, LLC, to place Well No. 63A-7 on Injection-Geothermal Resources Area, Hidalgo County, New Mexico.

And are the appearances the same in this case?

MS. HENRIE: I believe so, Mr. Chairman.

CHAIRPERSON CATANACH: Are there any additional appearances in this case?

(No response.)

CHAIRPERSON CATANACH: Okay.

So just for your information, we are going to do our best to try to finish this case today. I don't know if that's possible. But I would like to advise your witnesses to be concise and not to get too far off track.

It's going to be a long day and we are going to be working a long time. So if we can just try and keep it as concise as possible that would help.

Will the witnesses in these two cases --

MR. BRANCARD: I think they'll be sworn in one by one.

CHAIRPERSON CATANACH: Okay. We will do that.

Can you call your first witness.

MR. BRANCARD: Let's deal with some prehearing matters.

We had a prehearing conference among the attorneys two days ago. There was a motion to vacate, which to the Commissioners awareness was denied by the Commission Chair, to move ahead with today's hearing.

We also have a notice of intervention by the Hidalgo Soil and Water Conservation Commission. We asked for sort of a more detailed statement from Hidalgo, and that was presented by Hidalgo. Nothing was filed in opposition to that notice. And so unless there is opposition, we want to --

MS. HENRIE: May I say something?

MR. BRANCARD: Go ahead.

MS. HENRIE: Mr. Chair, we are not going to oppose the intervention. Our concern was -- as we are setting forth the procedures and the precedent for geothermal hearings, our concern was that people would just be allowed to intervene without having standing and it could be anybody. And so that is why we raised the concern.

After receiving notice and hearing more about why they felt they had standing and their concerns, we are fine with the intervention.

Thank you.

MR. BRANCARD: If there was a notice, we will just view it as being granted.

MR. DOMENICI: Thank you.

CHAIRPERSON CATANACH: Are there any other issues?

MS. HENRIE: Mr. Chair, I just wanted to remind the Commission, we had filed an amended proposed order to have some procedural matters. It suggested that the application for a hearing be denied. Obviously, we are here at a hearing so that they are probably moot, but there are some additional procedural matters in this order that really again go to the precedent of geothermal proceedings.

Also in this order are the Oil Conservation Division's proposed conditions of approval. And we support those, don't have any problems with those. And so I wanted to -- we have copies here of the amended proposed order. Would it be appropriate to just give copies to the Commission and make sure that it's something you have a chance to consider?

MR. BRANCARD: I believe that is in the record. As it's been submitted it's in the file. So since there is no motion pending, there is nothing to rule on at this point, and it would be considered along with all the other evidence at the end of the hearing.

MS. HENRIE: So given that, Mr. Brancard, just for my clarification, are the Division's conditions of approval officially entered as exhibits or do I need to do that --

MR. BRANCARD: No. The Division did its own prehearing statement and submitted exhibits. So the Division will be the one entering those proposed --

MS. HENRIE: Are they in the record or not?

MR. BRANCARD: They are a party to this proceeding, and then they will proceed with their documents.

MS. HENRIE: Okay. We might enter those as well just to be sure. Thank you.

MR. DOMENICI: Could I have a copy of that?

MS. HENRIE: Absolutely.

CHAIRPERSON CATANACH: You may call your first witness.

MS. HENRIE: Mr. Chairman, Commissioners, our first witness is David Janney.

CHAIRPERSON CATANACH: Will the witness please stand and be sworn in.

MS. HENRIE: Before we get started, I would just like to make sort of an opening argument, just a little bit of a statement of our case.

We are here to talk about the Lightning Dock Geothermal system and the larger Animas Valley aquifer, the water-bearing zone down in Hidalgo County. It is an area south of Lordsburg. Mr. Janney will talk about it.

We feel strongly that the concern and fears of the protestant and the intervenors will be addressed in this hearing. We have some good science to explain why those concerns are -- why this project is not going to be contributing to those concerns. There's some scientific correction that we think needs to happen.

So that's what we are going to present to you today. We think it is going to be about four hours maybe, until lunch, maybe after, to get through our case.

Another matter of procedure, I would just like to suggest, Charles, we go ahead and approve all of your exhibits and witnesses and you go ahead and approve all of ours. That may save a little time.

MR. LAKINS: I don't think that's going to be a problem, and, procedurally, for saving time, I agree to that.

MS. HENRIE: And OCD's exhibits as well, I'd like to go ahead -- do you have problems with OCD's exhibit, which was the conditions?

MR. LAKINS: Well, that's in their prehearing statement, so it's part of the record.

MS. HENRIE: Okay. If that's acceptable to Commission.

CHAIRPERSON CATANACH: Is that okay?

MR. BRANCARD: Well, normally at the end of your witness's testimony, you move your exhibits, so do you want to move -- I think it would better just to do that. It's good that we don't have any problems with them. But, just as a formality, after your witnesses testify and those exhibits have been used, then you normally move those exhibits into the record.

MS. HENRIE: David is not testifying as an expert, but with my experts, do I need to tender them as well after I qualify them?

CHAIRPERSON CATANACH: Yes.

MS. HENRIE: Okay, very good. Thank you for the clarification. I will sit down if I am not offending anyone.

MR. LAKINS: Are we all going to have

openings?

MR. BRANCARD: Do your opening before your witnesses.

MR. LAKINS: Yes, sir.

MR. BRANCARD: Mr. Lakins, we think it best if you do your opening before your witnesses.

MR. LAKINS: Okay. That is what I want to do right now.

MR. BRANCARD: No, but they're doing their witnesses first.

MR. LAKINS: Oh, I see, not at the beginning of the hearing but at the beginning of my case.

MR. BRANCARD: Right.

MR. LAKINS: Roger that.

MS. HENRIE: All right. We will go ahead and proceed with Mr. Janney.

DAVID W. JANNEY

having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MS. HENRIE:

Q. Mr. Janney, please tell the Commission who you are and what you do.

A. My name is David Janney. I am a professional geologist. I'm registered in California and Wyoming. I have been practicing minerals exploration for nine years.

Q. Can you speak up a little bit more.

A. Indeed. My name is David Janney. I'm a professional geologist registered in California and Wyoming. I have nine years experience in minerals exploration, primarily focused on epithermal deposits in the basin and range of Nevada. Many of those deposits are extinct hot spring systems or fossil hot springs systems similar to the system responsible for mineralization in the Lightning Dock area.

I also have 22 years experience of environmental consulting in addition to that. I have worked on a number of projects, ground water related, geologic investigation related in California, Wyoming, New Mexico, Colorado, Utah, and Arizona.

And I have been the permitting and compliance manager for Lightning Dock Geothermal since December of 2011.

Q. And, David, are you Lightning Dock's agent for purposes of OCD?

A. Yes.

Q. So you are familiar with various G forms and permitting requirements and applications?

A. Yes.

Q. As Lightning Dock's agent, have you filed G-112 forms to permit injection wells that have been approved by the Division or the Commission?

A. Yes.

Q. Now, did you prepare the G-112 application forms that are the subject of this hearing?

A. Yes.

Q. And are you familiar with AmeriCulture's Exhibit M? And let me show you what that is.

A. Yes.

Q. And what is that exhibit?

A. This is the application package for the 13-7 and I suspect the 15-8, the 76-7, and 83-A7 are all included in --

Q. When you say 13-7, 15-8, those are different injection wells?

A. Right. Those wells are named based on cattleman nomenclature.

Q. So where they are located within a section?

A. That's correct. Each one of those cattleman squares is a 10-acre square within a 640-acre section.

Q. So when we talk numbers that sound crazy, we are talking about different wells?

A. That is correct.

Q. Okay.

A. It is basically an 11-by-11 grid that starts in the northwest corner of a section and moves down to the southeast corner of a section.
Q. So AmeriCulture's Exhibit M is indeed exactly -- it looks the same as the forms that you, in fact, tendered?
A. That is my signature.
Q. Okay. Very good.
So when you filed each of these applications was it submitted to the Division in duplicate?
A. Yes.
Q. And when you filed each, did the application include a plat showing -- I'm going to list a few things, four things -- the location of the proposed injection well, the location of all of the wells within a radius of one mile from the injection well, the perforated open hole interval in each of those surrounding wells, and the ownership of all geothermal leases within that one-mile radius?
A. Yes.
Q. For each of those four applications?
A. That is correct.
Q. When you filed each of the G-112 application forms, did each application include a log of the proposed injection well if available?

A. No logs were available. The wells had not been constructed.

Q. Okay. And the regulations allow you to not file logs if the wells have not been constructed?

A. Yes. Once the well is constructed, the logs are submitted with one of the other G forms that are required that are basically attached to the G-112, which is the application to inject.

Q. I have another long question for you so bear with me. When you filed each of the G-112 application forms, did each application include a diagrammatic sketch of the proposed injection well, showing casing strengths, including diameters and setting depths, quantities used in tops of cement, perforated or open hole interval, tubing strings, including diameters, setting depths, and the type and location of packers, if any?

A. Yes.

Q. When you filed each of the G-112 application forms, were copies of the form G-112 without the attachments -- and that's the plat, the log, and the sketch, were copies sent to all other geothermal lease owners within a one-half mile radius of the proposed injection well?

A. Yes, where applicable.

Q. Do the regulations allow you to send the G-112 form without all of those attachments?

A. Yes.

Q. Will each of the proposed injection wells be cased, cemented, and equipped in such a manner that there will be no danger to any natural resource, including geothermal resources, usable groundwater supplies and surface resources?

MR. LAKINS: Objection. Calls for an ultimate conclusion of fact and a legal conclusion as well.

MS. HENRIE: I am just for opinion.

CHAIRPERSON CATANACH: I will allow that.

A. Yes.

Q. David, what I am handing you are OCD Exhibits 1 through 8. Can you take a look at those and please tell me what they are?

A. They are the conditions of approval for the four injection wells that we have proposed.

Q. And can you tell me more? There are two sets of conditions of approval, one is for drilling and one is to place the well on injection -- or what are they?

CHAIRPERSON CATANACH: I'm sorry, Ms. Henrie, what are we looking at here?

MS. HENRIE: We are looking at OCD Exhibits 1 through 8 that were tendered with their prehearing statement. These are the conditions of approval for the injection wells. And there are copies here that I can give to the Commission if you would like.

MR. LAKINS: For clarification, that's also Lightning Dock's Exhibit 5 -- my error. I retract that. That's a tab in my personal folder.

(Laughter.)

MS. HENRIE: I do have copies here, Mr. Chairman, if you would like. We can give them to the Commission.

CHAIRPERSON CATANACH: Go ahead.

A. I believe -- the answer to your question is, yes, these are conditions of approval for both the G-101 and the G-112, which are the applications to drill and the application to inject.

Q. Okay. Do you see any corrections that need --

A. I saw one minor typographical error on the 15-8. It's unit L, not unit E, I believe.

Q. And so that is both for the drilling and the injection --

A. That is correct.

Q. Do you have any opposition to these conditions of approval?

A. No. They are very similar to conditions for approval for previously permitted and placed on injection wells.

MS. HENRIE: At the close of our presentation, we will move for admission of OCD Exhibits 1 through 8 as corrected. And, again, that correction is with regard to well 15-8. It should be unit L instead of unit E.

Q. So, David, I see that you have a PowerPoint presentation. Was this presentation prepared by you or at your direction?

A. Yes.

Q. And would you like to proceed with that. I will actually be the person --

A. Pushing the button.

Q. Yes. So go ahead and tell me when to push the button.

A. Just for the purposes of education and location, we wanted to put up a slide that shows, with respect to the southwest corner of the state, the location of the Lightning Dock Geothermal project. It's down in the boot heel, approximately 16 air miles southwest of Lordsburg.

Next slide, please.

Q. Push the button?

A. Yes, please.

This particular slide shows the location of the power plant and the well locations. It's a little less visible then I would like to have it. But it also has the regional groundwater flow in the upper left-hand corner, which is to the northwest. It's difficult --

Q. Speak up, please.

A. So the power plant is basically in the lower center of the slide, right here. The production well, 45-7, is located immediately east of the power plant. The primary injection well, 55-7, is located immediately east of 45-7.

There's a pipeline that runs from 55-7, this blue line here, up to 53-7, another injection well that's currently on injection. And that line runs over to 63-7, the other well that is currently on injection.

Q. Can I stop you right there.

MS. HENRIE: I'd just note that Lightning Dock's Exhibit 1 includes a map that you could follow along maybe a little better if you are not able to see the screen. It also shows the well locations.

Q. I'm sorry to interrupt, David. Please proceed.

A. No worries.

In conjunction with each of the wells are monitoring wells. It was a requirement of the discharge permit to have a monitoring well approximately 100 feet downgrading of each of the injection wells.

And therefore monitoring well 1-A is downgrading of 55-7. There is also, for our benefit, a monitoring well, 1-B, which is actually upgrading of 55-7. Downgrading of 53.7 is monitoring well 2. Downgrading of 63-7 is monitoring well 3.

There are two other monitoring wells on the south end of the parcel, monitoring well 6 and monitoring well 5. And there is a deep monitoring well, 47-7, in that area as well.

So these wells are upgradient of the zones of injection and upgradient of the naturally upwelling geothermal plume.

And then downgradient of the power plant, we are required to have another monitoring well, which is MW-4, right there.

The other thing I would like to point out on this slide are the locations of the proposed injection wells that were protested. 15-8 is off to the east here in State section 8. 76-7 is immediately south of the Rosette greenhouses in this area here. 13-7 is over on the west side, the northwest side of the Lightning Dock property here. And 63A-7 is actually co-located on the 63-7 pad in this area here.

The other thing I want to point out is AmeriCulture's Federal Well No. 1, which is located here, and to point out AmeriCulture's State Well 1, which is located here.

Q. So, David, you talked about monitoring wells. Does Lightning Dock monitor any AmeriCulture wells?

A. No. Prior to commercial power plant start-up, we requested, as per the discharge permit, permission to access wells on AmeriCulture property, McCants' property, and Rosette property.

That letter was sent out via registered mail if I recall correctly. And we never received a response from any of those letter recipients.

Q. And we brought this visual --

MS. HENRIE: Commissioners, we used it in 2013.

Q. David, can you just walk us through, point to some of the main features so that we are all oriented towards the site.

Where is the power plant on this? In fact, there's a magic marker. Maybe you will draw in the power plant.

A. You can see this area is nearly graded for the power plant, so it's basically right there.

Q. Where is the production well?

A. 45-7 is located immediately east of the power plant.

Q. And we've got a primary injection well?

A. 55-7.

Q. And point to that, please.

A. Immediately east of 45-7.

Q. And the other two existing injection wells?

A. And then there's a pipeline that runs from 55-7 up along this ditch, and then goes east of 53-7 and then further east to 63-7.

Q. Can you put a star where the proposed injection wells are going to be, just so we've got a picture in front of us? A big star.

A. (Witness complies.) So that is going to be 63A-7.

Q. Okay. Approximate is fine.

A. 76-7, located approximately here.

Q. So that is kind of by Dale's house, Dale McKants' house?

A. Right. South of the greenhouses.

Q. Okay.

A. 15-8 on state land.

Q. On state trust land. I'm not sure the Commissioners can hear you.

A. And I think 13-7 is going to be just off the board here, just a little bit further west. So we will put it here (drawing).

Q. Okay. And AmeriCulture property, if you could kind of just point to that.

A. Well, the lease, there's a ten-acre lease here and a 15-acre lease here.

MS. HENRIE: I will put this over here for now just if people need bearings. I will get it set up in a minute to where everybody can see it a little better. Thank you for indulging me.

Q. So are you familiar with the Lightning Dock Federal BLM geothermal mineral leases?

A. Leases, yes. We have two of them. One is for 2,500.96 acres and the other one for 640 acres.

The larger of the two is outlined by this dashed line. And a 640-acre one-section lease is outlined by that line. It's 34790 on the large lease and 108801 on the smaller lease.

Q. For our bearings, where is the blacktop highway?

A. The state highway or Geothermal Road?

Q. The state highway.

A. I think it's this line here.

Q. So that's the route from I-10 down to Cotton City?

A. That's correct.

Q. And where is geothermal road?

A. I believe this line over here.

Q. And so the Rosette greenhouses, where are they?
A. They are the white in this area.
Q. And the power plant would be where?
A. Immediately west of that.
Q. And where is AmeriCulture?
A. That green spot right there is just west of the AmeriCulture greenhouses.
Q. Okay. Thank you. I am just trying to make sure everybody kind of has their bearings.
Are you familiar with the AmeriCulture leases and fee service ownership?
A. Yes. I have seen them on maps a number of times. One is ten acres and one is 15 acres.
Q. Are they represented on the screen?
A. These pink squares here, the larger 15-acre lease off to the west and the ten-acre lease off to the east.
Q. So when you said 15-acre lease, did you mean 15-acre ownership of the fee surface?
A. Yes.
Q. So AmeriCulture owns 15 acres. The lease is ten acres of minerals from the state land office; is that --
A. That is my understanding.
Q. Okay. And so, David, in your opinion, does this proposal protect correlative rights?
A. Yes, as far as I know --

MR. LAKINS: Objection. Calls for a legal conclusion.

MS. HENRIE: One of the criteria that we are trying to prove is correlative rights. There is a regulatory and a statutory definition of what correlative rights means.

It is tied to acres. And we just wanted to present to the Commission the acres that are -- the acres of geothermal minerals that are leased by Lightning Dock Geothermal and the acres that are leased by AmeriCulture.

Q. And, David, we should probably note with regard to the 15-acre fee ownership, does AmeriCulture lease those mineral rights or what's going on with that?

MR. LAKINS: We have an objection.

MS. HENRIE: You're right, Charles. Let me withdraw that question. I am sorry.

The objection was that we had asked for legal opinion. And as I had said, there are statutes and regs that do define correlative rights, and we were trying to make a case to support those statutes and regs. And if that is a legal opinion, I will withdraw the question.

I think the Commission just needed to know what the lease acreage and ownership was.

CHAIRPERSON CATANACH: So do you have another witness that is going to further address the correlative rights issue?

MS. HENRIE: Yes, I do.

CHAIRPERSON CATANACH: Maybe we should leave that for now.

MS. HENRIE: Fair enough. Let's see. AmeriCulture tendered a background and compliance report as Exhibit E. And that is a report that was submitted by Mr. Janney. I wanted to let him walk the Commission through it. We will need a copy of it in front of him for him to do that. It has been some time since he worked on it.

(By Ms. Henrie (cont'd:)

Q. But would you just tell the Commission what was going on with the report, why it came to be what it says?

A. Right. This annual water quality monitoring report and background concentration report was required under the terms of the discharge permit that was issued for the project in 2008, so it spelled out the sampling frequency and the analytes for all the production and injection wells as well as the location of the monitoring and the sampling frequency and analyte list for those monitoring wells in addition to the production and injection wells.

So this document presents the results of all of the sampling that was done prior to commercial power generation and some of the post commercial power plant generation analytical results in the 45-7 production well and power plant discharge as well as some of the monitoring wells.

Q. So, Mr. Janney, basically, what does the report conclude?

A. If you turn to the end of the report, the conclusions in a nutshell basically say that fluoride concentrations in ground water in the Lightning Dock Geothermal area are natural occurring due to upwelling geothermal system, that fluoride concentrations in the production well, 45-7, have remained constant over the period for the samples that were collected here, basically represent -- and those fluoride concentrations range from about 12 milligrams per litre to 14 milligrams per litre, and that the analytic results also indicate that running the water through the power plant does not contribute anything to that water.

Therefore, the analytical results of the influent to the power plant and the discharge from the power plant are relatively the same as far as constituents of potential concern are concerned.

It also indicates that there is some groundwater mounding around the points of injection in the range of four to six feet. It also explains some of the interesting analytical results that were received from the laboratory for the 45-7 production well in December and January. That would be December of 2013 and January of 2014. There were three samples that were collected that had anomalously low fluoride concentrations and anomalously low TDS and sulfate relative to the other samples that were collected from 45-7; and, interestingly, anomalously high radionuclides relative to previous and post samples.

Q. So what was going on with all of that?

A. Ultimately that is explained in one of the paragraphs in the conclusions, the tubing that's used to collect the sample from 45-7 is decontaminated prior to running the sample through the tubing and into the sample container. And I believe that that deionized water was just not totally flushed from that sample tubing prior to running the sample into the sampling container. And, therefore, we have those anomalously low concentrations of fluoride and some of the other constituents in the water.

Q. And so, David, before you go on, are we going to have other witnesses talk more about the mounding and the chemistry and some of the details?

A. Yes, Dr. Shomaker and Dr. Miller, and they have vastly more experience in hydrogeology and hydro geochemistry than I do, and they are going to address that issue.

Q. I just wanted to walk through the big picture on this permit. I also want to ask, with the report, is the chemistry provided?

A. Yes.

Q. And speaking of chemistry, do you have anything more you want to say about the report?

A. Well, there were some other things that were spelled out in the conclusions of the report, but I am sure they have read it, so we can proceed.

Q. Let's talk about chemistry. What are we seeing on the screen here?

A. This slide was used in the 2013 hearing. And the only reason --

MR. LAKINS: I object. Where is this as an exhibit?

MS. HENRIE: It's not an exhibit. It's mine.

MR. LAKINS: Then I am going to object to its use because it wasn't provided ahead of time.

MS. HENRIE: It was used in 2013, Charles.

It --

MR. LAKINS: It wasn't disclosed for this hearing as an exhibit.

MS. HENRIE: Not as an exhibit. We are not tendering this as an exhibit. May we proceed?

CHAIRPERSON CATANACH: Yes.

A. As you said, this slide was used in 2013. And this slide basically shows a comparison of the water sampled from 45-7, 53-7 and 63-7, Lightning Dock's production well and its three injection wells, in comparison with water sampled from AmeriCulture State 1 -- we have three different samples from AmeriCulture State 1 and one sample from AmeriCulture State 2 and one sample from Rosette State 3, which, if you look to the board in the back of the room, you will see is actually north of the AmeriCulture wells.

And really this is just a graphic representation of the chemistry of these waters. And the purpose of this is just to show that the concentrations of sodium and potassium on the left-hand side and sulfate on the far right and chloride and fluoride down the center access are relatively equal in the waters that are pumped from the 45-7 and the waters that were sampled in the 53-7, the 55-7, and the 63-7 prior to injection into those wells.

Q. So on the left we've got deep wells. What kind of ranges of depth are we talking about?

A. Well, the shallowest production casing is in the 55-7, and that is at 1,050 feet. The bottom of 53-7 is the deepest well and that's at 4,441 feet.

And the screened intervals in the 45-7 range from about 1,737 down to 2,900. The screened interval or the lined interval in 53-7 ranges from about 1,680 down to 4,441 and the screened or the lined interval in 63-7 ranges from 1,500 down to 3,500.

Q. So over on the right, are those shallow wells, characterized most of the shallow wells?

A. They are indeed. I believe AmeriCulture's State Well 2 is the deepest well out there. But I believe that AmeriCulture's State 1 has a total depth of 399 feet. It may be lined; it may be open hole to that depth. I think it's cased to about 150 feet. But, nonetheless, the total depth on that well is 399 feet.

I'm not sure at this point when the sample from AmeriCulture's State Well 2 was collected, but I believe that well has a total depth of 2,100 feet. But it was drilled to that depth over the course of a number of years. And that sample may have been collected prior to deepening the well from about 900 feet down to that total depth of 2,100 feet.

And Rosette State Well 3 I believe has a total depth of 440 feet, and I think it's open hole from 400 to 440 feet.

Q. So does this slide basically show that whether the water is deep or shallow the geothermal water pretty much has the same signature?

A. Yes.

Q. And I want to direct your attention to Exhibit 2, this is Lightning Dock's Exhibit 2, which will be in your green binder there. Tell me what this is.

A. This table is excerpted from the Water Quality and Background Concentration Report. And the purpose in making an exhibit out of it is to show that there's no changes in water chemistry as that water is produced from 75-7 and runs through the power plant and is discharged from the power plant prior to injection into the 55-7.

As you can see, the primary constituent and concern in this proceeding is fluoride. And as you can see from the analytic results of 45-7, those concentrations range really from 11 to 14 milligrams per liter.

I discussed earlier the issues that we had with the three samples from 45-7 on January 7th, January 28th, and February 25th of 2014.

Q. That is the three rightmost columns?

A. Almost. There is one prior to that, December 19th of 2013.

Q. Okay.

A. But those are the samples that I believe were contaminated with deionized water that had not quite been purged from sample tubing prior to placing that sample in the sampling container.

But the date range on the samples from 15 days to 180 days after power plant start-up is a direct comparison above and below. And so if you compare the fluoride concentrations in those three samples on 2/25, 1/28 and 1/7 with the fluoride concentrations of plant discharge on those same dates, you will see that the fluoride concentrations in plant discharge has basically remained constant over time.

At January 7th, 2014, it was at 14 milligrams per liter, and, then, 180 days later, it was at 12 milligrams per liter. And those concentrations basically agree 101 with the concentrations in 45-7 prior to running it through the power plant.

And that's really the thing I primarily wanted to show in this slide.

And you can see that the TDS, the sulphate and the boron and the chloride concentrations in 55-7 or plant discharge water are basically equal to those in 45-7 when it comes out of the ground.

Q. So plant start-up was?

A. December 20th.

Q. What year?

A. 2013.

Q. So this gives us a snapshot of before and after plant start-up?

A. That is correct.

MS. HENRIE: With that, I am going to pass the witness, but also move Exhibits OCD 1 through 8, which were the Conditions of approval, and move Lightning Dock Exhibit 1, which were the two aerial maps that show ownership and well locations, and Lightning Dock Exhibit 2, which is this chemistry table you are looking at now.

MR. LAKINS: No objection.

CHAIRPERSON CATANACH: OCD Exhibits 1 through 8 will be admitted and Lightning Dock Exhibits 1 and 2 will be admitted.

(Oil Conservation Division's Exhibits 1 through 8 were offered and admitted.)

(Lightning Dock Geothermal's Exhibits 1 and 2 were offered and admitted.)

CHAIRPERSON CATANACH: Mr. Lakins, your

witness.

CROSS EXAMINATION

BY MR. LAKINS:

Q. Can you still see this all right, Mr. Janney?

A. Yes.

Q. A couple of things. Mr. Janney, you said that -- Mr. Janney, I just want to make sure I understand for clarification some of what your testimony has been.

The fluoride that you are talking about is out of 53-7? The fluoride test that you were just talking about -- excuse me -- 55-7; is that right?

A. Are you talking about in reference to this exhibit (indicating)?

MS. HENRIE: Can we clarify which exhibit for the record, please?

A. Actually, there are fluoride concentrations for two wells on that exhibit, 45-7, the production well, and 55-7, the primary injection well.

But the lower set of analytical results on this exhibit are power plant discharge prior to injection into 55-7.

Q. All right. I want to get at the fluoride level that you are talking about is what's in the production well 45-7?

A. Correct.

Q. And you have monitoring wells placed on the property, correct?

A. Correct.

Q. We don't have the fluoride levels from those monitoring wells here today, do we?

A. Yes, they are in the background concentration report that you submitted as an exhibit.

Q. Can you show me where exactly --

A. Table 6, I believe.

Q. I don't have a table 6 in here.

A. I have one in my ring binder. It is the last of the tables in the back of the report. It is not an embedded text table.

CHAIRPERSON CATANACH: What report are we talking about?

THE WITNESS: The Background Concentration and Compliance Report, Exhibit B. It's an AmeriCulture exhibit.

By Mr. Lakins (cont'd):

Q. This page, table 6, that looks like this (indicating).

A. Yes, I believe that is correct.

Q. And the fluoride levels from those wells are all lower than the fluoride level from the production well, correct?

A. Yes.

Q. So the existing data is that the fluoride levels in the monitoring wells --

CHAIRPERSON CATANACH: Mr. Lakins, we really can't see that one. Can we move this back?

MR. LAKINS: Yes, sir. Thank you. (Moving stand back.) Does that work, sir?

CHAIRPERSON CATANACH: Yes.

Q. (By Mr. Lakins:) So just to establish that the fluoride levels in these monitoring wells as of the data that Lightning Dock submitted in the sample, the fluoride levels in the monitoring wells are all less than the fluoride level in the production well?

A. With the exception of Monitoring Well 3. There was one sample collected on November 24th, 2013, that was 12 milligrams per liter fluoride. And that's prior to plant start-up. So that was a naturally occurring fluoride concentration at that location at that point in time.

Q. And you don't have the fluoride levels of AmeriCulture's well?

A. I have seen some of that analytical data.

Q. And what have you seen?

A. We compared those analytical results and the Stiff diagrams that were presented moments prior to this and those fluoride concentrations in AmeriCulture State Well 1, I believe, range from approximately 8.8 to 10.2 milligrams per liter.

Q. What about AmeriCulture's Federal well?

A. I don't believe I have ever seen fluoride concentrations for that well.

Q. Now, Mr. Janney, I would ask you to turn to -- let me back up for a moment.

Turn to the locations of your proposed injection wells. One is here, close by 62-7, correct?

A. Yes.

Q. One is down here at the southern edge of the Rose Farm buildings?

A. Yes.

Q. And one is over here (indicating)?

A. Yes.

Q. Where is the fourth one?

A. To the right, to the lower right-hand corner east of the greenhouses.

Q. Okay. And the proposed injection depth is 150 feet, correct?

A. In three of the wells, that is correct. It is 500 feet in 13-7 but 150 feet in the other three.

Q. Over here it's 500; and the other three, the proposed injection well depth is 150 feet.

A. Yes. That's the bottom of the production casing. It's lined from there to 500.

Q. On the applications, that's the shallowest depth of the proposed injection?

A. Yes.

Q. Is that not into the shallow alluvial aquifer?

A. It is in the shallow alluvial aquifer.

Q. Now I ask you to turn to AmeriCulture's Exhibit C. Are you there?

A. I believe so.

Q. Page 3, which has paragraph 15 on it -- are you there?

A. Yes.

Q. Okay. Now at the last hearing back in 2013, the Commission found that Los Lobos presented evidence -- I am going to skip to the last part there -- I will read it. "Los Lobos presented evidence that the geothermal plume production zone in 52-7"-- which was over there -- and --

MS. HENRIE: Just for clarification, Charles, you said at the last hearing. This is from 2008.

MR. LAKINS: No. Exhibit C is the order from 2013.

MS. HENRIE: No. Go to the end. It's

signed by Mark Plesner.

MR. LAKINS: Hang on. Is your C not the same C? It's in the book that I gave you.

MS. HENRIE: Oh, okay. My C I downloaded so...

MR. LAKINS: You've got 5B and C backwards.

MS. HENRIE: Sorry. Okay. Thank you for that clarification.

Q. (By Mr. Lakins:) Let's get back to the question -- that the Commission found that at the 2013 matter that Los Lobos presented evidence that the geothermal plume production zone in wells 53-7 and 55-7 are the same -- that's these here, 53-7 and 55-7, correct?

A. (Nodding head.)

Q. And that the geothermal fluid flow intervals occur in the same geologic formations.

And that's those two deep wells, correct?

A. (Nodding head.)

Q. And they are not directly connected to the alluvial aquifer at 400 feet below ground surface in AmeriCulture's State No. 1 well, correct?

A. That's what it says.

Q. Here is what I am trying to figure out. If previously Los Lobos evidence showed that the production zone was in a different strata than the shallow alluvial aquifer, why is Los Lobos proposing to inject into the shallowest alluvial aquifer?

A. In order to maximize the production of the power plant.

Q. Now, since the power plant came on line, there have been changes in the monitoring wells, have there not?

A. Yes. I think we testified in 2013 that it is all connected.

Q. Well, the finding was that they were not in 2013, that's the evidence back then.

But since the production began, there have been increases in the water levels in these monitoring wells, true?

A. Yes. I stated earlier that there has been four to six feet of mounding observed in those monitoring wells.

Q. Even though the injection levels -- and you are currently injecting, basically, from 55-7 initially, correct?

A. All three of those injection wells are currently taking fluid.

Q. When did 63-7 come on line? When did you start injecting the 63-7?

A. I believe it was February. I can't say for certain. Mr. Morrison may have more information about that.

Q. How about 53-7?

A. About the same time.

Q. What is the injection amount into those wells? What are they taking?

A. I think currently they are in the neighborhood of 150 to 250-gallons per minute.

Q. Do you have any data whatsoever to show that?

A. I don't. But Mr. Morrison may.

Q. Okay. And the injection depth at 53-7 is 1,050 -- excuse me, at 55-7 is 1,050, correct?

A. Correct.

Q. Deep?

A. Yes.

Q. And the injection depth at 53-7 is what?

A. They are all relatively -- 53 and 63 are about 1,500 feet. It is 1,500 feet to the bottom of the casing in 63 and about 1,680 in 53.

Q. So the injection activities at 1,000 to 1,500 to almost 1,700 feet are affecting the monitoring wells, true?

A. Yes.

Q. And the monitoring wells, the depth of the

monitoring wells are 50 to 85 feet, are they not?
A. Roughly.
Q. So the injection activity that is currently ongoing is affecting the shallow alluvial aquifer, true?
A. Well, there is a measured response in shallow ground water to deep injection. And because I am not qualified at this point as an expert witness in hydrogeology or hydro geochemistry, I'm going to defer the more definitive answer to that question to Dr. Shomaker or to Dr. Miller.
Q. Let me put it this way. Since Lightning Dock has been injecting deep, you have observed increases in the water levels in the shallow monitoring wells, true?
A. Yes. That is clearly stated in our October 20, 2014, report.
Q. And in processing the decreases in the water levels at the production well, true?
A. Well, one would expect a cone of depression to form when that pump is turned on. But we have evidence to show that that water level is not in decline, that it is stable, that it is in equilibrium. And Dr. Shomaker will speak to that.
Q. How much has it gone down?
A. I don't recall the pre-pumping depth water in

that well. I believe it stabilized right about 300 feet below ground surface.

Q. So --

A. And so has the mounding stabilized as well.

I need to comment that based on our depth water results in the monitoring wells and the depth of water in 45-7, that the system appears to be in equilibrium with respect to pumping and injection.

Q. At current production?

A. That's correct.

Q. And your proposal is essentially to quadruple that?

A. I am not aware of that.

Q. You are wanting to drill four more injection wells, true?

A. Right. But that doesn't mean that there won't be a balanced approach to injection.

Q. Well, your proposal is for four shallow injection wells, correct?

A. At 500 gallons per minute per well.

Q. So 2,000 gallons per minute more of injection?

A. Correct.

Q. And so you will also be increasing production?

A. Correct.

Q. And increasing production will come from 45-7?

A. Correct.

Q. And how about 55-7?

A. That may be turned into a production well.

Q. How about 53-7?

A. Those will only be injection wells at this point.

Q. So your production will increase at 45-7 and 55-7?

A. Correct.

Q. And the fluoride from 45-7 to 55-7 is higher than the existing background in monitoring wells?

A. Well, as I stated earlier, we have a 12-milligram per liter fluoride concentration in Monitoring Well 3 and that there are a number of pre power plant samples collected by OCD that indicate fluoride concentrations in shallow water in the southern greenhouse area that range between 12 and 15.46 milligrams per liter of fluoride so --

Q. Go ahead.

A. (No response.)

Q. Now if you turn to our Exhibit P once again, page 4, the beginning of page 4, table 6, those are the background threshold values -- sorry, you are not there -- wrong page. This page (indicating), the narrative page 4.

A. Oh.

Q. Page 4 on the bottom, are you there?

A. Yes.

Q. Your data shows the Monitoring Well, Fluoride, that's the far left column, correct? NWFNG/L?

A. Which table are you on in the text?

Q. This page 4 at the bottom.

A. That is not the same as my page 4.

Q. It is in the beginning. It is about the sixth page in from the beginning.

There you go.

A. Oh. This is the 2015 document, not the document that we spoke of earlier.

Q. This is the most current information?

A. That's correct.

Q. Okay.

A. So I haven't previously testified about this document.

Q. Sorry?

A. I haven't previously testified about this document.

Q. Are you familiar -- you just testified you are familiar with the fluoride in the monitoring process?

A. That's correct. I am on page 4, table 6.

Q. And the fluoride levels in the monitoring well, the highest one is 12, correct?

A. Yes.
Q. And the lowest one is 1.3, correct?
A. Yes. Upgradient of the upwelling geothermal plume.
Q. And they are all lower than the fluoride level in your production well, correct?
A. Well, as I stated earlier, the analytical results for post power plant start-up on 45-7 indicates a relatively flat line of fluoride concentrations from 45-7 at 12 milligrams per liter.
Q. Agreed.
But my question was, the data that you have developed demonstrates that the fluoride level in the monitoring wells which are located fairly close to where you intend to inject, the fluoride level in the existing data that you have shows that the fluoride level in the monitoring wells and in the shallow water is lower than the fluoride level known to exist in the production well, true?
A. In some cases that's true. But it's all spacially related to the upwelling geothermal plume.
Q. Have you observed any increases in fluoride in the monitoring well since production began?
A. Yes. I believe one well has shown some increases. And that would be MW-1A.

Q. And that's --

A. Immediately north of 57. The primary injection well.

Q. Any other shown increase?

A. There may be some less than 1 milligram per liter increases, but we could go to the table to observe, if you wish.

Q. Where does that data show the changes in the fluoride levels in any of the monitoring wells?

A. It is table 6 from the previous background concentration report.

Q. Now, this table 6 is a single number. Do you have any data that shows a change in the fluoride from one test to the next?

A. Yes, those wells were recently sampled, and those results were provided to OCD at the end of last month.

Q. Because table 6 was a start-up. We don't have here today --

CHAIRPERSON CATANACH: Sorry, Mr. Lakins. What are we looking at?

MR. LAKINS: I'm sorry, sir. The table 6 in Exhibit P that is towards the back. It looks like this (indicating), sir.

CHAIRPERSON CATANACH: Are you referring to line 6?

MR. LAKINS: Those are fluoride, but I am also referring to the date at the top that is in November and December of 2013. So that's data from --

A. Pre-plant. And those wells have recently been sampled and there were some increases observed.

Q. Do you have that here today to show us what that is?

A. I don't believe I do.

Q. But there have been increases?

A. In some of the monitoring wells, on the order of one to two milligrams per liter, if I recall correctly.

Q. One to two?

A. Yes. In Monitoring Well 1A.

Q. In Monitoring Well 1A, the closest to the current injection well?

A. Yes.

Q. Are you saying that Monitoring Well 4 has not seen any increase in fluoride or you just don't know?

A. I don't recall without having that data set in front of me.

MR. LAKINS: Does anyone here have that data set with them?

THE WITNESS: It has been submitted to OCD.

MR. LAKINS: That's not my question. Does Lightning Dock have that data with them today to present to the Commission?

MS. HENRIE: Mr. Lakins, I think you are badgering my witness. I think you made your point.

MR. LAKINS: It is just a question.

Q. (By Mr. Lakins:) It's not here?

A. I have a document on my computer, yes. But it has already been submitted to OCD.

Q. Now, Mr. Janney, you proposed one of the shallow injection wells, 63A-7?

A. Yes.

Q. Why are you proposing that in such close proximity to the existing 63-7?

A. Because we believe there's permeability there.

Q. And that's proposed at 150 feet?

A. Yes.

Q. And that 150 feet depth is very near in depth to Monitoring Well 1A, which is at 80 feet?

A. Yes. And there is also another monitoring well, MW3 just on the north side of that pad.

Q. Have you seen any changes in Monitoring Well 3 fluoride levels?

A. Not that I recall at this point.

Q. You have seen changes in the water depth?

A. Yes. Mounding occurs in that vicinity.

Q. Mounding occurs in 3, yes?

A. Yes. But not to the extent that it does in 1.
Q. And have you seen increases in 5?
A. I don't recall that we have specifically. I think Dr. Shomaker is going to address the mounding issue more specifically.
Q. Very good.
And it is your opinion that injecting at 150 feet would not impact the underground drinking water --
MS. HENRIE: Objection. Define "impact."
MR. LAKINS: Harm.
Q. You testified it wouldn't harm --
A. Well, I think --
MR. BRANCARD: I believe, as you objected, this is a fact witness, not an expert witness. So we are trying to avoid him giving opinions here.
MR. LAKINS: Very well. Point taken. I am just going from my notes.
Q. Do you know if Lightning Dock has prepared and submitted to the OCD a water replacement plan?
A. I'm not aware of one.
Q. Mr. Janney, just to kind of clarify the appropriate witness, would it be you or would it be Mr. Miller that would be the one addressing the background threshold values for other areas outside of the monitoring wells?

A. Dr. Miller.

Q. Very good.

MR. LAKINS: I pass the witness. If I may ask for a break for a drink of water.

CHAIRPERSON CATANACH: Let's take a ten-minute break.

(Brief recess.)

CHAIRPERSON CATANACH: All right. Let's get started. Ms. Marks, do you have any questions of this witness?

MS. MARKS: Yes, I do.

CROSS EXAMINATION

BY MS. MARKS:

Q. Mr. Janney, I just have a couple of questions for you. Ms. Henrie moved to admit Oil Conservation Division's Exhibits 1 through 8 which also appeared in the amended proposed order submitted by Lightning Dock Geothermal HI-01, LLC.

Of the exhibits that were moved into the record, I want to draw your attention to Exhibits 3 and 7. In your testimony earlier, you discussed a proposed correction to a unit, correct?

A. Yes.

Q. I believe you testified that the unit number or letter should be corrected from E to L; is that correct?

A. I believe that's correct.
Q. And so would you suggest that the Exhibits 3 and 7 should be corrected as well?
A. I would.
Q. And these proposed conditions of approval with respect to placing the well on injection and with respect to drilling a geothermal resource as well are basic conditions of approval that Lightning Dock has seen before and conditions you have no objections to; is that correct?
A. Yes, that's correct.
MS. MARKS: I have no further questions.
CHAIRPERSON CATANACH: Mr. Domenici.
MR. DOMENICI: Thank you.
CROSS EXAMINATION
BY MR. DOMENICI:
Q. What is your position with the project? How would you describe your --
A. I have been the permitting and compliance manager there since 2011.
Q. And as part of that, are you familiar with the permit that was in place when you took that job in 2011, the groundwater discharge permit?
A. I have knowledge of it.
Q. And since you took your position, have you been

responsible for compliance with that permit?
A. That is correct.
Q. And is that permit transferred at some point in time from the original party who obtained it --
A. To Lightning Dock? From Los Lobos to Lightning Dock?
Q. Yes.
A. Essentially, yes. Everything is transferred from Los Lobos to Lightning Dock.
Q. You say everything, but you understand to do a transfer of discharge permit there's a --
A. That's correct. But the discharge permit expired in August of 2014.
Q. And what is the status of that discharge permit? You said it expired.
A. That is correct. Based on an opinion rendered by Mr. Brooks after the 2013 hearing with OCC, I believe it was his opinion that that discharge permit was not necessary, that OCD had within its jurisdiction the ability to regulate us with conditions of approval on various forms or applications that we submitted.
Q. So did you submit an application that governs the wells that were subject to the discharge permit?
A. I'm not sure I follow the question. Please restate the question.

Q. So the discharge permit had a number of wells permitted pursuant to the discharge permit?

A. Injection and production wells, is that what you are referring to?

Q. That is my understanding; is that your understanding?

A. That is correct.

Q. And then the permit was allowed to expire?

A. That is correct.

Q. Without a renewal application?

A. For the reason I just stated, yes.

Q. And then my question is so were all of those wells put under permit and compliance under another permit or compliance instrument?

A. There is an agreement, at this point verbal, between Lightning Dock and the Oil Conservation Division that agrees to monitor water quality in the production well and in power plant discharge and in the monitoring wells on a certain frequency and to provide those analytic results to the Division.

So, in effect, the monitoring conditions of that discharge permit are being met.

Q. What is the foundation or what is the -- who is involved with this verbal agreement?

A. Well, the chief of the Environmental Bureau and

Lightning Dock's attorney.

Q. Who is the chief?

A. Jim Griswold.

Q. And would someone, say, like my client, the Soil and Water Conservation District, would we have any reason other than this hearing to be aware that those requirements remain in effect? Do we have any information in the public domain that that requirement remains in effect other than what I'm hearing right now?

A. Well, we received a letter from Mr. Griswold on May 15th of this year, I believe. And that basically outlined in writing the requirements for monitoring going forward.

Q. And as I read the discharge plan, there's closure requirements; are you familiar with the closure requirements?

A. At this point, no.

Q. Do you understand that closure requirements continue regardless of whether a discharge permit is renewed or expires?

A. I'm not aware of the closure requirements.

Q. And so you don't know, one way or another, if Lightning Dock is subject to closure requirements for the discharge permit issued by the OCD?

A. I do not.

Q. And do you know if typically discharge permit closure requirements require that the permit holder restore the area impacted by the discharge permit to some specific levels or condition?

A. Define "area of impact," please.

Q. Let me just make it broader.

Do you know if -- does Lightning Dock have any plans to meet the closure requirements of the 2008 discharge permit?

MS. HENRIE: Can I just object. Can you specify -- are you looking at the --

MR. DOMENICI: This is Exhibit B. It's the last page of the permit.

MS. HENRIE: Okay. So it's AmeriCulture Exhibit B.

MR. DOMENICI: There's attachments but it's the last page of the permit.

MS. HENRIE: So not the last page of the exhibit but of the permit?

MR. DOMENICI: Page 23.

MS. HENRIE: Do you have that in front of you so he can at least see what you are looking at?

MR. DOMENICI: That would be on page 18, at the top left corner.

THE WITNESS: Okay. Would you restate your question, please.

Q. (By Mr. Domenici) Is Lightning Dock required to satisfy -- as compliance manager for Lightning Dock, would you agree with me that Lightning Dock is required to satisfy the closure requirements of paragraph 23?

A. I would say that since this discharge permit is expired, but since we are years and years from closure, I would think that Lightning Dock would on their own accord satisfy those closure requirements. But I haven't seen anything in writing.

Q. And if those requirements are to -- and it says -- the last sentence says, OCD may require additional financial assurance if surface water and/or ground water is impacted pursuant to the WQCC regulation cited there.

Do you see that?

A. I do.

Q. And you would agree that the injections that have already taken place under this permit that's in front of you and then the objections that are proposed as part of this procedure, they will impact the ground water?

A. There will be a response. There will be mounding and there will be potential changes in chemistry.

Q. And when we say "chemistry," just so I'm clear and the record is clear, chemistry, does that include the increase in the levels of regulated Water Quality

Control Commission constituents?

A. Yes.

Q. And there will be impacts and elevated levels of fluoride are expected as a result of this application that we are here today on, correct?

A. Yes.

Q. And those impacts will be in the shallow alluvial groundwater aquifer, correct?

A. Yes.

Q. And fluoride is regulated by the WQCC as a human health standard, correct?

A. 1.6 is the State MCL. 2.0 is the Federal Secondary MCL. And 4.0 is the primary MCL. And all of the water in the greenhouse area and water downstream for miles is above the 4.0 drinking water quality advisory. It is ubiquitous in many places throughout the valley.

MS. HENRIE: And will one of our other witnesses be testifying to that?

THE WITNESS: Yes.

A. That is not drinking water.

Q. When you say it's not drinking water, you are testifying as a fact witness that no one drinks that water; is that what you're saying?

A. No. I'm testifying as a fact witness that compared to the state and federal MCLs for fluoride that water is not fit for human consumption.

Q. But you are not testifying to this Commission that people don't drink that; is that correct?

A. I cannot say that. It would be folly if they did.

Q. Are there treatment processes, domestic treatment processes to remove that fluoride or reduce it that are available?

A. Yes. Both at the domestic level and at the commercial level. I believe that aluminum is the primary treatment method. But I think Dr. Miller can address that later.

Q. And do you understand that the WQCC regulations, the groundwater regulations, they use the term "background"; are you familiar with that --

A. I am.

Q. And you would agree with me -- it sounds like something in your prior testimony -- the injections that are proposed as part of this application will increase the fluoride above the background?

A. I don't believe that to be true. In a document that we submitted to OCD earlier this year, Dr. Miller ran PRO UCL for fluoride and other constituents and calculated with that software background threshold values for fluoride, TDS, and sulfate, I believe.

And those concentrations established in that document are basically set at 17 milligrams per liter for fluoride. And there is no evidence at all in any of the water produced from 45-7 that that concentration will be reached.

Fourteen is the highest we've seen, but it seems to have stabilized at 12 since production began.

Q. Are you familiar with the term in the Water Quality Control Commission regulations of the "existing concentration," the term "existing concentration"?

A. Not directly familiar.

Q. What do you consider the readings from the monitor wells to establish with respect to the background or just in concentration or the condition at the location of the monitor wells?

A. Well, I think I stated previously that depending upon where you are relative to the upflow plume, those fluoride concentrations vary.

And fluoride concentrations in shallow wells in the greenhouse area have analytic results that indicate concentrations up to 15.46 milligrams per liter. So that is a background concentration for fluoride.

Q. So do you consider -- you take the highest reading you can find and you call that background --

A. No. The program takes all of the readings and runs them through algorithms and compares standard deviations and other things that Dr. Miller can explain in detail and arrives at a background threshold value for fluoride or any of the other constituents that are modeled.

Q. So looking at the OCD exhibits which are the conditions -- do you have those in front of you?

A. Yes.

Q. So first of all, let me ask, if I may, just to clarify, you would agree that the background concentrations in the shallow aquifer vary depending on whether they are influenced by what I think you called the upwelling plume or whether they are not influenced by it, correct?

A. Correct. But you have to consider the upwelling plume as a whole in this particular case.

MS. HENRIE: Excuse me. We have a witness who is going to testify to all this stuff.

Q. If you are not comfortable answering, let me know.

MR. DOMENICI: Or object and I will withdraw the question. I am trying to get this from a compliance standpoint, is my approach, so we are clear.

Q. So looking at the conditions of approval, what is your understanding as to what OCD will be monitoring for -- will be requiring your client or your employer to monitor for in the monitoring --

A. I believe in the May 15th letter the analytical requirements are spelled out on a quarterly and annual basis.

Q. And I understand there is a requirement to look for certain things. But is there a trigger that says, if you find certain things, you have to adjust?

A. There is a trigger that says, if you find certain things, you have to resample.

I don't believe there's anything that says adjustments are required. I believe that after the resampling, the analytical results are reviewed and discussion takes place based on that second set of analytical results.

Q. So the monitoring is basically data gathering, if I am correct?

A. Yes.

Q. That is spelled out in these conditions?

A. And in the May 15th letter from OCD to Lightning Dock.

Q. How is the May 15th letter different from the conditions? Do they apply to different wells?

A. No. There are selected wells in quarterly monitoring events and there are selected wells in annual monitoring events, so depending upon where you are in the calendar year, different constituents or different wells are sampled.

Q. Let me ask just a real basic question. So the discharge permit expired, a letter was written -- I guess a verbal agreement was made?

A. And then the letter was written -- followed that, right.

Q. Was there any public process for the transfer of the discharge permit obligations to this letter agreement between Lightning Dock and OCD?

A. Not to my knowledge.

Q. And did the opinion of Mr. Brooks discuss or indicate that the public was allowed to be excluded from the transfer of the discharge permit to a letter agreement, if you know?

A. I don't know the answer to that.

Q. Was that letter made public?

A. The May 15th letter?

Q. I guess it was a legal opinion from Mr. Brooks.

A. Oh, yes, I believe so.

Q. Was it posted on a website anywhere that you are aware of?

A. Isn't it in the proceedings from 2013?

Q. And so if I may, is it your understanding that the agreement in this letter goes on indefinitely or does it have an expiration period or a renewal period?

A. It is indefinite, is my understanding.

Q. And would the permit -- if this permit is issued, is this indefinite, the one that we are here for today?

A. The conditions of approval?

Q. Yes.

A. Yes.

Q. And the application itself?

A. It has an expiration date. If we don't drill the well within a specified period of time, it would expire. But assuming the well is constructed as designed under these conditions of approval, yes.

Q. Okay. And I understood from your testimony there is no replacement plan --

A. Correct.

Q. -- as part of any submittal from Lightning Dock?

A. It is a non-consumptive use of water resources.

Q. And my understanding -- would another witness be better to testify as to the extent that the injected or exposed water will move over time?

A. Dr. Shomaker would be more prepared to answer that question.

Q. Is there a model to say where that impact will be

20 years from now?

A. There has not been to my knowledge.

Q. Or is there any calculation as to where that impact will be over time?

A. I would ask Dr. Shomaker to address that.

Q. To your knowledge as compliance and permitting director, is there anything in your mind that you can testify to as to where the extent of the impacts from these 500 -- 400- or 500-gallon permit injection wells will be over five-, ten-, 20-year intervals?

A. I think Dr. Miller or Dr. Shomaker would be better suited to answer that.

Q. Is there any submittal that has that information?

A. Not to my knowledge.

Q. Will the -- as permit and compliance manager, are you aware, one way or another, if the injection volumes will extend outside of what you consider the upwelling geothermal plume?

A. I don't believe that they will.

Q. What is your basis for that?

A. The mounding we see in the current monitoring wells due to injection.

Q. Does that provide sufficient data to determine how these wells will mound or the water will proceed, is that what you are testifying?

A. I think Dr. Shomaker would be better suited to answer that question.

Q. My understanding was that you designed these wells because -- or selected them and designed the casing so they would be more permeable and you would be able to disperse more water; am I incorrect in that?

MS. HENRIE: I object. He didn't design these wells.

Q. You applied for those wells because they would be capable of dispersing more water?

A. Yes.

Q. And just to go back and then I'll move on. Is there any level, that you as permitting and compliance manager, level of increase in fluorides that you would feel -- that shows up in the monitoring plan that is part of this set of conditions, is there any level in here that you think and can testify to that would cause an adjustment of the injection use or activities?

A. If we exceeded the current background threshold value for fluoride.

Q. And would that be in the influent or the effluent that leaves your plant or would that be measured at the monitor wells?

A. At the monitor wells. But plant influent and plant discharge are measured regularly as well.

Q. So if the plant influents become above the background fluoride levels, then you would be concerned?

A. Absolutely.

Q. So the background fluoride level is really at the heart -- if I'm correct -- it's at the heart of the way you as Lightning Dock's permitting and compliance manager are sort of measuring the tipping point of where Lightning Dock should stop or --

A. Adjust.

Q. Adjust --

A. Yes.

Q. And when was the background fluoride study conducted?

A. Well, there were samples collected by Lightning Dock prior to commercial power generation in November and December of 2013. And those values in addition to values of fluoride and other constituents that were collected in 2008 by Lightning Dock, in 1996 by OCD, and, I believe, 1983 by OCD were all used in the Pro UCL model to establish background threshold values for fluoride.

Q. And when was the model run -- my question is when was this established?

A. Earlier this year.

Q. After you already were operating?

A. Yes. If you look at the discussion in the background and compliance report regarding background threshold values for a fluoride in the shallow water bearing zone, the narrative there should explain why there was not enough statistical data in the monitoring well samples to be used in that calculation and why samples collected by others previously needed to be added to that data set to supply a statistically valid sample population for that analysis.

Q. And is that an exhibit to this proceeding?

A. Yes, sir.

Q. And are your monitor wells screened?

A. Yes.

Q. What is the screening interval?

A. The lower 20 feet.

Q. And why is that -- why is that selected if you know?

A. That was one of the conditions in the discharge permit. And that's first water, that is the shallow water drain zone. That's what they wanted to monitor.

And that goes back to the 2008 discharge permit, and I was not a party to the discussion of preparation of that discharge permit.

Q. Just so I am clear, when you say the lower 20 feet, I am just not clear what that means.

A. 60 to 80 feet, 65 to 85 feet. I don't think we have anything deeper than 85 feet. There's usually five feet of screen above the water table.

Q. And then the injection that is proposed here -- the objection wells would be screened from 150 feet to 500 feet?

A. In the immediate plant area and then further to the west in 13-7, it's 500 and below.

Q. And how far below?

A. 215, if necessary.

MR. DOMENICI: Thank you. That's all I have.

MS. HENRIE: Mr. Chairman, if I can do some redirect and maybe add some clarity to some of the things that have been discussed.

MR. BRANCARD: Maybe you want to wait until after the Commission asks questions.

MS. HENRIE: You're right. Thank you.

EXAMINER BALCH: I think I gathered that there is a witness later that will discuss the need for shallow versus deep injection wells?

THE WITNESS: Yes.

EXAMINER BALCH: Then I have no questions for you.

COMMISSIONER PADILLA: And with that, I will save my questions for later.

EXAMINATION BY CHAIRPERSON CATANACH

CHAIRPERSON CATANACH: Mr. Janney, I was not fortunate enough to be present for the last couple of hearings. But can you just basically explain the operation here for your power plant, just in general terms?

THE WITNESS: I can in general terms with counsel's permission, but I would rather Mr. Morrison do that because he is intimately acquainted with it.

CHAIRPERSON CATANACH: So you have another witness that will take care of that?

THE WITNESS: Yes.

CHAIRPERSON CATANACH: Well, is there a geologic witness that will discuss the various formations?

MS. HENRIE: Yes.

CHAIRPERSON CATANACH: Okay. I am a little confused. I believe you said that there is going to be elevated levels of fluoride, are expected. Where would those elevated levels of fluoride come from? Are you talking about the plume itself, the uplift?

THE WITNESS: In some cases, the fluoride adding monitoring location is lower than the fluoride concentration in plant discharge. So proximal to those injection points, we would expect to see some elevated fluoride.

MS. HENRIE: And, Mr. Chairman, we are going to have people kind of explain the dynamics of the geothermal system and the larger aquifer. I know it's hard in context with the first witness, but we are planning in tell you about that.

CHAIRPERSON CATANACH: Okay.

EXAMINATION BY COMMISSIONER PADILLA

COMMISSIONER PADILLA: I think I actually have one question. Can you explain the testing process that you referred to that resulted in some erroneous results?

THE WITNESS: The samples from 45-7 in early 2014?

COMMISSIONER PADILLA: The deionized water.

THE WITNESS: Right.

Well, the water comes out of the ground at roughly 312 degrees, and in order to prevent it from flashing, it has to be run through an ice bath. And there's a 22-foot to 30-foot long piece of stainless steel tubing coiled inside of a 55 gallon drum, basically according to ASTM method 948 I believe, that allows that water to be cooled to below flashing prior to placement in the sampling container.

And prior to each sampling event, that stainless steel tubing is decontaminated with a run of deionized water or perhaps deionized water with a little nitric acid. And then it is triple rinsed with DI after that.

COMMISSIONER PADILLA: And that is all taking place on the surface; I take it you're not talking about any --

THE WITNESS: It is all on the surface right next to the well head, that is correct.

COMMISSIONER PADILLA: Thank you.

CHAIRPERSON CATANACH: I don't believe I have anything else. You may proceed.

REDIRECT EXAMINATION

BY MS. HENRIE:

Q. So, David, let me just ask, in the permitting process, when you go to drill an injection well, is there a permit application, conditions of approval that are attached to that well?

A. Yes.

Q. And then when you place a well on injection, similarly, is there a separate permitting process, conditions of approval that are attached to that?

A. Yes.

Q. And so those conditions of approval go with the well. Some of those might relate to drilling, to testing during drilling, but there are some that then go on in perpetuity; is that your understanding?

A. Yes.

Q. So those structures are in place for all of the wells that have been drilled and also we are now trying to get those structures in place for the new proposed injection wells going forward; is that your understanding?

A. Those structures are in place for all production and wells that are placed on injection.

Q. Okay.

A. And, yes, to the second part of your question.

Q. So in terms of this Commission or the OCD regulating Lightning Dock, it would be through those conditions of approval going forward?

A. That is correct. That was Mr. Brooks' conclusion in 2013.

Q. But, then, in addition, does Lightning Dock have other things, like, for example, a groundwater monitoring plan that have been filed with OCD?

A. Yes. The groundwater monitoring plan was filed in late 2013 prior to the power plants' start-up.

Q. So Lightning Dock continues in perpetuity monitoring in compliance with that plan that is filed with OCD?

A. That is correct.

Q. And OCD accepted that plan?

A. That is correct.

Q. Okay.

Reference was made to a water plan of replacement. Do you know what that is?

A. I have not seen one for this site.

Q. Do you recall whether a State Engineer finding of impairment was a prerequisite requirement to that plan?

A. It may have been. I do not recall.

MS. HENRIE: That was all I wanted to ask. I just wanted to kind of explain the regulatory methods for this project.

So with that, I will let the witness step down.

MS. MARKS: I'm sorry. I just have a couple of more follow-up questions. It is follow-up to --

MR. BRANCARD: We can go on forever. We have a lot more witnesses to get through here.

CHAIRPERSON CATANACH: What is your question in reference to?

MS. MARKS: To the discharge permit.

CHAIRPERSON CATANACH: Briefly.

RECROSS EXAMINATION

BY MS. MARKS:

Q. Mr. Janney, were you present for the conversations regarding a discharge permit?

A. How far back are we speaking?

Q. Mr. Brooks said there was no longer a need for a discharge permit.

A. I think he verbalized that in this room at that time.

Q. Was that because the State's privacy application shows that classified geothermal injection wells are regulated under the Geothermal Resources Conservation Act, and not pursuant to Water Quality Act and WQCC regulations? Do you recall --

A. I believe that is correct. But I would have to read it to be certain.

Q. Was there ever a discussion also that there was never a discharge occurring by Lightning Dock?

A. That is correct.

MS. MARKS: Thank you. I have no further questions.

CHAIRPERSON CATANACH: Thank you. This witness may be excused.

MS. HENRIE: Mr. Chairman, Commissioners, let me tell you who is going to come speak to you. I should have done that right at the beginning for clarification to everyone.

Our next witness we are going to call is Monte Morrison, who is vice president of operations for Cyrq Energy, which is the parent of Lightning Dock Geothermal. He is going to talk to some of the business perspective, but he also was a power plant operator for 30-plus years, and so he can talk about how the power plant works, about how geothermal power plants work, not only this power plant but other places as well.

He is going to be followed by Dr. John Shomaker who will talk about hydrology, hydro geology, geology and some of the aspects -- the geothermal -- the aspects of this geothermal system and of the larger valley reservoir.

He will be followed by Roger Bowers, who is a geologist who has been involved in this project since 1987. And he can talk about the geology as well as some of the history of the project.

And then Dr. Greg Miller will be our last witness. And he is a hydro geochemist and can talk about some of the chemical properties of the water, what we see down deep, what we see on top and how this geothermal upwelling in the plume comes up and interacts with the native groundwater.

So we've got all of these kind of cued up for you. Monte doesn't know things like that about this particular reservoir. That's not what he's here for.

He's here to talk about business operations and geothermal power plants in general.

So with that, I would like to call Monte Morrison.

CHAIRPERSON CATANACH: Would you please swear in the witness.

MONTE MORRISON

having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MS. HENRIE:

Q. Would you please introduce yourself to the Commission.

A. Certainly. My name is Monte Morrison. I am a native Nevadan. I attended the University of Nevada, Reno, Mackay School of Mines, with a degree in chemical engineering, 1986.

And I was in geothermal power actually a year before that, starting as an intern. I progressed through the Ormat companies until 1992 when I began managing my first set of plants. And I continued through six companies. And I've managed geothermal power plants in Nevada, California, Hawaii, Utah, and now I am becoming more familiar with the power plant in New Mexico.

I am a professional engineer, licensed in Nevada in chemical engineering and a licensed emergency medical technician for my other set of duties, which is the vice president of safety for Cyrq Energy as well.

I recently joined Cyrq through the sale of the Soto Lake Geothermal Power Plant in Nevada. And I moved from my previous employer, Alterra Power, out of British Columbia and joined Cyrq in late January of 2015.

Q. Monte, will you please tell the Commission who is Cyrq Energy and what is its relationship to Lightning Dock Geothermal HI-01 --

A. Certainly.

Cyrq Energy is a multi-state geothermal power plant owner, operator, and developer. We currently have facilities in southwest Utah at Thermo 1, in western Nevada at Soto Lake Geothermal and an acquisition in progress of Petua Geothermal.

And as it relates to Lightning Dock Geothermal HI-01, Cyrq Energy is the sole member of Raser Power Systems, which is the sole member of Los Lobos Renewable Power, which is the sole member of Lightning Dock Geothermal HI-01, LLC. So it's a tiered relationship in the corporate structure.

Q. Thank you. And to answer the Chairman's question, please tell us how the power plant works.

A. Certainly. Lightning Dock Geothermal is a plant that is very similar to many other organic rank and cycle binary geothermal power plants. So in general terms these plants take hot water out of the ground, typically by pumping, almost exclusively by pumping. You take that water to the surface, and then you run it through heat exchangers where we extract heat as our form of potential energy and move that heat into the secondary fluid -- hence the term "binary."

In the case of Lightning Dock, the secondary fluid is R245, a refrigerant. In other sites, it's a hydrocarbon, such as pentane or butane.

When the heat is transferred from the hot water passing through the heat exchangers, it boils, and then it slightly super heats the secondary fluid, in this case the R245. That energy then is transferred as a driving force to turn a turbine or, in this case, four turbines through four separate cycles.

Those turbines in turn turn a generator, and that's the driving force to make the electricity through a common synchronous generator that is routine to industry. After the R245 energy is mostly spent through the turbine process, it is then sent to a condenser, in this case air-cooled condensers where we pass air across coils.

It cools the 245 to a point where it condenses. And then it drains into the suction of a pump. That pump pumps it back to the vaporization side of the process. And it goes, in essence, around and around through that process.

The geothermal water, after it passes through the heat exchange process, is then cooled, and it is sent to the injection wells in a 100 percent recycled situation.

Unlike a flash plant where there is consumption, binary geothermal is a 100 percent reinjected process.

Q. Does the water ever come into contact with the R245 or anything?

A. No. The water from the time it is pumped out of the well or wells through the process -- unless there is an upset through a broken tube or something like that -- and in a plant as young as Lightning Dock that would be highly unusual -- the water is then sent through the process and either through natural pressure from the outlet of the plant or a booster pump is then pumped into the injection wells.

Q. So at Lightning Dock, what is the temperature of the water when it comes out of the ground and then after it passes through the heat exchanger going back into reinjection?

A. Certainly. The production temperature is very stable, and it is approximately 312 degrees Farenheit as it is pumped out of the ground. We use a pump in order to maintain a liquid phase. It never turns into steam. It stays as a pressurized, saturated water, as a liquid.

And as it's sent through the heat exchange process, the water is cooled, because, as I said, we are extracting the heat to make our electricity. The exit of the power plant temperature is dependent on the number of operating units. Currently we have four installed with others in development.

It is also dependent on the ambient air temperature. The higher the air temperature, the less efficient the process is. And that will cause the outlet temperature to vary.

So to answer the question, right now the outlet temperature is between 180 and 210 degrees Fahrenheit. But that number can vary, typically downward, because as we have more units in operation and we enter the colder winter months, we'll extract more heat and the unit will run better and we will have cooler injection temperatures.

But all air cooled power plants have a wide range of injection temperatures based on several variables.

Q. So, Monte, is there a scenario where the injectate would be 80 degrees or something cold?

A. It is very unlikely. There's very minor scenarios during a brief period of start-up, for minutes. But it is highly unusual.

Typically, you will see much higher injection temperatures during upset conditions, where the geothermal water is bypassed around the operating units and sent directly to injection during an upset, during an unfortunate utility interruption or a plant stoppage, and so that would be the case.

It is very unusual to see injection temperatures below about 160 degrees Fahrenheit on any of these binary type plants.

Q. So the water is still hot; when we call it "cool," it's still hot?

A. We call it "cool," we call it "cold"; the operators will call it the cold side of the plant. In essence, it is still a very hot -- from my safety side, it is still a process that is hot enough to be dangerous to people. You have to insulate the pipes and be cautious of it.

Like I said 150, 160; we wouldn't want it any cooler than that, because the properties of the water can become corrosive or scaling. I'm not as familiar with Lightning Dock; but my other facilities, we like to keep it above 150 to be injected.

Q. So you mentioned Lightning Dock now has four units and there are other units coming into place. Will you please talk about the surface plans for this location, this facility?

A. Certainly. Our plans are -- currently we've just been in the process of improving the existing four 1.0 megawatt gross units. They are in service, they are in place. The fourth one is actually starting today after some maintenance work.

And then the plans are we currently have been building out phase II. And the first part of phase II is there is construction completed on site. We have concrete in place. We have equipment, heat exchangers and turbines and generators and such for an additional one, a 2.3 megawatt unit and an additional 0.975 kilowatt unit. Those two are being built as we speak. And those will be air cooled as well.

And further to that, we have -- the next set of equipment will be installed as phase II. And that construction will commence later this year and in early 2016, where we will add two additional 2.3 megawatt units and an additional .975 megawatt unit.

Q. So these proposed injection wells, how do they fit into the plan for expansion?

A. Certainly. As with all of these commercial sized geothermal power plants, they typically start with a reduced amount of production and injection as you prove out the field and the process. And currently we are producing out of 45-7 and injecting primarily into 55-7.

These four additional shallow injection wells as well as our expectations for the existing 53 and 63-7, what they will allow us to do is to increase production of our geothermal water to 5,000 GPM as a nominal amount. And when you have increased production, you need increased injection.

And so the shallow injection wells that are being permitted, their intent is to lengthen and to increase the breadth of the injection area. You typically want to have a broad rock mass -- speaking as I've heard from the geologists over my years, you want to have a broad rock mass that you're injecting into.

And so what this allows is a well field that is then able to be managed, which is what I do. We manage the well fields in all of our sites in order to maximize the injection, minimize the return to production in order to have a balanced well field.

And what this allows is for the maximum amount of electrical generation, which is our product, and, hence, the maximum amount of revenue.

That said, we need to be able to do that for the life of the facility, which is, you know, approximately 30 years.

Q. So Lightning Dock has injection wells 63-7, 53-7, another one not on our picture out to the west, 17-7. Why can't Lightning Dock just change those wells for its injections?

A. Well, unfortunately, the part of geothermal power that is the most challenging for all of the developers and all of the companies I've worked with is being able to drill a well that is a winner every time. And, unfortunately, 53-7 and 63-7 have shown themselves to be a marginal injector.

This is not uncommon. It has happened at other sites I have managed. And the plan going forward -- actually, as we are speaking today, we are improving the pipelines out to 53 and 63-7 to allow plant injection pressure to go out there.

What we'll do is we will increase the pressure going to those wells through a traditional normal steel pipeline, like we have to 55-7. And so over time, when you apply the pressure from the outlet of the plant to those injection wells, slowly over time typically they will improve.

And I'm not speaking as a geologist; I'm speaking as an operator. And I have seen that occur at several other facilities that we manage. We most recently had success at Soto Lake Geothermal, where we were able to improve an injection well from a near zero injection to capability to in excess of 2000 GPM over the course of three years.

It's not a quick process, but it is a process that is proven over time.

Now, that said, in the meantime, as we are building phase II, we do need to be able to improve the production out of 45-7 through the existing pump or even a larger one and then return 55-7 to its original permitted condition, which is a production well.

That will then give us our production, which will be centered, as we can see from the drawing, centered near the facility, and then injection distributed around the facility to the east, north, and west, which will broaden the injection capabilities of the plant.

Now, selfishly for me, what that allows is we will be able to produce and inject the adequate amount of water to run the equipment at its general capacity based on the time of the year.

Q. So you talk about well field management and production and capacity and all of this sort of stuff, tell the Commission what you are managing for. Is it the long-term? I mean what happens when you -- how do you manage a well field? When you get to tweak, how do you do that?

A. Certainly. From my perspective, we manage several items. The three legs of our stool in our organization are a safe working environment for our team and environmentally sensitive.

We are a green energy company. We don't burn things and create CO-2. It's our core value to be environmentally sensitive to the water that we're given to use. And the third is that we have to generate an adequate revenue to be a profitable company.

That said, what we manage through that is we'll manage the well field daily, hourly, where the operators, the plant manager, and myself will manage the well field by watching injection temperatures and pressures on all of our active wells, and we will provide those -- that data back to our geologist and our hydrologist and to me. And as we watch that, we look for certain indications.

The operators will look for changes in pressure. Hopefully, we would see a reduction in well head pressure in an injection well. That would be indicated or collaborated by additional injection flow. And from that we would watch.

We also watch to see that our production wells are not changing negatively in temperature. This is critical. Even our CEO watches that number from all four of our facilities every day in the reports. We all watch that very closely.

Now, the analysis as to why things change we leave to the geologists and hydrologists. But the fact is that we record it, we monitor it and we adjust daily and hourly as needed to keep a well field operating in what I would call the best situation.

Now, that said, Ms. Henrie, we do that in order to keep these well fields productive, meaning they have adequate heat to generate electricity for the life of the project. It does us no value to, say, inject a high volume into an area that you'd have very quick returns to a production well, and, hence, cooling. It's, in essence, a flash in the pan.

You'd see very high production rates from the plant. And then, very quickly, you'd follow that by very low production rates, and that has no value to us as a company.

Now that all said, we do all that while I hold my plant managers to the standard of all the conditions of all of our permits, not just injection permits, but we have many others. And so they are held responsible for managing this within the limits of all of the conditions of our leases and permits.

Q. And all that data managing and that monitoring is realtime all the time, correct?

A. Correct. We do training. Our operators who are on site 24/7 -- we are green energy but we are also base load renewable. So we do operate -- our existing projects run typically around 99 percent of the year. We do have several days of downtime for plant outages for maintenance and then upsets from utility interruptions.

But for that 99 percent of the time, the operators are there day and night, and the plant manager is there virtually every working business day. And they look for the changes. They will see it far before I will see it or the geologist will see it at the end of a monthly report.

And so that is our approach. We treat them as they're managers of that facility and that well field, and they need to be the first eyes to see a change.

Q. I have just two more questions.

You talked about changes. Have you had experiences of breakthrough or other kind of changes that would affect the long-term sustainability of the well field and what happens in those kinds of situations?

A. Certainly.

Everything we do is in -- planning, and then we review what we are doing, we build a plan, we execute the plan, and we review the results. And that's in power plant operations. It is in well field operations. It is safety management. It is all of our aspects.

And so we have had -- in my history at our Stillwater Geothermal Plant in northern Nevada, in 1989 we did have a very quick breakthrough. Our injection wells were too close to our production wells. And we had a rapid temperature decline.

We saw that. We made changes in 1990. And by 1991, we had recovered to near the original production temperatures.

At our Empire Power Plant, again in northern Nevada, we had very shallow injection wells that were near 100 feet of casing depth. And one of them caused a flow to the surface. The operators were able to witness this. I distinctly remember the call. We called the equivalent of the agency in Nevada, the Nevada Department of Environmental Protection, Underground Injection, and we reported it. We stopped it literally within hours of detecting a stream on the surface that was hot water.

We found that that well could not be used. We continued to use its twin and other wells in the area for many, many years after that. We sold the plant in 1996, so I am not sure of after that. But we were able to evaluate the results of a change, a negative change.

We acted on those very quickly, and then we proceeded to move on. And then we drilled other injection that provided normal recirculation, which is from the production well through the plant to injection and then optimally it's far enough both in height, in depth, and in distance from production that it provides the liquid level to keep pumping. Because if you move all of your injection far away, then your liquid level will fall and the pumps will stop operating and then you have no plant -- but far enough that you have adequate residence time between injection and production to mine the heat -- because we do, that's who we are, we do mine the heat off the rock faces -- and then far enough away for mining heat, close enough to allow the same water molecules to go from production to injection in an infinite cycle over the life of the plants.

And that's been typical. We did actually have one event where we actually increased temperature. But this is not always the case. That was a huge benefit to us at our Soto Lake plant. But we can't ever count on that. That was just a fortunate turn of events.

Q. So the last question from me is why is the Lightning Dock Power Plant expanding?

A. Well, we are expanding because we have -- part of the challenges that come with geothermal power and all power in the United States right now is the ability to obtain a negotiated power purchase agreement.

We have such an agreement with PNM, we are currently producing into that system and selling the electricity. But we have a larger power purchase agreement than the equipment installed on site will satisfy. So we have milestones and agreements with not only our off-taker who is buying our commodity but also our financial backers who are funding us to purchase the equipment.

As the equipment is installed, we need additional heat for it. And so from that we will need to have adequate injection and production. And that plan is then being carried out by the continued use of 45-7, the conversion back to production of 55-7, the use of 53- and 63-7, which we expect to see improvement over the course of the next two to three years, and then the four applications for injection wells that will be redistributing the balance of the water in the well field.

MS. HENRIE: No more questions. I pass the witness.

CHAIRPERSON CATANACH: Mr. Lakins.

CROSS EXAMINATION

BY MR. LAKINS:

Q. Sir, are your power purchase agreements with any entity other than PNM?

A. Unfortunately, I am not familiar with that. I have not yet taken over the operation of the facility as it is transitioning from development and commissioning in my joining the company. I'm sorry, I can't answer that. I don't know.

Q. You would agree that any given geothermal production site is geologically unique?

A. As I have been told and as I have experienced it, yes, they have what has been told to me to be a thermal anomaly, where you were able to either have a surface expression of hot water or steam to the surface. We like it to be deeper so we are able to pump it. But, yes, they are unique from what I've been told is routine geology, which is just temperature with depth that doesn't give us anything unique.

Q. Maybe that wasn't a really good question.

Would you agree that each of the sites that you are familiar with -- because you were talking about a couple of other sites --

A. Very much.

Q. -- the geology at your site in Nevada, as an example, is unique and distinct and different from the site where Lightning Dock is?

A. Based on distance, I would have to agree. But I'll leave the definition of "unique" to the geologists.

Q. "Different"?

A. Different.

Q. And one of the things that you said is that -- and to make sure I understand this right -- you had talked about how you wanted to see the same molecules from production back into injection; is that...

A. Over time we understand that won't be 100 percent complete. But we do understand -- and my most experience is with Soto Lake Geothermal, so let me speak to that. I have been there since it was a green field in 1987 until Monday when I left to come here.

And so what has happened is that you do see a homogenization of the water typically. You will see that the same water will pass from production to injection and back again.

There is some that does move other directions.

And I'm sure that there's some that comes in from unique directions. Again, the hydrologist will speak of it. But the way I manage is that I need to have an adequate level of water in the wells to be pumped and I need the injection to be adequately far away that the water is allowed to reheat to return.

Q. To make sure I understand, essentially, then, the goal of the injection is to have the water go back to where it can be reheated and then be extracted again?

A. I would say that's a secondary goal. The primary goal is that it is injected in a way that it follows all the conditions of the permit. As you manage the field, when you have achieved number 1, yes, you'd want it to be able to mine the heat and return to production because of the secondary need of maintaining the liquid level that is -- the well's pumped from.

Q. So if the injection wells are situated in such a way that the injected fluid does not return to the production zone, what happens?

A. Well, I think as far as geologically, I'd have to leave that to our geologists and hydrologists.

If I produced from a well and the liquid level in that well declined, I would reduce production until at a point where I could no longer pump from that well.

There's various things that you can do to affect that. But I can't really speak of where the water would go from injection. I don't think I am qualified to say that. I think I am qualified to say, if I don't have adequate production, I would have to reduce it until I maintained safe operating parameters for my pumps.

Q. Would you agree that any given reservoir has a certain maximum capacity, and if you extract beyond that, the reservoir would be depleted?

A. I would say each reservoir does have limits because we are in a geographic area. Speaking to those limits, what I have experienced is that we need to manage the fields that we have. Most of the ones I have been involved with have been expanded over time. And none of my plants have shut down due to a lack of resource.

Q. Now, you are talking about hot water; "hot" is a relative term, is it not?

A. It is a relative term.

Q. 160 degrees in your hand is pretty darn hot?

A. Yes, it is. From my EMT background, that would definitely result in a burn.

Q. Putting 160-degree water back into the geothermal reservoir is actually putting cooler water into the reservoir, correct?

A. It is putting water that has been cooled back

into the reservoir, that is correct.
Q. And the goal then is that that water reheats and is used again?
A. Yes. But let me say that the injection wells, whether it is Lightning Dock or others, typically have not been produced, so we may have some temperature logs in them, but I can't state for certain that the injection wells have the same temperature in them naturally that the production wells do.
Q. And would you agree it is possible to extract too much, and when you inject that cooler water, the reservoir will ultimately cool down?
A. That can occur. It can occur, but then that comes to the management of the resource to minimize that effect.
Q. And that's really dependent upon the scientific aspect of what is the maximum capacity?
A. I would agree that's one aspect.
Q. One aspect.
And just to make sure I understand, the current production, is it four megawatts?
A. The current production capacity is at four megawatts. We are not there today because we are in the finishing stages of improving the existing surface equipment with nothing to do with the well field.

Q. What's the current actual capacity?
A. The current capacity as of yesterday, it was about almost two megawatts gross and it was about 1.5 megawatts average net.
Let me give you -- when we talk about the output of a plant, being the obsessive engineer that I am, there's different ways of qualifying that. Yesterday the plant made 27 megawatt hours. So that in a 24-hour period is about 1.2 or -.3 average. But during the cool of the morning, it did better than that. And during the heat of the afternoon, it did a little worse.
Q. But you said the average is about 1.5?
A. About. And it's improving as we go day by day right now.
Q. But the plant as built can do four?
A. Four megawatts gross less the needs of the plant, the pumps and motors and devices that are required for the process as well as for pumping the water.
Q. And you want to add 8.9 in two phases?
A. In phase II we do, yes.
Q. What is the total between phases I and II, because I got it as 8.9 from what you said?
A. Adding it in my head, we are at about that, and those are gross capacities off the generator. So from four and then adding about 8.9.

Q. So from four up to almost 13?

A. Gross, yes.

Q. So you want to go from the 1.5 where you are averaged at now to 13?

A. I would need to qualify that.

Currently three of the turbine generator sets are capable of running at their 1.0 megawatt. We are still in the commissioning phases of the improvements that were completed all summer. And so we are building to go from the four megawatts gross capacity to the 13.

Q. So what was the average over the last year then?

A. Gosh, sir, I hate to tell you this, but I don't know because I haven't studied it. I only joined the company in January and I don't know.

Q. Okay.

MR. LAKINS: I pass the witness.

MS. MARKS: I have no questions for the witness.

MR. DOMENICI: Just a couple.

CROSS EXAMINATION

BY MR. DOMENICI:

Q. Are you familiar with the term in geothermal power production related to the water of a closed loop system?

A. On the geothermal side, yes.

Q. On the geothermal side.
A. I am familiar with a term that the definition may be similar to yours.
Q. And what would that be?
A. Mine would be that we are producing and injecting from a resource that is potentially bounded. And it isn't an open resource -- again, I am not a geologist. I am a surface guy. So I hear them a lot, but I am not one.
So I would view it as one that is from a resource that is more of a -- it's limited in its width and breadth as opposed to having natural water flowing past the site, which I have managed one of those as well, underneath ground water flowing.
Q. And what do you consider this site?
A. I would leave that to the geologists. My lack of familiarity with the geology leaves me pretty uninformed there.
Q. But you managed a site that you would consider not a closed loop?
A. Yes, I have managed the site that was non-closed loop. It's Steamboat outside of Reno, Nevada, where water was migrating out of the Sierra Nevadas toward the valley in the Truckee Meadows. And they are unusual. From my experience, they are typically unusual to have a

site where water is flowing past the site in a surface arrangement.

Q. And in terms of the -- not looking laterally but looking up and down --

A. Yes.

Q. -- do you know whether this is a closed loop site?

A. Again, sir, I will defer to my geologist/hydrologist.

Q. Just based on operations, do you know if this site was represented to the community as being a closed loop geothermal project; do you know one way or another?

A. Due to my term with the company, I don't know those representations.

Q. In your experience managing these kinds of operations, has that been important to your neighbors, whether or not your facility was operating in a closed loop aquifer or as this one you mentioned that you manage where the water was flowing through?

A. I would say it is important that the resources were managed to mitigate the challenges that come with injection through either temperature or level decline.

I would say as far as being in a totally segregated or separated system, I can't represent that, to what it was said to the neighbors there.

MR. DOMENICI: That is all I have. Thank you.

EXAMINATION BY EXAMINER BALCH

EXAMINER BALCH: So, Mr. Morrison, 13 megawatts planned through phase II, right?

THE WITNESS: Yes, sir, gross.

EXAMINER BALCH: Is that a cap or is there a potential for more?

THE WITNESS: Well, we would like to think -- because we are developers, we'd to think always that there is a potential to improve the site or be able to be near it. Right now that is the limit of the equipment that has been purchased and the limit of the power purchase agreement that has been procured.

It is also the intentions of the company to operate at the level with our existing production wells and future injection wells, to manage it and produce and optimize the site at that point. That would be --

EXAMINER BALCH: So phase II would be dependent upon the performance of phase I --

THE WITNESS: At any of our sites, that would be correct, yes. Any future expansion is based on previous performance.

EXAMINER BALCH: I know you're talking about a 30-year design life.

THE WITNESS: Yes, sir.

EXAMINER BALCH: But you would probably like to see it also go on longer than for 30 years?

THE WITNESS: Yes.

EXAMINER BALCH: 30 years is the minimum that you think you can get from the information that you have and the rate you want to produce?

THE WITNESS: If that's a question, I probably spoke from my experience. Most of my sites that I have operated are in service.

I started in 1985, and every site that I have managed is currently still in production, and a couple of them have gotten there.

The surface equipment typically will wear out in 30 years. The production wells at Soto Lake, Stillwater, Empire, Steamboat, southern California, Hawaii, they will go on beyond that and most have.

There are needs to drill in the future for wells that degrade through corrosion and other effects. But the equipment, typically the efficiency of it, much in the way automobiles are, 30-year cars don't get the mileage of 2015s. So that's the -- that is sort of the tipping point when you look at repowering a project.

The well field is such that I expect the wells that I have managed at Soto Lake to go far beyond

30 years. And their 30-year anniversary would be -- '87, so it would be 2017.

EXAMINER BALCH: Also as a business, 30 years would be what you're looking at?

THE WITNESS: Thirty years would be the look at as far as the durability. That's typically an industry standard that I'm familiar with.

EXAMINER BALCH: Do you work with a lot of engineers?

THE WITNESS: I do. I typically work more with business and operations people. I am an engineer but I typically am not with too many of them.

EXAMINER BALCH: So you're familiar with the engineering safety factor?

THE WITNESS: Oh, yes.

EXAMINER BALCH: Of two times or more. So I am presuming that if your business plan is taken into effect, then you could probably do more than you already are trying to attempt?

THE WITNESS: More in what regard?

EXAMINER BALCH: Well, you could produce more water and you would produce more energy in theory.

THE WITNESS: Yeah, that engineering safety factor kind of goes out when you get into hydrology and geology. So I will speak to the sites that I manage that I'm much more familiar with.

My intent is to produce the water that the wells are capable of, inject in such a manner that I maintain that, that I don't degrade my temperatures and I have long durability.

I would typically be very disappointed if I had a well that could produce twice the amount of water and I couldn't extract it. That would be disappointing to me. And, typically, we would want to be able to produce at the limits of the well.

Actually, one of the wells at Lightning Dock is so good that we probably will have some capacity left in that well, in 45-7, because the means through the pumps are -- through physics, they are just incapable of producing what the well can deliver.

I hope that answered your question. I didn't mean to be cagey.

EXAMINER BALCH: No, that's fine. Similarly for the injection site, I believe one of the reasons why you are in this room in front of the Oil Conservation Commission is that we deal with wells --

THE WITNESS: Yes.

EXAMINER BALCH: And injection.

THE WITNESS: Yes.

EXAMINER BALCH: And injection pressure

limits and things like that?

THE WITNESS: Certainly.

EXAMINER BALCH: So those factors all have to be taken into account in your design of your disposal field --

THE WITNESS: Yes.

EXAMINER BALCH: Or your recycle field?

THE WITNESS: It would be better termed, yes, yes.

EXAMINER BALCH: Right. Which comes to the next question and I think it's mirroring what Mr. Lakins was saying. If you are injecting shale, are you going to be able to ensure long term enough recycle to be able to keep your production up at a high enough level?

THE WITNESS: I will let the geologist speak to the underground pathways and methods.

What I would manage would be the injection pressure limitations based on the first entry into the well. I will manage to the temperature that the production wells produce at, and watching those to the tenth of a degree over time.

And we watch for changes in pressure and volume that are atypical. Our regulatory body in Nevada is very keen on this. And we do watch those plots very closely. So I think I will leave the subsurface view to the geologist. I would tell you what I would watch and what I will manage from the surface.

EXAMINER BALCH: From an operational point of view --

THE WITNESS: Yes.

EXAMINER BALCH: I am asking a little bit after Mr. Domenici's question.

THE WITNESS: Uh-huh.

EXAMINER BALCH: Is your design for the project to gradually deplete the reservoir over 30 years or is it to constantly maintain it --

THE WITNESS: Oh, my gosh. Absolutely we would want the resource to be in 30 years, after I am far retired, to be adequate for a repowering of the facility to produce additional electricity through more efficient means.

Certainly we would not ever intend to deplete a resource intentionally. Because the time frame we are dealing with in power plant time, the 30-year period, to me is so great that you need to work today to have it the same next year and in ten years and in 30 years.

Certainly we may plan for a very small degradation in temperature, and that has occurred across geothermal fields all over the western U.S. and internationally. But we certainly wouldn't ever do anything to exacerbate that. We would do everything in our power to maintain it.

And I have some very selfish reasons for that. I have budgets to maintain, I have generation forecasts to make. And if we lose one degree of temperature -- it is the old thing, if you are losing money on a widget, you can't make it up on volume.

If you're using your geothermal and you lose temperature, you're not going to make any more electricity unless you're more efficient. And at some point, that's a losing battle.

That said, I'm selfishly wanting the highest temperature for the longest time possible.

EXAMINER BALCH: Thank you, Mr. Morrison.

THE WITNESS: You're welcome.

EXAMINATION BY COMMISSIONER PADILLA

COMMISSIONER PADILLA: Can you quantify the small degradation that you just referred to?

THE WITNESS: It varies on every field I have operated. Some wells have a temperature decline of potentially a degree a year; others, much less. And the ones Ms. Henrie asked me to describe, they were much higher in the short term. And then those wells were stopped. I mean, we physically stopped and made radical adjustments due to those changes.

So we would potentially budget for less than one degree per year.

COMMISSIONER PADILLA: Going back to the safety side of the coin, what kind of injection pressures are we talking about for this project?

THE WITNESS: Again, because we are not -- we are producing at 312 degrees. I will give you a little background. We are producing at 312 degrees; therefore, we have to have a production pressure that is in the 100 psi range, plus or minus. And that's in order to maintain the steam in liquid phase. We don't want the steam to break out.

And we also don't want any gases. Now, I am totally unfamiliar with the amount of CO-2 or other dissolved gases in this water, but I will speak to my other sites. We would need to maintain a little bit of pressure to maintain those in solution. So that said, a typical 312-degree production well will be produced at about 100 psi, maybe 110.

After it passes through numerous tubes, valves, pipes, and such through the process and it is cooled, we would inject at less than 100 psi. But that said, that is dependent on each individual injection well.

An injection well with a 1,500-foot solid casing could be injected into at a much higher pressure than one with 150, of which three of ours are projected, and 500. And so we would limit that at the well head, if needed, to maintain it under the permitted injection pressure. And those vary on the gradient and the temperature of the water typically.

COMMISSIONER PADILLA: Mr. Janney touched on the fact that 63-7 and 63A-7 -- or 63A-7 was being permitted close to 63-7 because it had desirable porosity levels, for which he had testified that the 63-7 was a marginal well. I am just wondering if you can clarify.

THE WITNESS: Because I was not involved in the drilling of 63-7 and because of the vast difference of the height of first injection, I will let the hydrologist answer the question. But I could only assume why that is the case.

I would make assumptions, but it would only be guessing and not giving you fact.

COMMISSIONER PADILLA: Thank you.

THE WITNESS: You are welcome.

EXAMINATION BY CHAIRPERSON CATANACH

CHAIRPERSON CATANACH: Mr. Morrison, do you know if the reservoir temperature varies from the shallow to the deeper injection wells?

THE WITNESS: I do not know that.

CHAIRPERSON CATANACH: And currently you are not bringing any outside sources of water to inject into the injection wells; it is all producing from the formation --

THE WITNESS: That is correct. Everything that we produce from 45-7 is being injected into the field with no other waters being introduced.

CHAIRPERSON CATANACH: Currently you're producing out of 45-7 and injecting into 55-7; is that correct?

THE WITNESS: Generally, yes, that's correct. With 53-7 and 63-7, there are some small pipeline upgrades but they have been injected into as well over time.

CHAIRPERSON CATANACH: Smaller amounts?

THE WITNESS: Yes. That's the reason for injection permits we're requesting for certain.

CHAIRPERSON CATANACH: Is the injection interval in the 45-7 the same as the producing interval -- I'm sorry. The 45-7 and the 55-7, is that the same interval, do you know?

THE WITNESS: Unfortunately, sir, I don't have the schematics well evaluated yet on how the wells are constructed.

CHAIRPERSON CATANACH: They are pretty close in proximity. Have you seen a reduction in the temperature of the producing well with that?

THE WITNESS: I have not seen it. But, again, my time is limited. I have not heard of a temperature decline in that. They are very close together, and I haven't seen that temperature in my limited time of watching the site.

CHAIRPERSON CATANACH: So you don't know --

THE WITNESS: I don't know.

CHAIRPERSON CATANACH: Were you involved in the planning of the location of the four injection wells?

THE WITNESS: No, sir, I was not.

CHAIRPERSON CATANACH: Would it be your opinion that the way the proposed injection wells are situated that you would expose more of the formation than has currently been exposed to injection and possibly gain more heat that way by exposing more of the formation to water injection?

THE WITNESS: Based on my surface experience at other sites, by lengthening and broadening the geography of where the wells are placed, yes, that would be the case; as well as by deepening the zones where the water would have to migrate from the more shallow injection points to the deeper production points.

I am just making a general observation. If you took the site, made a cube of it, laid it on its side, we could all agree to that, I think.

CHAIRPERSON CATANACH: I have nothing further.

EXAMINATION BY MR. BRANCARD

MR. BRANCARD: I have a question. So the application is for four new injection wells. Are those four injection wells intended to get this project all the way through phase II and the 13 megawatt goal or may there be need for more injection wells along the way?

THE WITNESS: It is my understanding they will, but as the wells have yet to be drilled and the risk that comes with drilling -- if anybody in geothermal likes that risk, they are usually unusual and they go out of business too quickly.

It is our intent that if each were successful, yes, this would take us to a point where we are able to produce from the two existing producers of which one we are using as an injector currently, 55-7, we would inject as much as we can under permit to 53 and 63, and the balance to the four shallow injectors through phase II.

And then it is certainly my expectation that 53 and 63 would then improve over time and we would have a broad spectrum of injection capabilities at this site that we are able to produce locally and inject in that length and breadth.

CHAIRPERSON CATANACH: One more. What is the mechanism by which injection performance might improve in the 55-7 and 63-7?

THE WITNESS: The mechanics of the rock I'll leave to the experts.

As I watch the gauges through my operators and I read the reports, what we see is over time the wells will be limited to the maximum injection pressure; slightly under, we never want to go over. You never want to approach a notice of violation. So that is just good, prudent business practice.

Over time you will see wells that take almost no injection. And I will speak to the one that I am most familiar with at our site in Nevada. And over time that well improved where it barely kept the pipeline warm during very cold winter operations.

And over time, it would slowly improve, and the operators would -- and I mean very slowly. You would increase the valve opening one or two percent after a month or two, because what they would see is that the injection pressure would very slowly decrease.

And as that decreased -- usually the injection flow rate is inversely proportional to injection pressure. So as the injection pressure declined, you can increase flow.

In just general terms, we would go from -- the lowest a flowmeter can typically record is maybe 50 gallons a minute. You would see it go from 50 to 100 as the operator would make a step change.

All of us, my plant manager and the shift supervisors and such, would see that and we would ask, What's going on?

The operator would say, Well, I saw the injection pressure go down and I was able to open the valve and return the pressure back to near the permitted limit.

And that will occur on a time to time basis -- at Soto Lake, it took three years.

So that is the mechanism that we would use, the conditions of the permits, good prudent operation. And, at the same time, we are watching production temperatures.

Now this field is very small in number of wells. We have other fields that have 13 producers and injectors total, and it is more complicated. But we do the same thing at those sites.

COMMISSIONER PADILLA: Just one more question. Have you ever seen the reverse happen?

THE WITNESS: I have. Only on a production well, where I saw the temperature increase from 330 to 360 over the course of weeks. And it was a very deep well, and our understanding was that we were opening the resource -- and I am talking very deep, like a 9,000 foot directional well. And it was open for 7,000 feet. And we feel that we were getting deeper flow that we didn't anticipate.

So I have seen it once, a production well increase in temperature dramatically. Some will change, you know, over the course -- they will move around 1 degree or so. We never get nervous over that.

COMMISSIONER PADILLA: Thank you.

THE WITNESS: You're welcome.

MR. BRANCARD: Let me just follow up on the question I asked then.

So is there sort of a linear relationship between the amount of power you are trying to get and the amount of liquid that is moving through the system?

THE WITNESS: Absolutely, sir. We use the term "heat rate." It's the same as used in thermal power plants, whether you are using the radiation from nuclear or burning coal or gas. From a certain amount of potential energy, you will generate a certain amount of electricity through the efficiency of the process.

So that said, we typically on this project, at 212 degrees, we expect about 2 kilowatts per gallon per minute nominal, meaning, we get to about 5,000 gallons a minute, we will generate about 10,000 kilowatts or ten megawatts.

Now, that is all dependent on ambient air temperatures and the number of units that are on line for maintenance purposes. But, generally, that's the case. It is a linear relationship. Where that does break down is in the heat of the summer in air-cooled condensers, you do have a much quicker fall-off in production.

One of our sites actually moves ten megawatts in one day. From the heat of the day to the cool of the day, it will move ten or more megawatts. It is very troubling to management when they see this in Salt Lake City. We've explained it to them.

That is a nominal number, using the annual energy we generate in megawatt hours over the course of a year and the average production flow rate, it is about linear at about 2 kilowatts per GPM.

MR. BRANCARD: So if you are now producing sort of at a average of one-and-a-half megawatts and your goal is 13 --

THE WITNESS: Our goal is 10. The 13 would be gross, because we do have the parasitic load from pumps and motors and fans and computers and coffee machines and so on.

MR. BRANCARD: So one-and-a-half to ten net?

THE WITNESS: Right.

MR. BRANCARD: Are you looking then at an increase in injection of six to seven times the --

THE WITNESS: No, sir. We are looking at -- the production well currently can produce in excess of 2,000 gallons a minute. And we can inject that into 55-7. So our intent would be to supplement the injecting through the four shallow injectors, improving through 53 and 63 in order to accommodate the entire -- and I didn't get into this, and if I may speak freely on one bit of physics -- is that okay?

EXAMINER BALCH: I'm a geophysicist so go for it.

THE WITNESS: All right. There we go. You know this, then, so we're good to go.

The water actually shrinks in volume over the course of cooling. And this process from 312 to, say, 160 degrees Fahrenheit, the water will generally shrink about 8 to 9 percent. So if you produce 5,000, really you are only going to inject about 4,500 gallons per minute.

The mass is the same. If you put it on a scale, that mass of water is the same. But, physically, if you could contain a gallon of 312-degree water in a sealed high pressure vessel, that same gallon when you cool it to 160 will physically shrink about eight to nine percent. And I say about because it depends on the injection temperature.

So to answer your question, we are looking to inject that 4,500 gallons a minute, where currently we can inject into 55-7 all that the 45-7 will produce. So it's an increase of about two times, a little more than two times, not the six times.

The reason we are producing so low right now is we are in the final stages of commissioning the improvements on the equipment at site. The site is new, the manufacturer had some improvements. We are very pleased to have them do that for us. And so we are just in the mode of improving production.

The site could produce on a hot summer day right now probably more on the order of about 70 megawatt hours, give or take. And, again, my lack of familiarity -- I am guessing a little bit -- you know, in the 60 to 70 megawatt hours instead of the 27.

And that is nothing to do with the resource. None. It's solely due to the process equipment at the surface and its availability.

Does it make sense?

EXAMINER BALCH: You didn't mess it up.

THE WITNESS: That's good. Thank you.

CHAIRPERSON CATANACH: Anything further of this witness?

MS. HENRIE: No.

CHAIRPERSON CATANACH: This witness may be excused. How long is your next witness?

MS. HENRIE: It is Dr. John Shomaker, and I anticipate a lot of questions.

MR. BRANCARD: Mr. Domenici, you have a non-technical witness?

MR. DOMENICI: She will just take two minutes if you want to do that. No problem. Then she'll get to go home. But she did be here after lunch, too.

CHAIRPERSON CATANACH: Let's do your statement.

MS. SHANNON: I am just giving an emotional statement, more or less. Thank you for letting me speak. I will go quickly.

THE COURT REPORTER: Please state your name.

MS. SHANNON: I'm sorry. I am Darr, D-a-r-r, and my last name is Shannon. I am from Lordsburg, New Mexico. I am a commissioner of Hidalgo County and the vice chairman of the Hidalgo Soil and Water Conservation District.

My family has been from Hidalgo County for 125 years. And I have a very, very, very deep love for my county and everything that goes on in it.

Hidalgo Soil and Water Conservation District is charged with protection, conservation, and wise use of our natural resources located within our district. We have been following with some concern and great interest the development of geothermal energy in the Animas and southern Hidalgo County area.

In the spring of 2013, concerned citizens brought to our attention the issues they had with the geothermal initiative brought on by Cyrq/Lightning Dock Geothermal, specifically the reinjection process.

In our effort to better understand the process and form an unbiased conclusion, several public meetings were held and information was given out concerning the geothermal energy projects.

At our regular monthly meeting on November 17, 2013, it was explained to us that it would be a closed-loop system and that it would have no effect upon our shallow water aquifers, which we were extremely concerned about at the time. And that is the reason why we requested this meeting.

The deep geothermal water would be extracted and then reinjected into the same deep geothermal waters with no mixing or interfering with our shallow water aquifer that is used for irrigation, human consumption, livestock water, and other domestic uses.

Over the last year and a half, several expensive deep wells have been drilled and used with very limited success. And the proposal has now changed to reinject the water into the much shallower waters' aquifer. This mixing of water will have a tremendous detrimental effect on our water quality as the geothermal water has different properties than the water we are currently using and consuming.

This violates the original intent and permitted request -- and I emphasize the word "permitted" -- that has allowed this development to go forward to start with.

The Hidalgo Soil and Conservation District wishes to go on record as extremely opposing these requests.

Thank you very much for your time.

EXAMINER BALCH: Ms. Shannon, you are opposing the shallow water injection?

MS. SHANNON: Yes, sir. Sorry I sat down. Do you need me to come back up?

CHAIRPERSON CATANACH: That's all right.

MS. SHANNON: Yes, sir, we do oppose; I mean we are extremely concerned.

CHAIRPERSON CATANACH: Thank you, Ms. Shannon.

MS. SHANNON: Thank you.

CHAIRPERSON CATANACH: I guess we will break for lunch at this time.

MR. BRANCARD: I just wanted to bring up in regard to non-technical statements, we received -- and I think I forwarded it to the parties -- a statement by a Mr. McKants. I forwarded it to the party that week.

I believe he wanted to put something in the record. And I can pass that around and folks can look at that.

CHAIRPERSON CATANACH: Have you seen the documents?

MR. LAKINS: No.

MR. BRANCARD: It was submitted to Commission Clerk also.

MR. LAKINS: Mr. Brancard --

MR. BRANCARD: I forwarded an e-mail from Mr. McKants. And, basically, he took his e-mail and turned it into --

MR. LAKINS: Oh, that one. That was not just recently. That was some time ago?

MR. BRANCARD: Some time ago.

MR. LAKINS: Yes. I have seen it.

MR. BRANCARD: Okay.

MR. DOMENICI: I will take a look at it.

MR. BRANCARD: We can talk about it after lunch.

MR. DOMENICI: Sure.

CHAIRPERSON CATANACH: Let's break till about 1:30.

(Lunch recess from 12:20 p.m. to 1:35 p.m.)

---oOo---

CHAIRPERSON CATANACH: We will call the hearing back to order and turn it over to Ms. Henrie.

MS. HENRIE: We would like to call John Shomaker as our next witness.

CHAIRPERSON CATANACH: Please swear the witness in.

JOHN SHOMAKER

having been first duly sworn, was examined and testified as follows:

MS. HENRIE: First, Mr. Chairman and Commissioners, I am going to be asking to qualify Dr. Shomaker as an expert. His bio and credentials are in your exhibits under the Shomaker tab.

DIRECT EXAMINATION

BY MS. HENRIE:

Q. And with that, Dr. Shomaker, I'm going to ask you to just tell us who you are and some of your credentials to be qualified as an expert in hydrogeology and also geology.

A. Yes, thank you.

I'm John Shomaker, one of the principals in the consulting firm in Albuquerque called John Shomaker and Associates and a geologist and hydro geologist by education and experience.

I have a bachelor's and master's degree in geology and master's and Ph.D. degrees in hydrogeology. My experience in hydro geology began in 1965 with the U.S. Geological Survey.

And then I had four years with what was then called the New Mexico Bureau of Mines and Mineral Resources.

And beginning in 1973, I have been a consultant in hydro geology dealing with groundwater problems of all kinds, almost all in New Mexico.

Q. Very good.

MS. HENRIE: Commissioner, I would move to qualify the witness as an expert.

CHAIRPERSON CATANACH: Any objections.

MR. LAKINS: No objections.

CHAIRPERSON CATANACH: So qualified.

Q. Dr. Shomaker, did you testify before this Commission at the 2013 hearing?

A. Yes, I did.

Q. And what was the gist of your testimony back then?

A. The testimony I gave at that time was partly about a general description of the hydrologic aspects of the geothermal system, partly about the fact that testing up until that time had led to the conclusion that the system would be a closed-loop system in equilibrium.

I spoke a little bit about a pumping test that had been carried out by AmeriCulture.

Q. And what does equilibrium mean?

A. To me, when I use the term "equilibrium" in this context, I am talking about a system in which the pumping from the geothermal production well and reinjection into injection wells are in balance so that the flow from the injection well or at least the pressure response comes into equilibrium with the drawdown in the production well, so it is truly a closed loop.

Q. And what kind of data would tell you whether the Lightning Dock Geothermal system has come into the equilibrium post plant start-up? What kind of data would tell you that?

A. The primary information would be the pumping water levels in the production well and the casing head pressure in the injection wells.

Q. Has that data been provided to you?

A. Yes, it has.

Q. And I'm going to direct you to Exhibit 3, so Lightning Dock Exhibit 3. And could you tell me, was Exhibit 3 prepared by you or at your direction?

A. Yes, it was.

MS. HENRIE: I would like to move admission of Exhibit 3.

MR. LAKINS: No objection.

CHAIRPERSON CATANACH: Exhibit 3 will be admitted.

(Lightning Dock Geothermal Exhibit 3 was offered and admitted.)

MS. HENRIE: Thank you.

Q. Please walk the Commission through this exhibit.

What does it show?

A. Yes. I would like to begin on the second page of Exhibit 3 with a sort of logical sequence with the graphs relating to production well 457.

On this graph there are three plots. One is the temperature that has been measured as the well has been produced since the beginning of last year. And that's the orange symbols. And then the flow rate, the pumping rate from that well is indicated with the green symbols, and the depth to water, the pumping water levels in the well are indicated by the purple symbols.

And in my examination of this plot, it appears that the water levels have not changed very much and the flow rates, the pumping rates, have not changed very much since the latter part of 2014. And the temperature also has been very stable during the whole period once the plant was in operation.

In moving to the first page of the exhibit relating to injection well 55-7, here the casing head or injection pressure at the surface is given by the green plot. The flow rate is given -- excuse me -- I meant by the blue plot. The flow rate is given by the green part and the ratio of the flow to injection pressure is given by the red symbols.

And here again it appears clear that since late

2014 the flow rate has not changed greatly in terms of its trend, and the pressure has not changed very much in terms of its trend. The ratio of flow to casing head pressure did not change very much during most of 2014. And then it rose significantly in the latter part of 2014 and has been relatively stable since then.

The combinations of fairly consistent flow rate, pumping rate, and injection rate into the 55-7 and the fairly consistent pumping water levels in 45-7 and fairly consistent casing head pressure in 55-7 lead me to believe that the system is in equilibrium, things are stable and, therefore, that a closed loop exists.

Q. And I think I heard you say this, but let me ask anyway, what, if anything, have you learned about the temperature of the production well, 45-7?

A. Looking again at the second page of the exhibit, here the orange plot is the temperature. And it has been essentially stable at approximately 312 degrees Fahrenheit since very early in 2014.

Q. So if the temperature were going down, that orange line would dive off?

A. That's correct.

Q. Are the monitoring wells also in equilibrium?

A. I think they are. The water levels in the shallow monitor wells generally rose during the early part of the operation. But in the last number of months, those water levels are relatively stable, suggesting that whatever groundwater mound has been created in response to the injection has now become stable as well.

Q. At the hearing in 2013, do you recall discussion about a boundary condition between the production well 45-7 and the injection well 55-7?

A. Yes, I do.

Q. And what would you expect to see in this data if such a boundary existed?

A. If there were a barrier to flow or to pressure response, propagation of pressure across a boundary, I would expect to see the water levels in the production well decline and I would expect to see the casing head pressurize, given the same pumping rate and injection rate.

Q. Do you recall where the boundary -- what was the source of the hypothesis system about boundary condition?

A. I think there are two conceptually. One is that there is a mapped fault and clearly is a fault between the two wells, which, apparently, from the records that we have just been discussing, is accompanied by enough fracturing that it does not constitute a barrier.

The other source of the concept that there might be a barrier to flow arose from the interpretation of a pumping test that Mr. Witcher prepared on behalf of AmeriCulture.

Q. If you could turn to Exhibit 4, and let me ask you if that is a report of the pumping test that you are referring to?

A. Yes, it is.

Q. And can you describe to the Commission, just real briefly, what was involved in this well test?

A. There were two observation wells and one well being pumped. One of the observation wells was on the same side of the projected fault as the pumped well and the other observation well was on the opposite side.

And the interpretation of the test was that -- and it is given in this report -- was that a barrier must exist because of the late onset of drawdown effects in the monitoring well or the observation well that was on the opposite side of the fault.

Q. And how did the report get to that conclusion? What methodology?

A. I don't think that the results or the data from the monitor well on the opposite side of the fault was actually used in the calculation. I think the conclusion was drawn based on the evident late arrival of drawdown effects shown in the plot.

Q. Okay. And did they use a Cooper Jacobs or Tice equation to get there?

A. The test was interpreted using the Cooper Jacobs simplification of the classic Tice equation. But, again, that interpretation seems to have applied only to the monitor well or the observation well that was on the same side of the fault.

Extending that same interpretation, using the same method to the well that was on the opposite side of the fault, I found no indication that a barrier existed, and, in fact, given the different distances of the two monitor wells from the pumped well, the two sets of responses seemed to be perfectly consistent.

Q. AmeriCulture's prehearing statement had discussions about ground water or shallow ground water. Can you describe the shallow ground water in the Lightning Dock area?

A. I think the shallow ground water should be thought of -- in the Lightning Dock area, within the area of the geothermal anomaly, should be thought of as a part of the geothermal system. The geothermal water rises from depth and fractures.

The water arrives there, I think, through flow through a semiconfined or a leaky artesian aquifer at depths and then rises through fractures until the fractures reach the base of the valley fill and then that water moves into and mixes with water in the shallow aquifer. I think such mixing also occurs at depths below the alluvial fill.

And I think we will hear testimony from geochemical background that goes to the point of mixing the hottest geothermal water with the fresh recharge at depths considerably below the bottom of the valley fill.

But, certainly, when the geothermal water already partly mixed reaches the bottom of the valley fill, it mixes with still more fresh recharge and the mixture moves down gradient in the Animas Valley.

So, in my mind, the shallow aquifer, the alluvial fill or the valley fill contains part of the geothermal system. The system as a whole is the water in the fractures in bedrock and also water, top fluoride-rich water in the valley fill.

Q. So if it is hot fluoride-rich water, even if it is not the hottest, most fluoride-rich water, and even if it's shallow and not at depth, if it's hot and fluoride-rich, you would characterize it as part of the geothermal system?

A. Yes, I would, because some of the development of this geothermal resource in general has been from shallow wells, from wells that were completed in the valley fill.

Q. And do you have an opinion -- one of the questions from the Commissioners earlier was about the scope of the impacts from the mounding or from the effects of the power plant well field or the power plant operations in the geothermal system.

Do you have any thoughts about the scope of what those effects might be, geographic scope?

A. I think as long as the system -- let's put it this way. As long as the geothermal project involves a closed loop, involves reinjection into the geothermal system, as I defined it, the effects will not go much beyond the limits of that geothermal system, just because all the water that's moving as a result of the pumping and reinjection from the project will stay within that system.

On the other hand, certainly, pumping and reinjection changes the way mixing occurs. It changes the distribution of pressure in the system and will also change, to some degree, the chemistry within the system. And we have already seen that. We know that the pressure changes as a result of the injection because of the mounding that's occurred.

We also know that the mounding, if the system is a closed loop with balanced injection and pumping, we know that the mounding represents an increase in groundwater head, at the higher, at the upper part of the system which moves that water downward, so that we, in effect, create a flow loop within the geothermal system, with water moving down to replace the water that's been pumped.

So I think the effects will stay in the system in that way.

Q. So would you expect that the proposal for these injection wells, would you expect these wells to expand the scope of the geothermal system laterally?

A. I think the geothermal system is a natural phenomenon, and I don't think the addition of wells will change its size and configuration.

As I said, I think that the placement of pumping and injection wells and their depths will change the way mixing occurs and will change the relative groundwater heads and, to some degree, the chemistry.

Q. Would that be true of all wells in the geothermal system, including AmeriCulture's and the old Rosette wells?

A. Yes, I think so. I think it would apply to all of them.

Q. And let me go back just a second, back to

Exhibit 4. And I asked probably the wrong question. We talked a little bit about using the Cooper Jacobs solution as a way to analyze or frame the data that was derived from that pump test.

And I just wondered if you think the Cooper Jacobs was the right approach for evaluating data obtained from this well test.

A. The Tice equation and the Cooper Jacob variant, which is a simpler solution to the Tice equation, is designed for an infinite homogenous isotrophic fully confined aquifer, none of which tests are met here, because we have at least a depth, a permeability almost entirely confined to fractures and we think that the system has significant limits, not very far from the center of the geothermal system.

So Cooper Jacob would be a thing to try, but it is certainly not a fully appropriate way of modeling the system.

Q. And, Dr. Shomaker, I have seen in writing and heard it said that this Exhibit 4 well test shows that well 55-7, which is right now Lightning Dock's injection well, is in direct hydraulic connection with shallow water wells.

A, does the report prove anything about the 55-7 and, B, how much connection is there in the Lightning

Dock -- or I should say actually the geothermal system, how connected are the deep wells and the shallow wells?

A. Let me make two answers.

Q. To two questions, fair enough.

A. The data that were collected in well 55-7 during this pumping test that is represented in Exhibit 4 only consisted of about seven hours of water level measurements made right at the end of nearly two days of pumping.

There was kind of a complicated pumping system scheme. After the part of the test that was interpreted came pumping from two other wells, two additional wells, which complicates things.

There were very few measurements at the end. No measurements during the bulk of the pumping period. No pre-pumping measurements, no record of water levels in that well prior to pumping.

And it is interesting to note that in some information received from AmeriCulture, which actually came from the state engineer measuring water levels in the well in the area, the range or variation among three of the state engineers' water level measurements, taken at the same time on the same day, is almost as great as the range of variation in the measurements that were taken of the 5-7 well.

And so I think I would be tempted to reject all of the data from the 55-7 well measurements, partly because there was no connection in terms of data with almost all of the pumping test and partly because the range or variation, it seems that it could well be within instrumental error, the way that measurements were made, or the small random variations in water levels that occur in wells anyway, especially geothermal wells. So I would not draw any conclusions from the 55-7 test.

Q. That being said, deep wells and shallow wells within the geothermal system, are they in relationship with each other?

A. Yes. I promised you two answers and I only gave you one. The answer to the second question is that I think all the wells in this system, regardless of depth, are connected in the sense that the system itself consists of water moving in fractures until those fractures reach the bottom of the valley fill aquifer in there. Of course, the valley fill aquifer connects everything.

So I think it would be correct to say that the water being pumped from well 45-7 and injected into 55-7 would be in some degree of connection.

Q. One of the protestant's concerns is the

AmeriCulture federal well. The state engineer's number was A444. And I think you know where the well is. It's not actually labeled on that chart, but if you look real close, you can see where it's been placed.

And the concern is that -- there you go, John. Excellent.

A. Sorry. I'm getting a little old.

Q. And the concern is that there's been some mounding in that well, which I think protestant is going to say attributed to 55-7 or the injection well that we have been operating.

What are your thoughts about that?

A. Again, the water level measurements made, I gather, by the state engineer and furnished by AmeriCulture as part of an exhibit, do indicate that the water level in that well has risen and has risen more during the course of the production from Lightning Dock's production well and injection into its injection well. That Well A44 water level has risen more than the water level in monitor well about halfway between the injection well and the A444.

So, yes, in looking at that record of water levels, I think mounding has occurred. It is evident to me that Well A44 is immediately downgradiant to the west -- I am speaking now of the surface gradient --

from AmeriCulture's own facilities.

And, as I understand it, AmeriCulture is not a closed loop system. We've talked a lot about closed loop geothermal systems in which all the water stays within the system.

I think the AmeriCulture geothermal activities are open, in that geothermal water is pumped and it's mixed with cold water from outside the geothermal area and then simply discharged on the ground.

And I think the areas in which that water is discharged can probably be seen on the aerial photo in the form of evident vegetation on the west side of AmeriCulture's facility in here and just upgradient or upstream from the A444 well.

The A444 well is very shallow and casing begins right at the water table at about 60 feet. And it seems clear to me that a large part of the mounding must result from recharge of effluent from AmeriCulture's facility that is just discharged into the surface drainage.

I should also point out that I believe the historic development of geothermal waters, geothermal heat before Lightning Dock's project began was also open to the environment. The water was produced from wells -- geothermal water was produced from wells within the geothermal system and then simply discharged on the ground.

And that clearly represents a much different threat to other ground water, potable ground water, than a closed loop system does.

Q. And, Dr. Shomaker, at one time -- let me ask this differently. Do you see any strata within the geothermal system?

A. There are strata. I think that certainly the geologic picture which I believe another witness will address in more detail includes sedimentary rocks which are stratified. And certainly there are strata within the valley fill aquifer.

On the other hand, the geothermal system, the water in the geothermal system is in fractures, not limited to specific stratigraphic zones. And so I think it's difficult to talk about this geothermal system as residing in a particular stratum if the system as a whole is interconnected by fracturing and extends all the way from the depth at which the hottest water enters that fracture system all the way to the water table.

Q. I think this is the last question from me. But Commissioner Shannon brought up that we at one time said to the community, Here's what the project looks like -- and that has changed. Can you comment on what was different between then and now?

A. Yes. Before the production began, the concept involved pumping from and reinjecting into a fracture system, a fracture system that could be reached and could be accessible at a significant depth, depths below 1,000 feet.

As we have learned more as more drilling has been done, a better understanding of the system has arisen through the closed loop test that I testified about two years ago; and, still more recently, information has been collected during the early operation.

We now understand the system as this whole that I have talked about today that extends all the way from a leaky artesian aquifer at depth through fractures that crosscut the entire geologic section all the way into the valley fill.

Q. So our scientific understanding now is based on everything we could get our hands on, but it's different than what it was a few years ago?

A. That's correct.

Q. And just to be clear, in the geothermal system, water moves up through fractures, moves down through fractures. But you don't see the system expanding laterally, you don't see the water spilling out like this?

A. No, I don't. And the reason is whatever is pumped out is reinjected and vice versa, whatever is reinjected is being -- we've now changed the relative heads in the system so that whatever is injected will be moving toward the pumped well.

And so I think all the water involved in this project will stay within that geothermal system. I have made the point clearly that mixing patterns will change and they have evidently changed already and the groundwater heads have changed, but only within that system.

Q. And that geothermal system goes all the way from the surface down to the deep geothermal source. If it's hot water, if it's high fluoride water, even if it's mixed water, it's part of that geothermal system?

A. Yes.

But let's also be clear on the fact that the geothermal system itself as a natural system does discharge, because the water at great depth is at higher head than the water at the water table. So there has been a constant upflow of geothermal water in nature before any development took place.

And that upflow has led to a plume of, in effect, geothermal water, mixed, original geothermal water with fresh recharge that has formed a plume that extends for many miles downgradient to the north from the Lightning Dock project.

So, in my opinion, the project itself, the pumping and reinjection and its effects will all stay within the system, but the system itself discharges water into the groundwater system and always has.

Q. And that's naturally occurring?

A. That occurs naturally. And that accounts for a high fluoride plume and a high temperature plume that we will hear more about from Mr. Miller.

MS. HENRIE: All right. With that, Mr. Chairman, I pass the witness.

CHAIRPERSON CATANACH: Mr. Lakins.

MR. LAKINS: Thank you.

CROSS EXAMINATION

BY MR. LAKINS:

Q. Dr. Shomaker, good to see you again.

A. Good to see you, sir.

Q. Dr. Shomaker, do you remember seeing this diagram a few years ago as part of Mr. Richards' presentation in this same room?

A. I remember seeing a diagram like that. I can't recall specifically whether it was an exhibit during the 2013 hearing.

Q. This is part of our Exhibit B.

One thing you just talked about, Dr. Shomaker, was sort of an overall description of makeup of the geothermal reservoir. Okay. And what I heard you describe was that the pressure at depth is a higher head and there's a constant upflow and then there is a plume that goes to the north?

A. Yes, sir.

Q. Is that kind of a visual of your description that you just gave?

A. This is not inconsistent with my description.

Q. So water comes up from depth and mixes shallow and it exits -- it moves to the north, correct?

A. That's correct. I think mixing occurs at greater depth than is suggested here. I think mixing occurs in that fracture system that is labeled upflow zone at greater depths.

And I think the evidence for that is in the chemistry and isotope chemistry that Dr. Miller will deal with.

Q. Is it your testimony that all the water in the alluvial fill comes from depth?

A. No, sir.

Q. Where does the water in the alluvial fill come from, the shallow alluvial fill?

A. Some of the water in the valley fill is fresh recharge, from precipitation mostly on the higher slopes to the east.

Q. And that shallow alluvial fill, some of that mixes with the geothermal, correct?

A. Yes, some of that mixes with hot geothermal water and creates thereby a mixed geothermal water within the alluvial fill.

Q. Within the shallow alluvial fill?

A. Correct.

Q. And then the shallow alluvial fill, the general flow is to the north and away from the hot geothermal source, correct?

A. That is true. I think in terms of today's flow pattern, that is correct.

I think pattern of high fluoride waters which are suggestive of geothermal waters extends to the south and southwest from the Lightning Dock project area. And that has to do, I think, with other geothermal water rising into the system.

Q. But the general flow of the shallow alluvial flow is to the north?

A. Yes, sir.

Q. And I thought I heard you testify that the water that potentially would be injected through these permits into the shallow alluvial fill would make its way back to depth; is that your testimony?

A. I think -- yes, my testimony is that the water that is going to be reinjected at whatever depth, whether at great depths or at the 150 feet, is going to stay within this geothermal system, which to me includes all of the red that is shown on this diagram except for the part that is labeled outflow plume.

I think the geothermal system -- and we know this is true because some of the geothermal production -- some of the utilization of geothermal heat has come from water in the shallow aquifer in the valley fill.

Q. What I am trying to understand is if you have water that is injected into the shallow alluvial fill and it is at 150 feet, not at depth -- let's just talk about 150 feet -- which you do agree is the alluvial fill, yes?

A. I think it depends on where you are. I don't know from my own knowledge whether that involves valley fill in every case or not.

Q. Where the drilling locations are, let's take this one over here, 13-7, do you know if that is in the shallow alluvial fill of 500 feet?

A. I suspect it is, yes, sir.

Q. Do you know anything about the water chemistry of 13-07 at all?

A. No, sir.

Q. Do you know anything about the geology of 13-07 location well?

A. I don't think the well has been drilled. And I think the geologists in the room probably -- the other geologists that have involved themselves with the project probably know better what to say about the geology.

Q. Now, the other location, the 76-7 at 150 feet, to your knowledge is that in the shallow alluvial fill?

A. I think it probably is. But, again, I don't know for sure, and I don't think the well has been drilled.

Q. Are you familiar with the monitoring well geology?

A. I think all of the monitoring wells are in valley fill.

Q. And they go down to 85?

A. I think the deepest is about 85 feet, yes.

Q. So can you explain to me, are you familiar with the geology between the shallow alluvial fill and the production depth of the wells?

A. Only in a general way. I think the best source of geologic information would probably be Mr. Bowers.

Q. Well, you're the hydrologist?

A. Yes.

Q. "Hydro" is the movement of water?

A. Correct.

Q. Can you explain to me how in injection in an alluvial fill at 150 feet water would migrate through strata into a deep reservoir?

A. Where you've shown me that injection to take place is not in the geothermal system. You have indicated it far downgradient from the geothermal system, and what you've described would not occur.

Q. I am talking about what you testified to. That is what I want to get at -- is that you testified that these locations of these proposed wells at 150 feet, in the shallow alluvial aquifer, the water would migrate downgradient and to depth where you also testified there's a higher pressure.

Can you explain to me how the water in the shallow alluvial fill that is moving northward would migrate to depth of 1,000 to 1,500 feet?

A. What I was talking about in my testimony was what would take place within the geothermal system. And in my opinion the geothermal system includes this water.

And my testimony is that water injected here, even in the shallow system, in terms of mass balance, would stay in this zone because although there is a natural upward flow, we are also going to be pumping at the same rate that the sum of all the injections will be taking place at. So we are creating a lower pressure which will be balanced by injection.

Q. You would be basically creating a cone of depression down?

A. Yes, sir.

Q. -- down the depth?

A. Yes, sir. We know that, for example, we have 300-odd feet of pumping level drawdown in the 45-7 well. So we have created a downward or a cone of depression. And we are putting water into the fracture system in various places within this system. And we are putting water into water that is already geothermal water. It is mixed with some fresh recharge, but it is already a geothermal water. It is part of this system.

Q. So I understand your position then, it is that you will have a cone of depression down here and the natural flow is upward and out to the north but the water injected into this shallow reservoir area here would be drawdown?

A. Yes. We are keeping the mass balance constant within this zone as far as the project is concerned, the pumping and reinjection. And we are changing the mixing pattern as I have pointed out.

And there may very well be increases in some constituents in this zone, in the mound that is created there. And it is possible that water -- that in that water, as it moves downgradient, will move downgradient in the system.

So we are admitting the evident fact that not only water levels change but water chemistry changes as a result of pumping in the injection.

Q. So the water chemistry will change?

A. I think there will be a difference in the mixing patterns, because we are injecting into a different part of the system different fractures at different depths.

Q. And can you say with any degree of scientific specificity that the mixed water will not exceed any underground drinking water standards?

A. Certainly not. The water that moves in this natural flow downgradient already exceeds the fluoride standard.

Q. How about in all the monitoring wells?

A. We're now talking about this plume. Everything that I have talked about so far has been in this -- in the geothermal zone itself, in the geothermal system.

Q. Okay. Well, let's talk about the monitoring wells and the impacts to any other wells. All right.

Can you testify with any scientific precision -- that's the wrong phrase. Can you tell me, for instance, in monitoring well 5, whether or not the proposed injection from what is well 76-7 would exceed the water quality standards that exist in those wells, change them to exceed drinking water standards?

A. I think there will be an increase in fluoride concentration. I don't purport to predict how much that will be.

Q. So you can't tell us if it will not exceed drinking water standards?

A. In the first place, I don't remember whether monitor well 5 exceeds the fluoride standard now. And since I don't know that, I also do not know whether it would exceed it in the future. And I'm not going to predict what it will be in the future.

Q. How about any of the other wells? Can you give us any testimony with any degree of scientific certainty that the injection at the proposed injection sites, which you admit will change the water chemistry, that the wells that have below existing drinking water standards will not be changed to existing drinking water standards?

A. I don't know what the fluoride concentrations and other concentrations will be once the system reaches equilibrium again.

Q. Let me make sure I understand. You said that in your opinion the existing operation has reached equilibrium?

A. Sorry. I didn't understand you.

Q. The existing operation as it's ongoing now has reached equilibrium?

A. I think it has, yes.

Q. How do you explain the mounding in the monitoring wells?

A. The mounding is part of that equilibrium. The cone of depression is basically a pressure change at depth. We don't see that reflected at surface, but we do see the -- well, maybe we do. We just don't have monitoring wells that show it. But we do have a response at the water table that's attributable to the reinjection.

To pump water from a well requires that you lower the head there. And to reinject water in such a way that it will form a closed loop requires that you raise the head somewhere else. And that raising of the head somewhere else is reflected in the mounding that we have discussed.

And I should point out that there has been a groundwater mound there since the beginning of the project. The first water levels, the first measurements before any production were contoured and show the presence of a groundwater mound. And I think that is simply an expression of the upwelling from depth of the geothermal water.

And as the operation has continued that mound has grown, has increased in elevation. And I think once injection is back -- injection into the applied for wells has continued for a period, that that mound will look different, it will probably be higher. And, again, I would expect it to reach an equilibrium position.

Q. Will there be more water leaving, flowing north out of the plume? Will there be more water up here that will be leaving the system in that event (indicating on chart)?

A. I don't think so. I think the fact that the system within or the pumping and reinjection within the geothermal system will be in equilibrium means that the raising of the mound, if you will, simply reflects that the fact that the greater heads will be pushing water down in the system to replace what's been pumped.

So I don't think there is reason to believe that more water would leave the system because of the mound, because I think that -- I think what will happen is that the increase in the downward component of flow will occur.

Q. How does the downward flow component increase?

A. One reason that it increases is because of the mounding; the head has been raised at the water table and, therefore, downward flow would increase.

Q. So if I understand you correctly what you are saying is you took more water up here and you are going to fight mother nature's natural flow and, essentially, push against it?

A. What we are actually saying is that the upward gradient would be decreased, which algebraically is the same as a downward gradient. But we are decreasing the differential head in the upper direction by creating the mound.

Q. So my understanding of what you just said is that by injecting up here, the upflow would just be slower, it wouldn't reverse --

A. We're replacing the water that's being pumped, the depth. So we have a decrease in the upward flow above that position.

Q. But does a decrease in the upward flow result in a downward flow from the alluvial fill through strata and back down to the production zone?

A. I think it results in a net decrease in upward flow.

Q. How large is the upflow zone?

A. I have seen a variety of maps. And I think, since I'm not a geothermal energy expert, I should probably defer that to people who are. And it really is essentially the zone that has been mapped through which geothermal water rises.

Q. So can I properly paraphrase your answer as you don't know?

A. I have no professional opinion about it, that's correct.

Q. You said there is no evidence of a barrier between AmeriCulture's State well and its Federal well; is that correct?

A. I have seen no evidence.

Q. Why is its chemistry different?

A. I think one reason the chemistry -- let me ask you, you asked about the AmeriCulture Federal well and the AmeriCulture State well?

Q. Correct.

A. Is the chemistry you are asking about related to the AmeriCulture Federal well?

Q. Between those two wells, yes.

A. I think one profound influence on the water chemistry in the AmeriCulture Federal well would be the return flow from AmeriCulture's operations, recalling that not all of that water is geothermal water that's is discharged into the arroyo.

Some of that water, as I understand the system there, is cold water, which has much different chemical characteristics, notably smaller fluoride concentration. So looking at that shallow well placed, as it is, directly downgradient from the effluent discharge from AmeriCulture's facility, I would expect to see a water chemistry change in the direction of the water in the alluvial aquifer, the valley fill aquifer outside the geothermal zone.

Q. So as I understand your testimony then it is that your opinion that the water chemistry is different is based upon AmeriCulture's pumping of its well?

A. No, sir.

Q. And its discharging water onto the surface? I am not quite following you.

A. Let me say it again. I think it would -- it's an easy way to explain a change or a difference in the chemistry of the AmeriCulture Federal well, to look at the fact that it is placed so that it is likely to be -- the shallow aquifer there is likely to be recharged by the wastewater effluent that's discharged into the arroyo.

And since that wastewater discharge is partly composed of water from the alluvial fill, cold water from outside the geothermal zone, we would expect to see that influence the water quality in the AmeriCulture Federal well.

Q. Do you attribute any change in AmeriCulture's well water chemistry to Lightning Dock's operations?

A. That is beyond my realm of study. I think Dr. Miller may want to ponder that question before he gets on the stand.

Q. And your field of expertise is the movement of water, correct?

A. Yes, sir.

Q. In your opinion, is water that's being injected into Well 55-7 having any effect of making it to AmeriCulture's wells?

A. No, I wouldn't think it would be.

Q. Is it making it up to the monitoring wells that are located in this vicinity?

A. I doubt very much that it would. I think that what we will see is pressure response, but that's not the same as actual water moving from one well to another.

Q. So is it your testimony, then, that the water that is being injected, the actual wet water that is being injected is not having any effect other than pressure on the remaining -- on the wells in the remaining area?

A. I don't think we know quite enough to say that it's not reaching any other well. I think predominantly the water that's being injected into well 55-7 is moving through a network of fractures largely toward the pumping well 45-7.

There may be water, injected water, seen in another well at some time. But I don't think we know enough to know exactly when or where that would occur.

I think the great preponderance of the water that is being injected will find its way through fractures directly into the sink in the groundwater head represented by the pumping well 45-7.

Q. So you don't know?

A. I am not sure my answer was quite as simple as that, Mr. Lakins.

Q. What would the effect of the well -- of the four proposed wells be on the actual water movement within this shallow alluvial aquifer fill?

A. I think it will be, as I said earlier in my direct testimony, that will be changes in the pattern of mixing and, therefore, there will be some changes in groundwater chemistry and certainly some changes in groundwater head very much on the order of the changes that we have already seen into a year's operation.

Q. Are you aware that the levels of water of

AmeriCulture's wells actually rose after Lightning Dock's injection commenced?

A. I am aware that the water level in AmeriCulture Federal well rose, yes, sir.

Q. Would you attribute that to Lightning Dock's operation?

A. A part of it may be. It is not very far away from where mounding was observed in monitor well 2.

I think a more likely explanation is the one that I have already given having to do with direct recharge of AmeriCulture's wastewater effluent under the ground in the place where it could easily infiltrate the aquifer that could be found in that well.

Q. Are you familiar with the time frame of the change in that well and when it changed in comparison to AmeriCulture's operations?

A. I'm familiar with the measurements that were in the State Engineer record, and I took the measurements in the monitor well MW-2 for essentially that same period. And the beginning and the end of the period varied by a few days in each case.

But for a parallel period, the water level in the AmeriCulture Federal well seems to have risen more than the water level rose in the monitor well MW2.

Q. Are you familiar with that the operation continued and AmeriCulture's operation was in place before Lightning Dock's operation began and there was no change in the federal well, and the federal well level rose after Lightning Dock's operation began; are you aware of that?

A. Yes. And I think in the beginning of that last response, I said I thought -- and I intended to say that I think part of the response in the AmeriCulture federal well may be related to Lightning Dock's operation for the reason that it is not very faraway from where we see mounding.

But the fact that mounding during that period of common data has been greater in the AmeriCulture Federal well suggests to me that there is some other thing going on, which I'm suspecting is the discharge of wastewater from AmeriCulture's operation.

Q. Turning to Lightning Dock's Exhibit 3, can you tell us how those measurements were made, what was utilized?

A. I didn't make the measurements. These measurements were furnished by Lightning Dock to me to interpret. So I am not in a position to describe how they were taken.

Q. Do you know who would have the answer to that question, Dr. Shomaker?

A. I would ask Lightning Dock management who took these measurements and they would tell me. I don't know personally who did.

Q. I ask you to turn to Exhibit P in the blue binder there, please, sir.

A. (Witness complies.)

Q. Are you there?

A. Yes, sir.

Q. Have you seen the report from Mr. Janney to Mr. Griswold before?

A. I have seen a lot of this data, Mr. Lakins, but I don't remember whether I'd seen this report.

Q. Let me stop there and just ask to switch gears ever so slightly.

Are you familiar with water sampling protocol and data compilation?

A. In a general way. My sphere of activity is much more in the realm of groundwater flow and related issues. So if the question is going to be about sampling, I think it would be better directed probably to Dr. Miller.

Q. Fair enough.

Now, do you recall -- I ask you to turn to Exhibit C in that binder, C as in Charlie, and turn to the third page at paragraph 15.

A. Yes, sir.

Q. And at that previous hearing back in 2013, the evidence that was presented was that the geothermal fluid production zone in well 53-7 and well 55-7 were the same. That came largely from you, did it not?

A. I think it probably did. I would have agreed with that.

Q. And that the geothermal fluid flow of intervals occur in the same geologic formations. That came largely from you, did it not?

A. I am not sure about that part, but I wouldn't disagree with it.

Q. And that they are not directly connected to the alluvial aquifer at 400 feet below ground surface, that came largely from you as well, did it not?

A. I don't think that I would have been quite that explicit. I may have been.

But my testimony today is that the fracture system that constitutes this geothermal system does extend to the base of the valley fill aquifer and the geothermal water rises into the valley fill aquifer.

Q. So then is it your testimony today that the evidence presented back in 2013 was wrong?

A. I would say that the last part of the sentence in paragraph 15 is certainly oversimplified. We could have a long discussion about what was meant by "directly"; but I would say today that the geothermal system is made up of water that is flowing in fractures from a deep leaky artesian zone, flowing upward in fractures until it reaches the base of the valley fill and then moving into the valley fill.

Q. So the water that's injected then in well 55-7 at 1,050 feet, that's not cased off from the shallow aquifer then, is it?

A. It is cased off from the shallow aquifer.

Q. But it is connected to it, it makes it into the shallow alluvial aquifer at 400 feet?

A. I think the testimony I would give is that the fracture system connects all the way from the deep artesian -- leaky artesian aquifer all the way to the water table. And so there is flow, there is a movement of the ground water, but I do believe that the 55-7 well is cased well through the valley fill.

Q. But the water that is injected makes its way up to the shallow alluvial aquifer?

A. The pressure response, I think, does. I don't know -- I know that when we speak of water making its way, we need to be careful about that difference. I think what we will really be seeing is the pressure response, and that's what accounts for the mounding.

Q. So the pressure response is the pressure is up?

A. The pressure is increasing because of the injection and that causes the water table mounding that's been observed.

Q. If the pressure is increasing and the water is moving up, how do you explain how water moved down for more injection?

A. Well, more injection into the geothermal zone reduces the head gradient, the upward head gradient, because we are taking that water out as it's being injected. We are balancing the inflow with the outflow.

Q. In your opinion, is it possible to construct a well in the geothermal reservoir that cases off and prevents water from flowing into the underground drinking water source?

A. I'm not sure I grasp the question.

Q. Let me try it again. In your opinion, is it possible to construct a well, an injection well within the geothermal source such that the injected water does not mix with the underground drinking water source?

A. The underground drinking water source would be outside the geothermal system. And, therefore, my answer would be it is possible. Because the water that is at the water table, the shallow ground water in the alluvial fill or in the valley fill within the geothermal system is not, strictly speaking, drinking water because of its elevated fluoride concentration.

Q. But you are aware that there are drinking water wells, that Mr. Seawright and AmeriCulture actually has a domestic drinking water well on its location?

A. I am aware, yes.

Q. And is that well not within the geothermal -- the reservoir area?

A. I think it is, but I think it is a water well used for drinking, which, in my opinion, is to be distinguished from a water well that produces from a drinking water source.

Q. Where is it drawn from?

A. The drinking water source in my opinion would have to be outside the geothermal system, because the quality of the water within the geothermal system is not suitable for drinking.

Q. Can you give me the definition of an underground source of drinking water?

A. I think there are probably several definitions. One that probably fits what you are asking about is underground water that people drink.

Q. Are you familiar with the Code of Federal Regulations, the Federal Code of Regulations definition?

A. I am not going to quote it without looking at it, no, sir.

Q. Would you agree that Federal regulation 40-C-FR applies because these are classified injection wells?

A. They probably do, yes, sir.

Q. Now, you are making the distinction between the source of water that is AmeriCulture's drinking water well from its other wells. But you also said that there's no barrier between the wells, correct?

A. If by AmeriCulture's drinking water well, you are referring to the A44 well or the AmeriCulture Federal Well, what I would say is that there is no barrier, I see no evidence for a barrier between that and AmeriCulture's hot well.

I see that there is a significant difference in water quality as between the two. And I think a large part of the difference may be attributable to the recharge of much fresher water as effluent from AmeriCulture's operations.

The reason that water would be fresher, if that is the case, is that it comes largely from the cold water supply that is not within the geothermal system. A cold water well would be producing from further west from the valley fill where it contains better quality water.

Q. How about any other wells in that area, domestic livestock wells and irrigation wells, is there any way to insure that there is no leasing of water for any of the wells that are in that outflow plume?

A. I don't think things will change very much in the outflow plume once we're outside the geothermal system because the mass balance will be at zero within the geothermal system. We will see that water staying in place.

Q. So your belief is that the water that would be injected in this area will not continue in the outflow plume and flow in the existing alluvial point?

A. I don't think there will be a measurable effect. I think that the water that's involved in the geothermal system, the pumping and the injection, will stay there because it's a closed loop.

I think the fact of mounding is an indication of increased groundwater head, which is tending to reduce the upward gradient so that the system will be -- within itself will be a loop. And I don't think there will be very much movement down that -- or very much change in the chemistry in that plume.

And I invite you to ask Dr. Miller the same question because he is the one that has looked at the chemistry.

MR. LAKINS: I pass the witness.

CHAIRPERSON CATANACH: Ms. Marks, any questions.

MS. MARKS: Yes.

CROSS EXAMINATION

BY MS. MARKS:

Q. Dr. Shomaker, do you want to give a legal definition of underground source of drinking water?

A. No, ma'am.

MS. MARKS: I have no further questions.

CHAIRPERSON CATANACH: Mr. Domenici?

CROSS EXAMINATION

BY MR. DOMENICI:

Q. Are you familiar with the definition of "ground water" within the water quality regs?

A. In a general way. I am not going to quote the regs without having them in front of me.

Q. And I quote, "Ground water means interstitial water which occurs in saturated earth material and which is capable of entering a well in sufficient amounts to be utilized as a water supply."

Are you familiar with that?

A. Yes, sir.

Q. And everything in the blue and the red would be ground water, correct?

A. It would.

Q. And you are not here to testify that the groundwater regulations -- excuse me -- the water quality control regulations that apply to ground water do not apply to any of the red water -- I think you called it the geothermal system --

MS. HENRIE: I need to object. This is a legal conclusion. And there is a definition in those regs that carves out geothermal waters --

MR. DOMENICI: Where is that?

MS. HENRIE: Give me a minute. I'll find it.

MR. DOMENICI: Let me just continue.

Q. As far as the definition I just gave you, everything in that red area would be capable of -- it would be interstitial water capable of producing a well as far as you know?

A. As long as we allow the word "interstitial" to include fractures, yes, sir.

Q. Now, looking at that, and then if you will turn in your exhibit book to Exhibit 4, page 5. This sort of looks like -- I'm not sure what you call it -- a geologic cross section.

Do you see the diagram?

A. I do, yes.

Q. And have you prepared a geologic cross section that would assist you in your opinions that you just rendered?

A. I have not prepared one, no, sir.

Q. Is there a specific geologic cross section that you can refer to that you'll base your opinion on, and particularly the opinion that the mass balance of four shallow injection wells with one deep production well means that all the water stays within that system, is there a cross section you can point to that helps you validate that opinion?

A. I don't think that a cross section would be the way to understand that opinion. I think the fact that the system is constituted flow in fractures is the basis of the opinion. And exactly what strata those fractures are in is not so relevant. I think it is the presence of the fractures.

And I think the evidence from the water level history and both the production and injection wells and the monitoring wells indicate that that whole system is interconnected, to some degree, and that that is the basis of my opinion.

A good geologic understanding is obviously an important thing too. And I think that Mr. Bowers can provide that.

Q. Looking at this, do you dispute that the well

55-7 is approximately 7,000 -- if I have this correctly -- how deep do you interpret that well to be?

A. This diagram indicates that its total depth is 7,001 feet.

Q. In your analysis of this equilibrium, mass balance equilibrium, doesn't the depth of the production well make a difference?

A. I think the evidence for the understanding of the system as a closed loop comes after we have seen and experienced the water level history in the production and the injection wells.

Certainly, on the ground and in the mechanism itself where in the fracture system the water is pumped from and where it is reinjected to will make a difference in the pattern of mixing that occurs.

So I think the evidence for the closed loop is in that water level history and that that isn't inferred from the geologic cross-section. And, in the first place, I don't think the injection into well 55-7 is anywhere close to 7,001 feet deep. I think it's much closer to 1,000 feet.

Q. As far as the production, how deep is the production?

A. My recollection is it is around 1,500. But we should consult a geologic cross section to see.

Q. And how wide is the screen for that production well?

A. I don't recall.

Q. The purpose for which I'm asking this is do you have an opinion as to how long it will take the system to come into equilibrium; is it instantaneous?

A. No, sir.

Q. So there will be a lag time where the injected water will not be pulled down by a production well that's substantially deeper and perhaps not located proximate to those injection wells?

A. That's correct, there will be a lag time.

Q. And during that lag time, the injection water will be spreading laterally into the outflow plume, correct?

A. I don't think so. I think the system water flow is slow enough that the water will stay in the geothermal system. I don't think we will know the definitive answer to that until we have seen the water level history and the water quality history.

Q. So are you saying that the water would mound on top of the injection wells but it wouldn't move laterally, is that your testimony?

A. I think it will mound. I don't think there's a doubt in my mind that further mounding will occur. But

I think that mounding has the effect of increasing the head to move water downward. And while it may be that some water moves laterally out of the geothermal system, the total amount -- the total change in the water in and water out is zero. So there would not be a net flow as a result of the geothermal system.

And whether the effect of the mounding is such as to move water that already exists at the water table further downgradient somewhat more rapidly than it moves now remains to be seen. But it will still stay in the outflow plume of hot spotted fluoride water that moves out into the shallow aquifer in the valley.

Q. Well, it will stay within the plume, but it will actually increase the mass of the plume?

A. I don't think it will increase the mass of the plume because we are not adding any water to the system. To the degree that we're increasing the head in the mound area, we are decreasing the head at greater depth. So we are inducing a net downward flow, which is what makes the system a closed loop.

Q. Just so I'm clear, is any system with fractures in it a closed loop? If you produce and inject the same amount of water in a fractured system, ipso facto it's a closed loop system; is that your testimony?

A. If the fractures are interconnected and if they are limited, if the area within which the fractures occur is bounded.

Q. And so if the production is 5,000 feet and 1,000 feet, it is still a closed loop; it doesn't matter the differential of depth between the wells?

A. If the factors are all interconnected and if the system is bounded, I think that's correct.

Q. When you say if the system is bounded, what do you mean?

A. If the factors don't exist or are closed or that the permeability that they represent becomes zero at some distance away from the geothermal window.

Q. Where is this geothermal system, as you call it, bounded?

A. I was asked that question by Mr. Lakins. And I referred to the experts in geothermal energy development. There is at least one of those here today that would answer the question better than I can.

Q. But that is an essential assumption to your conclusion as I understand your testimony?

A. It is a basic assumption in that conclusion, yes, sir.

Q. And you are not giving -- that's an assumption that you are relying on a third party for, am I understanding that correctly? You are not reaching that conclusion yourself?

A. I am reaching that conclusion based on the studies of the geothermal reservoir, the geothermal system that I have seen. And they indicate that this is a discrete hot spot. There appear to be other hot spots like it. And there may be extension of it to the south and west. But it is a discrete window into the leaky confined aquifer that carries the really hot water.

Q. Well, do you agree that under the oil and gas regulations an underground source of water means an aquifer that supplies water for human consumption or contains ground water having a TDS concentration of 10,000 milligrams or less and that it is not an exempted aquifer?

A. If you are reading from the document you say you are, then I agree that that is what it says.

Q. And we agree, we are not dealing with excess of 10,000 TDS water anywhere in what we have been addressing here?

A. No, sir.

Q. So, Dr. Shomaker, I know you testified many times. How many geothermal projects have you testified in relation to?

A. I don't remember testifying about a geothermal project other than this one. I would have to think about that a minute before I was certain of that answer. But this is the only one I remember.

Q. And how many salt water disposal well proceedings, if any, have you testified in?

A. I haven't testified in any. We've done some salt water disposal wells, but I have not given testimony in hearings about that.

Q. How many times have you given testimony, if any, that a geothermal system is in equilibrium based on the injection wells are constructed in comparison to the production wells?

A. The system that we are talking about and the equilibrium that I have talked about is based on the basics of groundwater hydrology and, in effect, has nothing to do with the fact that it is a geothermal system.

So I have testified a great many times about head changes that would occur as a result of pumping and recharge. And I think the fact that I have testified about those groundwater basics on many occasions extends to this situation regardless of the fact that it's about a geothermal resource.

Q. So what is an example of a case where, the testimony you've given, where the production well is, say, 2000 feet beneath the injection well or the proposal well location, and you testified that that situation is not in equilibrium?

A. I don't remember testifying about a case in which an injection well was not in equilibrium with a production well. Again, I think it's simply an exercise of basic groundwater hydrology, and the fact that the heads in the two wells have reached an effective steady state tells me that the pressure connection exists and that enough water is flowing across -- flowing from the one field into the other, that the system is a closed loop.

Q. And did you help design the well locations that are proposed?

A. No, sir.

Q. You didn't select those?

A. No.

Q. Did you design the length of the screens in those wells?

A. No, sir.

Q. Did you have anything to do with the design or location of the injection wells?

A. No, I did not.

Q. And have you done any analysis -- or would that be another witness -- as to whether or not those injection wells actually are within what you're calling the geothermal system?

A. They are; to the extent that the geothermal system can be recognized by the presence of hot water and high fluoride concentrations in the area, they would be within that.

Q. And that is based on other well data?

A. Yes.

Q. And as far as the -- was the entire screen length of those wells within the geothermal system?

A. I think it is, because, in my opinion, the definition of the geothermal system encompasses the body of fractured bedrock and the part of the valley fill aquifer in which hot high fluoride water occurs.

Q. But my understanding was that the monitor wells are much shallower at some of those locations -- are you assuming the hot fluoride-rich water goes deeper than the monitoring wells?

A. Yes.

Q. And what's the basis for that assumption?

A. I think just looking at the records of the deeper wells and at the periphery of the system, which, in my understanding, is not well defined. It may be well defined as the people who have looked at the water quality more closely have recognized it.

I may be mistaken about that point. There may be good quality water under hot water upgradient from the geothermal system, but I doubt it.

Q. What is "good quality" water?

A. In my testimony, it would be water that is not geothermal water, therefore, as I'm defining it, not hot and not high fluoride.

Q. Now looking at the chart here, do you know if there is irrigated agriculture in -- well, from being on the site, is there irrigated agriculture within the vicinity?

A. I know that there is irrigated agriculture to the west and generally further out into the valley. I think there had been irrigation very close by. But, as I recall, the recent irrigation has been to the west of the area.

Q. And do you know if the Animas Basin is being adjudicated?

A. I think an adjudication is in progress. I don't know whether it has been completed.

Q. Do you know if irrigated water is being adjudicated or proposed, recognized in the vicinity?

A. If the adjudication is in progress, then irrigation rights would be included in that.

Q. Do you know where the closest irrigation production well is to this location?

A. I couldn't say at the moment. I think probably just to the west of the geothermal project, I think there's probably an irrigation well.

Q. And how deep is that well?

A. I don't remember.

Q. Do you know if the Animas Basin is considered a mined aquifer?

A. Yes, sir. It has been, I think, by the State Engineer.

Q. What does that mean, can you tell the Commission?

A. I think a mined aquifer or a mined basin is one in which the withdrawals have exceeded the recharge over a period and the water levels therefore have declined.

Q. Do you know one way or another if water from the plume, the downgraded plume from the geothermal system is usable for irrigation?

A. I don't know of my own knowledge what effect fluoride has on usefulness in irrigation.

Q. I wasn't at the last hearing. Could you explain to me, why are more deep wells not being proposed for today, rather than these four shallow wells, if you know?

A. I do not know. I was not involved in the discussions that led to the application.

Q. Do you know any reason a deep well wouldn't create the same equilibrium, mass balance, that you have described?

A. A deep injection well certainly would create the same closed loop as I have described.

Q. And is there a problem with the injection wells that have already been installed, putting them to use?

A. I think Mr. Morrison or Mr. Janney has told the Commission that the deep wells that have been drilled so far have not encountered enough open fractures so that there would be enough hydraulic conductivity to accept the desired flows of injection water.

Q. But at the last hearing those wells were proposed to take the injection water, if I understand correctly?

A. I believe that's true, but we would need to look at the record of the hearing to be sure. I can't remember.

Q. And I think that is what the permit was at the time, for those --

A. I think that's correct.

Q. You are involved in a lot of well drilling, more than I am, but deeper wells are more expensive than shallow wells?

A. Yes, they are.

Q. And a several-thousand-foot well is quite a bit more expensive than a 150- to 500-foot well?

A. That is correct, yes, sir.

Q. So in some ways this is an economic issue, would you agree with me on that?

A. Its implications are certainly economic, yes, sir.

Q. And is it -- strike that.

MR. DOMENICI: I am just about done.

Q. When you talk about this equilibrium, did you calculate a rate of upflow from the artesian force?

A. No, I have not.

Q. But you do agree there is an artesian force or an artesian head?

A. Yes. There is a head differential that makes the hot water move up. It is less dense than the shallow water for the beginning.

Q. And then my understanding, from looking at the reports, there also is a downgradient in the shallow alluvial?

A. Yes, sir, I suspect there would be.

Q. And is that going to be changed by these injection wells?

A. In the area where mounding occurs within the geothermal system, there will be a change in gradients, yes.

Q. And what will the change be?

A. I'm not able to predict that because we haven't yet seen what that mounding will be.

Q. Just to wrap up, so in the agenda notice for this hearing, the issue was stated as -- the issue addressed concern of whether the proposed injection will contaminate any underground source of drinking water or otherwise cause waters of the state of New Mexico to exceed applicable water quality standards.

And there is another section.

But with respect to that only, you are not offering any opinions one way or another on that; is that correct?

A. My opinion is that the proposed injection will change the mixing pattern within the geothermal system but that that water is already in general hot and high fluoride water and will not meet the fluoride standard.

Q. Will the fluoride levels in that water be increased?

A. In some wells, it very likely will be, because it has been shown already to have increased in some monitoring wells.

Q. Do you -- strike that. In the conditions OCD has proposed, they are talking about there must be an OCD approved water quality monitoring plan for the geothermal project. Are you familiar with that condition?

A. I have heard it spoken of, yes, sir.

Q. And you have seen similar types of conditions on other water rights matters where monitoring plans are required?

A. Certainly, yes, sir.

Q. What is the public supposed to understand from that, if you know; what is the monitoring plan the people of Hidalgo County can expect based on this condition?

A. The monitoring plan is one that will be approved by the public's representatives in the form of the OCD.

Q. At some point in the future?

A. Yes, sir.

Q. And will it -- would there be a way to monitor whether or not your opinion that the mass balance is in equilibrium and therefore there is -- therefore the water injector is not leaving the geothermal system, is there a way to monitor that?

A. There certainly is a way to monitor whether the proposed pumping and reinjection has created changes in water quality or groundwater head that would be interpreted as water leaving the system. So the data would be there on which to base that interpretation, yes.

Q. And what would that be, just so as to totally understand?

A. I think the combination of water level measurements, the measurements of groundwater head and measurements of groundwater quality would provide the data that could be interpreted to answer your question.

Q. And would there need to be new or additional monitor wells to gather the data to perform the analysis?

A. I think there are enough wells. I think monitoring of all the existing wells of whatever ownership within the geothermal system and also some wells peripheral to it would be valuable.

Q. What do you mean by "peripheral"?

A. The wells that are not within the geothermal system but that are very close to it, within a quarter of a mile or something.

Q. And are any of those wells available currently today?

A. I don't know.

Q. Thank you.

MR. DOMENICI: That is all I have.

CHAIRPERSON CATANACH: Commissioner.

EXAMINATION BY COMMISSIONER BALCH

EXAMINER BALCH: Good afternoon.

THE WITNESS: Good afternoon.

EXAMINER BALCH: I just have a few questions, Dr. Shomaker.

THE WITNESS: Uh-huh.

EXAMINER BALCH: I am a little bit curious about the gradient and the flow of that outflow plume; do you have a sense for the strength of that gradient or any sort of volume of what that flow might be?

THE WITNESS: I haven't tried to calculate it. It wouldn't be difficult to do. The State Engineer has a groundwater flow model that could be used for that purpose and it would really be simple to do without the model.

EXAMINER BALCH: So in the context of 5,000 gallons per minute of pumping from the well, is that a large proportion of that flow or a small proportion of that flow?

THE WITNESS: I don't do arithmetic in my head on the stand, I'm sorry to say.

EXAMINER BALCH: Just a gut feeling would be fine.

THE WITNESS: Well, in the first place, the flow in the loop would be 5,000 gallons a minute, but the net flow, the net change of flow at the boundary of the geothermal system would be zero as far as the pumping and injection are concerned.

The only potential change in the flow would be related to the mounding to the extent that greater lateral flow occurred. And I think most of the effect of the mounding is to increase the vertical.

EXAMINER BALCH: And that was my reason for the question about the strength of the flow down gradient, is you need to have significantly higher mounding to impact a strong down flow gradient than you would a weak one.

THE WITNESS: Yes, sir.

EXAMINER BALCH: So do you have any sense or a feeling for how strong that downward gradient flow is?

THE WITNESS: How strong it would be in the future, I do not. I think it could certainly be calculated based on what we know now from the current head relationships based on the current operation.

EXAMINER BALCH: It sounds like your current interpretation is that the mixing of the water from deep in the aquifer to near the surface, it's really going to provide a similar chemistry, irregardless of whether you're extracting some from the middle of it and injecting some from the middle and some near the surface -- there may be some slight variations.

Do you think that the fact -- I think Mr. Domenici brought up, that they are mining the basin -- that there's any potential for expanding the width of the plume, east and west?

THE WITNESS: My recollection of the system in the valley as a whole of the groundwater system is that the water levels are, nowadays, after a long period of mining, that the water levels are roughly stable again, and have been for a while.

And so while there is a -- would be a gradient toward the axis of the valley from the position of the plume, I don't think that the mining of ground water would change that much.

And I think -- I have not looked lately to see what the water levels are doing in the valley. But when I have looked at it previously, it appeared that the period of very significant mining ended decades ago and that things have been fairly stable since.

EXAMINER BALCH: So if we have a system in equilibrium and we have a mass balance, any widthwise growth would probably morbidly impacted by the outside factors than the mining of the aquifer in the basin?

THE WITNESS: Yes. If the plume, once it's outside the geothermal system, is not affected by a change in groundwater heads in the valley, then it will stay, more or less, as it is.

If it is affected by an increased gradient within the valley fill as a whole, then it would be larger, become larger.

EXAMINER BALCH: So I am going to ask you a grand hypothetical question. 1,000 years from now if you are at the end of the plume, are you going to notice a difference in the water chemistry, at the north end of the plume?

THE WITNESS: At the north end of the plume. In terms of the rate of flow of ground water in the system, I would say no. The movement of a fluoride molecule in that plume is so slow that 1,000 years might not lead you to a change in water quality at the north end of the plume.

EXAMINER BALCH: Do you think the injection pattern of the proposed wells would impact the shape of the plume besides -- really the only impact is going to be your mounding and if there is a sufficient gradient to overcome --

THE WITNESS: I think that's right. I don't think it will affect the plume once it has left the geothermal system area.

EXAMINER BALCH: If you were to have your four wells granted and you start injection and then the monitoring well were to exceed the baseline, what would happen then?

THE WITNESS: I don't know. I think management would have to answer that question.

EXAMINER BALCH: And I think this may be just a clarification. But I believe you implied that injection even at a shallow level would mostly likely have an impact on AmeriCulture by increasing -- sorry -- by decreasing their depth of the water table because of some mounding; it would be unlikely that chemistry changes would occur because of that mounding all by itself?

THE WITNESS: Yes. I think that's probably true, although there certainly will be a little change in chemistry because of the change in the mixing pattern. And so there may be some change in the water chemistry in the AmeriCulture wells as there has been in the monitor wells.

EXAMINER BALCH: Will those be small or large?

THE WITNESS: I think they'll be small.

EXAMINER BALCH: I do agree with you that the concept of equilibrium does not apply to only one type of case. That's my last question.

CHAIRPERSON CATANACH: Mr. Padilla.

EXAMINATION BY COMMISSIONER PADILLA

COMMISSIONER PADILLA: It is nice going after Dr. Balch because he threw some of my questions in with his.

I just have one question for you. With regard to the stratigraphic image that we see on Lightning Dock Exhibit 4, page 5, which you referred to earlier, did you say that the entire basis for the communication between these different levels or reservoir bodies -- I guess is a very generic way to term them -- is due to the naturally occurring fracture patterns?

THE WITNESS: That is my opinion, yes, sir.

COMMISSIONER PADILLA: Is there any other basis for communication other than the naturally occurring fracture patterns?

THE WITNESS: Well, hydro geologists are reluctant to say that there's such a thing as zero hydraulic conductivity. So to the extent that there is some hydraulic conductivity in most any rocks, there would be some communication. But I think the great preponderance of flow near enough all of it is in fractures.

COMMISSIONER PADILLA: Thank you, Dr. Shomaker.

EXAMINATION BY CHAIRPERSON CATANANCH

CHAIRPERSON CATANACH: Just a couple.

Dr. Shomaker, the geothermal system you are describing, does that go from depth all the way to the surface?

THE WITNESS: In terms of hydrology, it goes all the way to the water table, all the way from the depth which it emerges from, I think, the artesian aquifer all the way to the water table.

CHAIRPERSON CATANACH: To the bottom of the water table or does it go all the way through the water table.

THE WITNESS: I think all the way to the water table because of mixing. I think we have mixing of fresh recharge from upgradient that combines with that geothermal water.

CHAIRPERSON CATANACH: So within the geothermal system, all that water has already been affected by the deep intrusion of the geothermal water.

THE WITNESS: I believe that's true. I think the fact that there are shallow, relatively shallow heat production wells in the area demonstrates that the ground water in the valley fill aquifer within the geothermal system area is partly geothermal water.

CHAIRPERSON CATANACH: So would you agree that all the parties that own property here are within the geothermal system as you defined it?

THE WITNESS: I believe that's the case. I think my testimony about where the boundaries of the system are was a little vague, and I referred to primarily Mr. Bowers. But I think it's true that all of those properties are within the system.

CHAIRPERSON CATANACH: Is there a difference in the temperature of the rock as you go deeper; is there a temperature difference.

THE WITNESS: I think there would be, yes, sir. Again, I think Mr. Bowers would be a better place to answer that.

CHAIRPERSON CATANACH: That's all I have.

MS. HENRIE: Mr. Chairman, if I could just move Exhibit 4. And I have one other item of business, which is to read from the Water Quality Act, 74-6-12(G). And it says, "The Water Quality Act" -- and this is the statute, not the regulations -- "does not apply to any activity or condition subject to the authority of the Oil Conservation Commission pursuant to provisions of the Oil and Gas Act and other laws conferring power on the Oil Conservation Commission to prevent or abate water pollution."

Just so the Commission is aware that's the basis of the Division's position in 2013 as to why geothermal should be regulated by the Geothermal Resources Conservation Commission Act and not by the Water Quality Act.

CHAIRPERSON CATANACH: Exhibit 4 will be admitted. And this witness may be excused.

(Lightning Dock Geothermal's Exhibit 4 was offered and admitted.)

(Brief recess.)

CHAIRPERSON CATANACH: Let's go. You may call your next witness.

MS. HENRIE: My next witness is Roger Bowers. Come on up, Roger, and I will be asking to qualify him as an expert in geology.

ROGER BOWERS

having been first duly sworn, was testified and examined as follows:

DIRECT EXAMINATION

BY MS. HENRIE:

Q. If you would please tell us about yourself. We are going to qualify you as an expert in geology, so tell us about your education and training.

A. I received a bachelor of science degree in geology and a master's of science degree in geology at the University of Texas at Arlington. Part of that, I did do most of my undergraduate work at the University of Utah.

When I started graduate school in January of 1973, I also got a part-time job at Penn Oil Company in Dallas, Texas, and worked there doing air photo studies on the overthrust area of Wyoming. So it gave me a lot of good practical experience.

Two months before I received my master's degree, I was hired full time at Hunt. And this was in March of 1974. Later that year, without going into a lot of history of the Hunt family -- this is the infamous Hunt family of Dallas, Texas.

The patriarch H.L. Hunt passed away in 1974, and turned over control of Hunt Oil Company to his youngest son, Ray. I worked for Bunker, Herbert and Lamar Hunt. And they formed a separate company called Hunt Energy Corporation.

And one of the reasons for that is because, starting in late 1973, they heard about this newfangled thing called geothermal. And they along with several other oil companies decided to take a serious look at geothermal as an alternate energy resource.

I was one of the few that had any knowledge of the western United States, so I was given the task of doing some preliminary research, regional studies to pick areas where we might obtain the leases.

The federal regulations for geothermal went into effect in 1974. And there was a literal land rush of lease applications to the Bureau of Land Management.

We had picked up or we had filed for leases all throughout the western United States. We had identified over a million acres of prospective geothermal properties. And it became my job to start exploring all that acreage. This was even before the leases were issued by the Bureau of Land Management. It took them months to get their system in place.

So we started doing reviews. We started deciding what needed to be done where. And that really started our on-the-ground exploration program in late 1974, 1975.

I was the staff geologist. I eventually worked my way up to the operations manager for the geothermal department of Hunt. And eventually I became the geothermal manager for Hunt.

I stayed with Hunt Energy until February of 1987. You may recall in 1986 the Hunts filed for bankruptcy thanks to the silver fiasco. But we shut down the department, and I departed on very good terms with them. In fact, it is part of my severance package.

They gave me a lot of data that we had generated over my 14 years with the company. And that included prospects here in New Mexico. We explored areas all the way from Jemez Springs, Valles Caldera, on south, Truth Or Consequences, Radium Hot Springs, all the way down to the Mexican border. So it gave me a feel for the Rio Grande rift.

In addition to that, we had numerous properties in the basin and range, western Utah all throughout Nevada, Oregon, Idaho and California. I explored all of those properties. When I say I explored them, I would design the exploration programs, where there would be geophysical surveys, drilling programs, and, at any one time, I may have up to ten crews working for me in the field.

Hunt was a very lean company. And we were basically managers of the programs. Any technical services, if we needed an expertise, we contracted it, whether it be drillers or geophysical companies to run the surveys.

So my involvement with Lightning Dock started in 1987 after I left Hunt. And I had dealt with Amax while I was at Hunt. Amax had the lease NM34790. And we had done joint ventures at places like Cove Fort, Utah, so I was very familiar with the Amax folks.

And they had an agreement with another party. It was Geothermal Properties out of New York City. And when Amax decided to get out of geothermal about 1985, that lease was to revert to Geothermal Properties who I had also worked with.

By early 1987, Geothermal Properties did not really want the lease back but they wanted to keep an involvement with it. So I joined with three other individuals and we formed Lightning Dock Geothermal, Inc. That is a New Mexico corporation, and it took ownership in 1987 of the Federal Geothermal lease at Lightning Dock.

From that point on, I became involved. We didn't have a lot of money to do studies, but we slowly put together what available data we had. We also inherited all of the data, whether it be drill hole logs, temperature data, geophysical surveys from Amax, who had explored the area since 1975.

In 2000, the Department of Energy announced some research grants for the geothermal industry and Lightning Dock applied for some of those grants, and we won some of those grants. We were the only project basically in the state of New Mexico.

We partnered with Ormat, which is a big producer and builds power plant equipment and has numerous properties on line. It is a worldwide company.

We partered with Ormat to do an initial study of Lightning Dock which involved gathering all available information. As part of that, we contracted out or we subcontracted certain aspects of the research to a company called Geothermex, which has been a consulting company to the geothermal industry since the mid-1970s. And we also contracted work out to Dr. David Blackwell at Southern Methodist University, who is an internationally known heat flow expert.

So my involvement with Lightning Dock continued, although it was sporadic. Early 90s we started doing more and more field studies. In 2000, we got the grants. 2001 we ran geophysical surveys. In 2003, we drilled holes. In 2004, more geophysical surveys.

And, finally, in 2006, our partner in New York passed away, and we decided to sell the company. We sold the company in 2007 to two individuals who then later sold the federal lease to Razor Corporation, which is now Cyrq Energy and Lightning Dock H-I-01.

So that is a brief history. I've worked -- in 1987 I decided to consult on my own, and I have been consulting ever since. I worked for numerous other geothermal companies. I worked on evaluations of properties all throughout the western United States, primarily focusing on properties or resources within the basin and range.

MS. HENRIE: With that, Roger, let me tender you as an expert in geology.

MR. LAKINS: No objection.

CHAIRPERSON CATANACH: Mr. Bowers is so qualified.

Q. Roger, thank you for that background. I think it is very important. I want to give you a chance to talk about any geology briefly, if you would like, and then we also have slides that show some of the exploration efforts. I want to go through those pretty briefly as well.

A. Okay.

Very quickly, just to familiarize everyone, this is a slide of the regional geology. Lordsburg is at the top of the map. The town of Animas is south in the middle part of the map.

I must explain that this geologic map is very, very simplified. It was created more than ten years ago for a small private presentation. It omits a lot of detail. It was primarily developed to show the tertiary volcanics, which are the pink areas labeled with a TV.

In the western part, central part, you see a blue area called KPC. Those are old sedimentary rocks. And they go from Cretaceous all the way to Precambrian granites, intrusive rocks down in place on the very south end where Highway 80 goes through. It's called Grand Gap. So, again, it is extremely simplified.

The other thing we wanted to show on here, you'll see a circular dotted line, black dotted line. It is labeled as the near Calder and Outer Ring Fracture. And this was taken from a work published by Elston, Deal, and Logsdon as New Mexico Bureau of Mines Circular No. 177.

Q. Let me just point out to the Commissioners that is Exhibit 6 in your binders.

A. That publication really became the basis, laid the groundwork for a lot of subsequent work on the area.

Also shown on that slide is a north/south dashed line. That is the mapped Animas Valley Fault. And the other thing I would like to point out is the red in the bottom center there labeled QB. That is a quaternary basalt flow that is on the surface. And you can drive right across it as you go west of Animas.

So, again, this was a slide that was developed many years ago just to be a general overview for a presentation.

Q. And, Roger, is this the lease area?

A. That is the lease area. There is two leases there. The larger one is the NM3479, which is the

Federal lease. And then the smaller square one is 108801. Those are both BLM leases that are owned by Lightning Dock.

Q. Next slide?

A. Yes.

Q. Do you want to talk about underground or talk about --

A. Let's go to the history.

This is just to provide you with a quick overview of the history of exploration. I mention the regulations went into effect in 1974.

Companies started in 1975, if not sooner. Most of them were oil companies, but not all of them. You had Hunt, Phillips, Chevron, Union. But then you had companies that were more into mining, like Amax.

Prior to that, though, there were some water samples that were taken and analyzed. And this goes all the way back to Reader's work in 1948 and 1954. This is with my understanding that when the -- this was a major producing cotton-growing area and Reader was one of the first to do some groundwater studies and monitor the wells in the valley, but he also did some chemistry.

And then in 1949 all the way through 1968, there is a gentleman named Somers who came out and sampled the wells. And at this point, the hot water well at

Lightning Dock had been discovered.

It was drilled by a farmer who wanted to irrigate his cotton fields, and he got this horrendous hot water instead of cold water.

So Somers actually sampled the discovery well out there and a couple of others. And then Amax came in in 1975 -- it is hard to distinguish the colors from here. But they took additional water samples. Delashay came in in 1975. He was associated with Amax. Logsdon came in in 1981 and took additional water samples.

And then in -- also in 1981, we had New Mexico State University take some. And, then, finally, Lightning Dock in cooperation with OCD took some samples in 1985 and 1986. And, lastly, I have on there Dr. Dave Norman at New Mexico Tech took some samples in the 1990s.

And these are just samples for which chemical analyses were run that we thought could be useful to identify what was going on in the valley.

Q. We will move through these kind of quickly, but we wanted to show the Commission sort of the scope of the study that's been involved in the valley.

A. Back up one.

Q. Okay.

A. Again, Amax, starting in 1976, drilled numerous holes up and down the valley. They went all the way south of Animas, all the way up almost to Interstate 10, and just were drilling over the place. This was kind of a shotgun approach, but there were reports of hot water wells elsewhere in the valley. So they were doing a regional reconnoissance exploration program.

They came in with a second round in 1976. And Phillips Petroleum also came in in 1976, drilled a few holes. Most of them were somewhat close to Lightning Dock.

And Aman Oil came in and drilled a few holes. Those were mostly between Lightning Dock and Interstate 10 to the north.

And then Amax came in about the 1978, 1979 time frame and drilled four deep temperature gradient holes. And if you can see, those are the larger green dots right on the east side of the Federal lease at Lightning Dock.

Most of the gradient holes were anywhere from 3 to 500 feet deep. And, keep in mind, temperature gradient holes are small diameter holes. They usually completed them with 2-and-7-eights-inch tubing or something like that, so you could go back into the hole and take temperature measurements over a period of time.

Q. Data from these TG holes, would that be an example of some of the information you got from Amax?

A. We have data from every one of these holes that is shown on this map.

Q. The next slide?

A. Yes.

I apologize for the mishmash on this, but it shows other geophysical surveys that have been done. The triangles that you see are actually a dark green, but they are scattered throughout the whole region there.

Those are gravity stations that the data are in the public domain. And we worked with Dr. Randy Keller at the University of Texas at El Paso, and he provided public domain data.

In 1978, Amax again ran a large or flew a large areomag survey that covered basically the whole valley, actually extended eastward and west to the border, but focused on Animas Valley. They were looking for magnetic anomalies.

And then in blue more focused up and down, north and south of the Geothermal lease is an areomag survey that we, Lightning Dock Geothermal, Inc., flew in 2001 with a DOE grant.

More recently, Cyrq Energy/Lightning Dock, LLC, flew another areomag survey in 2014, just last year.

And that's the diagonal rectangle in red in the middle. And that was to provide much greater detail in the resource area.

One other survey was MT, mag needle Tallert survey. And that's by the dashed line. It's a little larger. It covers a fairly large area and it was run by Lightning Dock in first rounds in 2011 and the second few detailing stations within that same box last year in 2014.

These are seismic lines that have been run in Animas Valley. And they go back to 1969. There was an oil company out of Houston, Cockrell Corporation, and they were looking at the petroleum potential of the Animas Valley.

They ran two seismic lines, and they are hard to see. They overlap. But there is an eastwest red line and a north, south red line almost right up and down the Animas fault.

There also was another company called Harvey Geophysical that ran some speculative lines. Some of these geophysical companies would just go run lines on spec that they thought they could later license to oil companies or other companies, which they do and they did. Those are in the blue. Those were run in 1982.

Lightning Dock came in in 2002, again using a DOE grant.

And two east lines in yellow across the lease area, we evaluated those.

And then we came back in later in 2002, November, and ran additional east, west lines across the Animas Valley fault zone. This was to test some hypotheses that there may be additional resources up and down the Animas Valley fault. And so we wanted to confirm the location of the fault to see if we had any indication of other potential resources. And so we ran those east, west lines in November of 2002.

Finally, in early 2004, we came back in and redid an east, west line and a diagonal line that went real close to well 55-7. We wanted to get a better interpretation for that.

And, coincidentally, that diagonal line that runs from northwest to southeast essentially went right over the location for well 45-7 even though it was several years apart.

Finally, in August 2011, Cyrq decided to do a 3D seismic survey. And that is outlined by that pink box.

So this just gives an idea of Lightning Dock Geothermal, Inc. When I was a part of it, we did look at the Cockrell seismic lines. We did get a license for part of the Harvey lines. And all of the rest of the data were ours.

So there is a tremendous database and quite a history of exploration in Animas Valley.

Q. Next question, Roger. Do you recall reports from any of these studies that provide information about reservoir capacity and what can you say about what the reports state?

A. There's been a few reports done on the reservoir capacity. The reservoir estimates, probably the first one was a well-known publication put out by the U.S. Geological Survey. It was Circular 790. I believe the final publication date was 1978.

It was the first federal government assessment of geothermal resources in the United States. And they covered all of the states including Alaska, and did their best to calculate what the true energy potential would be for geothermal resources.

Very little other than a couple of hot wells were known at Lightning Dock. But they compared it to other basin and range resources primarily in the Nevada that they had a little more information on.

They did have to make some assumptions. They used an average volume size for the size of the resource, some heat flow. And they calculated that there were probably in the range of 24 megawatts potential at Lightning Dock, a very acute assumption.

Subsequent to that, in 2001, I mentioned that Lightning Dock had commissioned a couple of studies as part of the DOE grant. One of them was to Geothermex. And they have studied just about every geothermal resource in the United States and around the world.

They give their professional opinion. They do sophisticated calculations. And they did a resource estimate based on their calculations. And if I remember right, they gave a range of basically 9 to 15 megawatt capacity.

Also in that year, 2001, I mentioned that we had contracted or subcontracted Dr. David Blackwell at Southern Methodist. He is known as a heat flow expert. He independently did his calculations. And he came up with a size estimate of 5 to 15 megawatts.

Later after Lightning Dock drilled four deep gradient holes in 2003, we asked those contractors to update their estimates. And, indeed, Dr. Blackwell did and came out with an estimate of greater than 15 megawatts. Also Roy Caniff, who was president of Lightning Dock, he was an engineer. And he did his estimate and again came out with roughly the same range.

The last one that I am aware of was done in 2010. It was done by a company called Isor. They are basically the Icelandic equivalent of the U.S. Geological Survey. And because Iceland is rich in geothermal, that is their specialty.

They came in and they reviewed all of the data. And they came up with an estimate of anywhere from 19 to 35 megawatts.

So there have been several estimates, calculations on the size of the resource.

Q. It sounds like there's lots of different opinions of that out there?

A. There are. And most of them give their opinions as a range of values. Who knows what it ultimately will be. But there's a lot of very strong opinions on it.

Q. And do you have an opinion on what the reservoir could produce?

A. I am not a reservoir engineer, and it is really not in my area of expertise. I look at the geology and more at the temperature, rather than doing all the calculations. I have just an opinion, that it's easily ten to 20 megawatts.

And as more wells are drilled and we get more data, that is a moving target. It is a dynamic process to constantly reevaluate the resource itself, get a better understanding of what is going on.

But I guess my main comment would be as we gain new data, it seems to be getting larger.

Q. So, Roger, I would like to turn to some history now because you did testify about your involvement with the Lightning Dock site and the lease and so forth.

Could you look at Exhibit 5, Lightning Dock Exhibit 5 in the green binder.

A. I got it.

Q. And can you identify that for us?

A. Yes, I can. This is a joint facility operating agreement. It is dated the 6th day of September, 1995.

Q. And who is it between?

A. Lightning Dock Geothermal, Inc., a New Mexico Corporation; and AmeriCulture, Inc., a New Mexico corporation.

Q. And I just wanted you to read into the record one provision from here, and that's over on page 6.

MR. LAKINS: I object to the reading into the record. The document will be admitted as an exhibit --

MS. HENRIE: That's fine.

Q. I would just like to call the Commission's attention to a paragraph on page 6, item B-3.

Roger, do you have an understanding of that paragraph?

A. Yes, I do. Perhaps I should explain why this agreement came about.

Q. Please do.

A. Lightning Dock, as the owner of the Federal Geothermal lease --

MR. LAKINS: Which paragraph are we at again?

MS. HENRIE: Page 6, paragraph B, as in boy, 3.

MR. LAKINS: Okay. Thank you.

MS. HENRIE: Okay.

A. When Lightning Dock obtained the lease from Geothermal Properties in New York, it was a Federal lease. And it's a rather unique situation in geothermal that you have private landowners who own the surface land under federal minerals or over federal minerals. So it is called a split estate lease.

And what happened is when the lease was first issued way back in I believe it was 1979, because they were private landowners, the BLM required an operating agreement with those private landowners to account for access and development.

When Lightning Dock, Inc., got that lease, those operating agreements came with it. There were two of them, one with Thomas McCants and one with Dale Burgett as Rosette, Inc.

Later when AmeriCulture purchased the 15 acres which was shown previously on the one slide, BLM came to Lightning Dock and said, You need an agreement. And by that time they were no longer called operating agreements. They had developed this joint facility operating agreement.

So Lightning Dock, Inc., signed this agreement with AmeriCulture for that 15 acres that is under-liened by the Federal Minerals.

Q. And, briefly, what does the agreement do?

A. It just provides for operations. It gives Lightning Dock the authority to go ahead and develop geothermal. There are certain provisions in there. One of them is that AmeriCulture cannot use any part of their lease for electricity generation. It can only be for direct use.

The other provision is that they are not allowed to drill deeper than 1,000 feet, and that Lightning Dock, Inc., does have all the authority to develop that lease for geothermal electricity generation. Those were the main distinctions.

Also, there was a provision in there that should AmeriCulture be harmed or degraded in any way from loss of heat, that Lightning Dock would provide replacement heat for them in their operations. So it protected both sides, so no one lost or no one gained.

Q. And next, Roger, I have just a couple of historical reports, and I wanted you to read a couple of sections from them and I brought copies for Counsel.

I wasn't intending to admit these as exhibits, but I am happy to share them with you all.

Do you know what these are?

MR. LAKINS: I am going to totally object to the use of this. This was not disclosed prior. This is six pages, single spaced, and I haven't even had a chance to look through it and analyze it before a question is asked.

MR. BRANCARD: The Commission doesn't have copies.

MS. HENRIE: Let me tell you where I am going and then maybe that will help you understand the context.

These are two historical documents, one describes a visit to Rosette and it describes the use of water by Dale Burgett at the time. And it actually calculates the extent of that use of water.

And I think that's relevant because there are some questions about use of the geothermal system and Burgett was using a heck of a lot of water out there, which just kind of shows what happens when there is use; in other words, AmeriCulture was not harmed by that use by Dale because of the very great extent.

The other report describes AmeriCulture Federal Well No. 1, casing depth of 60 feet, and how that well is influenced by Service Bar.

Roger can testify to those points because he is familiar with them. He doesn't need this. But it would be something you could read into the record if you want.

MR. LAKINS: This is a 6-page document without a signature on the back. It is hearsay. I have no opportunity to cross-examine the person who wrote it.

The document is something that happened almost -- more than 20 years ago. 1998 is the date on it. It is not relevant to the purposes of today's hearing and Applicant meeting its burden of proof for this hearing.

And it wasn't disclosed before this very moment, so I object to its use or any reference to it.

MR. BRANCARD: This is not Mr. Bowers' document, is it?

MS. HENRIE: He can identify it, though. It was his business partner's document and so Roger can identify it or he can just use it to refresh his recollection of facts from the past.

MR. BRANCARD: I would think -- I'm not sure where you are going with all of this and how it is relevant to your application. But just ask the questions of the witness --

MS. HENRIE: Okay.

MR. LAKINS: I would also object to the relevance of anything that happened in 1998. How is a site visit in 1998 relevant to what's on the ground today and the Applicant's burden of proof.

And Mr. Bowers here has testified that he's an expert geologist, not here as to facts about what happened by somebody else back at that point in time.

MS. HENRIE: He has also testified that he has been active with the Lightning Dock lease for many, many years. And if we are going to have anyone ever in front of this Commission who can explain how the Rosette operations really looked at the time when they were up and running and operating, and not anymore, it's going to be someone who knows it from the past.

MR. LAKINS: And how is what happened with Rosette relevant to the application before the Commission?

MS. HENRIE: Because Rosette was using geothermal wells, a lot of water, a lot of water from a lot of geothermal wells at the time. And look at what happened, the aquifer is still hot and AmeriCulture is still in business despite huge uses of water out there on site. And I think it's interesting information for the Commission to consider whether our proposed injection wells are going to have any effect.

MR. LAKINS: I further don't think it is relevant because Rosette's operation did not involve injection, and we are talking about injection.

MS. HENRIE: We are talking about a geothermal system.

CHAIRPERSON CATANACH: Let's go ahead and allow you to question him on it. It seems to be kind of interesting.

MS. HENRIE: Okay. Thank you, Mr. Chairman.

BY MS. HENRIE (cont'd):

Q. So, Roger, are you familiar with a site visit in 1998 to the Burgett or Rosette facility?

A. Yes, I am.

MR. LAKINS: If he doesn't have personal knowledge, I am going to object entirely.

Q. Were you there?

A. I was there. And it was, I believe, February. It was a cold winter morning. And Roy Caniff and I -- Roy was president of Lightning Dock Geothermal, Inc. And we made the trip out there to see what Mr. Burgett was doing as far as his geothermal heating that night.

And during the cold winter nights, he would use the hot water from several different wells to heat his greenhouses. And every bit of that water was being disposed of on the surface, allowed to run down that ditch that you see running north, south there.

And we easily estimated that he was pumping more than 2,000 gallons per minute, all of which was being dumped on the surface. And this was water that was close to 200 degrees Fahrenheit. We observed it, we documented it, we measured it. We later reported it to OCD. We were dealing with Roy Johnson at the time.

Q. Did Roy make an estimate of the total acre feet being used, acre feet per year --

MR. LAKINS: Objection. Speculation. This is hearsay. How is it relevant? Mr. Burgett who was pumping water almost 20 years ago --

CHAIRPERSON CATANACH: Let's just focus on what he can answer from his personal knowledge.

MS. HENRIE: Okay.

Q. Roger, going to the other report that I was going to read out of, can you describe the history for Federal Well No. 1?

A. I first knew it as the Beale Well. It was drilled by Tom McCants, but there was a competing rose grower. His name is Tom Beale. He was out of the Seattle, Washington area. And he wanted to move to Lightning Dock.

Tom Beale had drilled this well, which is now AmeriCulture Federal No. 1. Roy Caniff and I did personally run temperature surveys in that well and also observed and documented that during rainstorms that well could cool down by as much as 40, 50, 60 degrees Fahrenheit just from the cold water rain runoff. But it was very shallow.

So later when AmeriCulture purchased the 15 acres from Tom McCants, the well, as far as I know, became their property. But the fact is that there were extreme temperature variations noted in that well, again very shallow, subject to cooling from just rainstorms in the area.

Q. Thank you. New topic.

Roger, from your experience, do you know what the principle of correlative rights means?

A. Yes. I had some firsthand experience when I was at Hunt Energy. Basically, in my mind, it means where different operators or landowners are producing from the same resource or common pool, if you will.

The correlative rights means that they get that portion of the resource based on their surface acreage.

It is a way of preserving the resource, and not overproducing it.

Probably the best example I can think of is the geysers, although it's a dry steam field. There were many different producers. They overproduced it and all of a sudden, you had a huge field-wide pressure decline. And it put some of them out of business.

The one I had personal involvement with was at Cove Fort, Utah, and it was with Union Oil Company. Hunt had some adjoining leases, and it was believed to be a common resource, so correlative rights came into play based on the acreage.

Q. So do you believe that these proposed injection wells will harm AmeriCulture's correlative rights?

A. Not at all.

Q. Let's go through each of the proposed injection wells and talk about them and talk about what you think will happen in that area to the injected cool fluid. We say "cool" fluid, but it's still quite hot. But let's kind of go one by one.

Out to the west is 13-7. What do you think will happen out there?

A. Based on nearby temperature data, I think it may have a very slight warming effect, but I think it will be very minor. There is a well just to the south of it that produces warm water. There is a gradient hole just to the north of it that we have temperature profiles on.

And based on that information, I would conclude that it would have a pretty minimal impact on it from a temperature standpoint.

Q. Because the ground water is already pretty hot?

A. The ground water is already pretty warm out there.

Q. Let's go to 63A-7, which is marked on the graphic there, 63-7.

A. Right. That is proposed just off to the southeast of well 63-7. And, again, based on temperature surveys and drilling logs, geophysical logs from that well, it will basically -- the water being put back in will basically be the same temperature as what is already there in that well.

Q. And so going clockwise over to State Land 15A that's down kind of on the lower right-hand corner...

A. It's east of the greenhouses there. It is just across the line. It is on state land. I've got two well controls, one just to the north of it that Dale Burgett drilled and then another one just to the southwest of it.

The injected water will probably have a slight warming effect. But at the same time, it's already headed towards the main greenhouse area, which is a lot hotter.

So I would think that in a very short distance that temperature is going to equilibrate. So it may have a slight initial warming, but it would dissipate quite rapidly in my opinion.

Q. And down south of the greenhouses by Dale's house with the white square at the bottom.

A. And that's almost the opposite. It would probably have a slight cooling effect, because it's that area down there that Mr. Burgett drilled some of his hottest wells. You've got temperatures exceeding 230 Fahrenheit at 200 feet of depth.

And so it's already the hot area plus the groundwater flow is to the north. So there actually may be a slight cooling, but I think there is enough flow there that the temperatures would equilibrate very rapidly.

Q. So when you talk about temperature equilibration, what do you mean?

A. Just the temperature of the injected water matching the ground water. I mean, overall, you are putting in such a small amount of water into such a large system that the temperatures are going to modify or equilibrate, balance out, very, very quickly, plus you've got a big mass of hot rock down there.

So the small amount of -- the relatively small amount of water going into those injection wells, I just don't see having any large effect on the temperature regime.

Q. So you don't see it having any effect on any of the AmeriCulture wells to the north?

A. Well, I think that's so far north that they probably wouldn't see anything from a temperature standpoint.

Q. Roger, are you familiar with Exhibit No. 4 which is the report on the AmeriCulture well test back in 2000? The report is dated 2001.

A. Yes, I have seen it.

Q. Do you have any comments on this report?

MR. LAKINS: What exhibit are you at?

MS. HENRIE: Exhibit 4.

MR. LAKINS: Okay.

A. I guess, in a general sense. I'm not a hydrologist, so I will defer to Dr. Shomaker and Dr. Miller on the actual pump test.

But a couple of comments that come to mind, his figure 2 on page 4, it shows one thing I didn't show on my slides of the history. It has scheme reserve well 55-7 on the central part.

And then north of that, by roughly two miles, is the Cochrell No. 1 Federal Pyramid Well. And so he uses those as his primary comparisons.

Those are basically the only two deep holes that were drilled in Animas Valley. Steam Reserve 55-7, which is 7,001 feet, and the Cochrell Pyramid Well went to 7,400 feet. So those are the only deep ones. They are useful for providing a geologic overview and Mr. Witcher did use that.

I don't necessarily agree with his interpretation of the geophysical faults based on the geothermal or the geophysical surveys I've looked at. There is some question exactly where these faults are.

And the west, northwest basement structure, again, I don't argue with that. It has been identified. My only comment on that is that it is an extremely old structure. This is Laramide, which is millions of years old, and in my opinion, basically, has nothing to do with the geothermal system.

And that goes back to the publication by Elston, Deal and Logsdon, New Mexico Circular 177. They proposed a northeast, southwest trending cross structure in there. And based on the data that I've seen, I would agree with that.

So rather than a northwest trending structure, there is more of a northeast structure. But that's a differing opinion from the geologic basis.

If I remember correctly here, I was concerned about the monitoring of some other wells during the pumping test. And at that time, as an owner of Lightning Dock Geothermal, we were very concerned about Well 55-7. That well was property of Lightning Dock Geothermal, Inc. Mr. Burgett and no one else had any authorization or right to go into that well. It was a trespass. But, more than that, I would question the way that they took water level measurements.

Other than that, I will defer to others on how they'd want to comment on it.

Q. Did Mr. Witcher or anyone else have access to all of the studies and the reports and the data that you had access to?

A. Not that I am aware of.

MS. HENRIE: Mr. Chairman, with that, I'll pass the witness.

CROSS EXAMINATION

BY MR. LAKINS:

Q. Mr. Bowers, good afternoon. You used the term geophysical system in your testimony.

A. Okay.

Q. Right?

A. I believe I did. I probably did. I've used that terminology for years.
Q. That phrase actually is not included in New Mexico's Geothermal Act, is it?
A. I don't know.
Q. And you are not qualified as a reservoir engineer by your own admission, right?
A. That's correct.
Q. And so your testimony about the effect of Lightning Dock's proposed injections on all of the wells is your personal opinion and not an expert opinion that you are qualified to give, correct?
MS. HENRIE: Objection. He was qualified as a geologist.
MR. LAKINS: Right. But he also said he is not a reservoir engineer.
MS. HENRIE: Reservoir engineers calculate capacity. They don't talk about heat flow necessarily. Geologists can talk about heat flow.
THE WITNESS: May I respond?
MS. HENRIE: Sure, you may respond.
A. My response is based on temperature data of the rock.
Q. (By Mr. Lakins:) So you don't know what is going to happen with the water flow, though; you are not a

hydrologist?
A. That is correct.
Q. So you don't know what impact any of the water injection may have anywhere, do you?
A. No, I don't.
Q. All of your testimony about potential impacts on the water flowing into AmeriCulture's well, you are not qualified to give that opinion, correct?
A. It was just based on temperature data.
Q. I understand that you said that the proposed injection would not harm Mr. Seawright of AmeriCulture's correlative rights?
A. That's my understanding.
Q. That was your testimony?
A. My testimony.
Q. And what do you base that on?
A. My understanding of how correlative rights work.
Q. And you said your understanding is based upon the surface acreage, correct?
A. Yes.
Q. Are you familiar with the definition of correlative rights in New Mexico's Geothermal Act?
A. I couldn't recite them, no.
Q. I am going to read it to you.
A. Okay.

Q. This is from NMAC 19-14-17, which is Definitions in the Geothermal Power Act: (C), Correlative Rights. Correlative rights shall mean the opportunity afforded, insofar as it is practicable to do so, the owner of each property in a geothermal reservoir to produce his just and equitable share of the geothermal resources within such reservoir, being an amount so far as can be practicably determined and so far as can be practicably obtained, without waste, substantially in the portion of the quantity of recoverable geothermal resources under such property bears to the total recoverable geothermal resources in the reservoir and for such purposes to use his just and equitable share of a natural energy from the reservoir.

Now, that definition doesn't include surface area, does it?

A. I did not hear that.

Q. Wouldn't you agree that, for instance -- the lease MN108-801, that's the 640 acres, right?

A. Correct.

Q. There has been no geothermal resource found that can be developed in that lease, is there?

A. Not yet, no.

Q. In the entire leased area, there is only the one geothermal resource and that's the one that we are talking about that has been identified as practicably developable, correct?

A. As so far identified, yes.

Q. So the correlative rights under New Mexico law has to do with what can be obtained from the resource, not based upon total surface area; would you agree with that?

A. Yes, I would agree with that. I was asked to give him my opinion based on my experience. And I always understood that it was based on surface area of the defined resource.

Q. Understood.

Will the reservoir temperature drop as a result of the injection proposed?

A. I would be very surprised that it would.

Q. I have to take it, you probably have a lot of knowledge of the geology of the area?

A. I have a fair amount. I don't know how you would quantify it.

Q. And that top 400 is an alluvial fill?

A. It depends where you are.

Q. Where the proposed injection site is, is that within the alluvial fill?

A. For the most part, except 76-7.

Q. What's the geology -- sorry -- except for 76-7, did you say?

A. Yes. And it has not yet been drilled. But it seems to be on what we call the siliceous cap of the geophysical system. So it may not be 400, 500 feet of valley fill. It may not be 150 feet of valley fill. That's based on the old Burgett wells that would hit the hard silicified rock at its shallowest at about 150 feet. So I can't say that's valley fill.

Q. Okay. The other three are?

A. I don't know. They haven't been drilled yet, but I suspect they would be.

Q. And are you familiar with the remaining geology between the alluvial fill -- let's take well 55-7, that well. Is that one you drilled?

A. No. I was not involved with that. That was Amax.

Q. Which ones did you drill -- were you involved in, I should say?

A. I was directly involved in deep gradient holes drilled in 2003. They're labeled as TG 12-7, 52-7, 36-7 and 57-7.

Q. Thank you. So the well 55-7, are you familiar with the geologic strata that exists at that one?

A. Yes, I am.

Q. And could you explain what it is?

A. Off the top of my head --

MS. HENRIE: Do you want to put up those well logs?

THE WITNESS: If we could put up a cross section or a well section?

MR. LAKINS: Sure. If Ms. Henrie has that, that would be great.

MS. HENRIE: I will just try to get it on the screen.

(Pause to project the illustration.)

A. What was your question?

Q. Just to explain the geologic strata of that well.

A. Okay. First of all, the yellow -- well, to qualify this, this was taken from the mud log of the drillers. Again, I was not on this.

The well was spudded in late 1984 by Amax and completed in early 1985. It was logged by a professional logging company, a mud logging company.

Basically the yellow near the top is alluvium. There is an orange unit in the middle of that yellow and those are silicified sediments that we believe are produced by the geothermal waters.

Most of those alluvial sediments are volcanic in origin. There are all sorts of different volcanics that come off the Pyramid Mountains and even evidence of some sediments that came from the Peloncillos on the west side of the valley.

That pink section is what we call volcanic clastics. And, again, it's just all volcanic types of rock. They are indurated, which means they have some hardness to them when you drill through them. It is not just loose alluvium.

And then you have that complete section of the pink of these volcanic clastics.

That brown unit immediately under it is where you get into older sedimentary rocks. And these are believed to be probably Mesozoic in age.

The blue is a limestone unit.

And below that I think you get into a shaley limestone. And then you get into some dolomite. And it goes on down for dolomitic limestone, shaley limestones, and other Paleozoic units.

What this does not show is that it goes to 7,000 feet, which would be way down to the bottom of screen. And at that depth, they got into what they called the Precambrian granite.

Q. Okay. Thank you. And all of those Lightning Dock four wells, that top layer is the alluvium. How deep is that layer in those wells, in that area?

A. I would have to estimate. If you look at depths are in vertical lettering off the left of each well. You can see 500, 1,000, those are depths.

Q. So the top 150 feet of each of the known wells is alluvium, of those four wells?

A. Roughly, yes.

Q. And the same thing with the AmeriCulture wells?

A. Yes, sir.

Q. Now, you are talking about the Joint Facility Operating Agreement --

MR. BRANCARD: Would the parties be okay with that being printed out and available to the Commission?

MS. HENRIE: This is confidential. We don't mind showing it to you, but I don't want it in public records. And if I give it to the Commission, it is going to go on the Internet.

EXAMINER BALCH: It puts us in a little bit of a quandary, because we have a site where we have Mr. Witcher's report and then we have all of your great data, in 2-D lines, 3-D lines, small scale aeromag, a 3D survey, and we have none of that data available to us to help make our decision. This really is a challenge.

MS. HENRIE: Mr. Chairman and Commissioners, with respect, as I read the regulations, we are not asking you guys to characterize the reservoir. We are trying to explain what's going on.

EXAMINER BALCH: Some of the questions we want to answer or at least I want to answer have to do with the scale and size and characteristics of that reservoir.

MS. HENRIE: Which is why I brought the witnesses to try to help answer those questions.

You know, we could try to do something to show you some of that information. But I can't have it in public records. It is trade secret. We have worked very hard to compile that information. And it means something to the company.

I don't know what you guys do in oil and gas.

EXAMINER BALCH: Usually you don't have the data given to you. You have the interpretation given to you, so something that summarizes the data that's available to you would be useful, a cross section for example. It is not the data, it is not the well logs, it's not the seismic cross section; it's an interpretation. That's what we get from the oil companies.

MS. HENRIE: So a different interpretation than my witnesses have been providing?

EXAMINER BALCH: Well, we are getting a

verbal description or a conclusion from the knowledge that's presumably in their heads. But we have nothing visual that we can reference when we want to ask a pointed question about where the fault is.

And I presume you know exactly where the fault is, because you have all that great data. And all we know is there is a fault, and there's different interpretations on which direction that goes.

So Mr. Witcher's report has it trending north, northwest. He thinks it's north, northeast. Where is my proof?

MS. HENRIE: We go with Elston, which is in your materials. I can circle with my team tonight and try to figure out what to provide you. What we have been trying to do is tell you reasons why we think the Witcher report is wrong, provide you with Elston, which we think is right --

EXAMINER BALCH: But some illustrations of why and where the data came from would be incredibly useful for that purpose.

MS. HENRIE: The Elston report?

EXAMINER BALCH: If you are going to tell us Mr. Witcher's report is wrong, I want to know why and have some evidence of why it is wrong.

MS. HENRIE: Okay. When Dr. Miller

testifies, we will do that.

MR. LAKINS: May I?

EXAMINER BALCH: It is his cross-examination. I interrupted him. Actually, I am not sorry.

MR. LAKINS: I think that the aspect of confidentiality was just thrown out the window by putting a confidential document up in a public hearing where there's members of the public here that now have it.

Ms. Henrie has asserted that it's trade secret; however, in the hearing that we had, we discussed my motion to vacate, reset because we wanted some documents.

Their legal expert said that underlying scientific data is not trade secret. I think it would be most beneficial for the Commission to have that document for its review. And it could be stamped as confidential, not for public release, because the Commission has the ability to do that, to keep things confidential, and that it ought to be produced for the Commission's benefit.

MS. HENRIE: If I may respond if we are doing argument. What our intellectual property attorney said, yes, scientific data at data point is not trade secret; the compilation of the data is. When you take all of the information you have to create logs or data compilations, that does become trade secret. An individual data point is not protectable. But what they are asking for are things that have actually been compiled.

MR. BRANCARD: I think Mr. Lakins is correct that we can work out a confidentiality agreement here on these matters. We certainly had a wild and wooly Oil and Gas versus Potash a few years back in which a large portion of the record ended up being stamped confidential, even though it was it an Oil Conservation Commission hearing.

MS. HENRIE: And just to be clear, I don't mind doing that to give you guys some information. I am not letting them take it home.

MR. BRANCARD: They can sign a confidentiality agreement.

MS. HENRIE: I don't want them taking it home. If they want to look at it, that's fine. I don't want them taking it home.

These are project deponents, business competitors. And we spent a lot of money developing this resource; and, in fact, maybe we will talk about some of the requests for information that go back historically as we've been trying to develop the resource and they just want our data. They just want our information.

EXAMINER BALCH: Presumably the data would support your arguments.

MS. HENRIE: And tell them more about the resource.

EXAMINER BALCH: Unfortunately, I think I need to know more about the resource.

MS. HENRIE: So can we make a deal with you guys to make an agreement -- I haven't ever done in camera in court, but we could...

MR. LAKINS: I would say that Lightning Dock can't have it both ways. If they don't want to give it to us, then they shouldn't give it to you; if they want to give it to you, then they need to give it to us too. And I am fine with not getting it.

MS. HENRIE: So you see how it really is.

MR. LAKINS: So then nobody gets it. The Commission had a benefit of a look and had the benefit of testimony, but if Lightning Dock wants to keep it from everybody, then we will keep it from everybody.

MS. HENRIE: No, Charles. I said I wouldn't mind sharing it with the Commission, I just want to keep it from you.

MR. DOMENICI: If I could make my objection on the record. I think whatever expert opinions are offered and that you would rely on as the Commission, that there needs to be a basis for those opinions.

So whenever I get a chance to argue, I will argue some of these opinions really shouldn't be given much weight. There is no data to support; they're just statements.

EXAMINER BALCH: That's my point quandary. It really is. I have to then decide which expert do I believe more.

I have to tell you the one who gives you something; at least I can go home and look at it tonight.

MR. BRANCARD: Do you want to think about it overnight?

MS. HENRIE: Thank you.

MR. LAKINS: Okay.

CROSS EXAMINATION (resumed)

BY MR. LAKINS:

Q. Turning to Exhibit 5, which is also AmeriCulture's Exhibit O for the Commission's reference. Is that the Joint Facility Operating Agreement that you were referencing a little bit earlier, Mr. Bowers?

A. Yes, sir.

Q. That agreement did only pertain to 15 acres, correct?

A. That's correct in my understanding, yes.

MR. LAKINS: Thank you. I pass the witness.

CROSS EXAMINATION

BY MR. DOMENICI:

Q. Sir, did you help locate any of the four proposed new injection wells?

A. I did not locate them, but I reviewed them.

Q. After someone had suggested where they would go?

A. Yes.

Q. What did you review them for or what was the nature of your review?

A. Again, basically, from the temperature standpoint and the valley fill, the geology.

Q. And was the objective to try to make sure there was a screened interval in the valley fill so that the quantity of water injected in those could be absorbed?

A. Yes. We are always looking for permeability to inject.

Q. So you have been on this project for decades, it sounded like. Hasn't it always been obvious that the best place to inject would be the alluvium; to any geologist that would be obvious, wouldn't it?

A. Basically, yes, but it's not guarantee. Sure, it would always be nice. I guess I don't understand -- I mean --

Q. Well, you are also looking for strata that would absorb the water?

A. Right.

Q. My question is isn't it obvious that the alluvium should be given at least primary consideration as the best place to take high volumes of water?

A. It would certainly be a consideration.

Q. Why is it being proposed now after the facility is already up and operating rather than at the time of the first application, if you know?

A. I really don't know the answer to that, basically because I haven't been involved in that aspect of it since I left the company in 2007 or I sold my interest in the company.

Q. In 2007?

A. Yes. I am just a consultant to the company now.

MR. DOMENICI: Thank you. That is all I have.

MS. MARKS: I have no questions for this witness.

EXAMINER BALCH: I have a couple of questions.

THE WITNESS: Uh-huh.

EXAMINATION BY COMMISSIONER BALCH

EXAMINER BALCH: Sorry. I didn't mean to interrupt your cross-examination there.

My primary question, of course, is where are all the great cross sections and geologic maps, from this wonderful data you have. But I had that one answered already.

THE WITNESS: May I?

EXAMINER BALCH: Sure.

THE WITNESS: Believe me, I understand your concern. There was a significant amount of data released as part of Lightning Dock Geothermal, Inc.'s, final deal we recorded in 2005. That is in the public domain, and it summarizes a lot of the geophysics, the deep gradient holes that were drilled. So that is in the public domain.

EXAMINER BALCH: So you could have based your presentation off of that?

THE WITNESS: Yes.

EXAMINER BALCH: And maybe differentiate a little bit on your interpretation, and that would be useful.

THE WITNESS: Okay.

MS. HENRIE: Okay.

THE WITNESS: The other aspects of it, I

have no control over what the company decides to release. But I understand what you're saying.

EXAMINER BALCH: Do you think you know the boundaries of the geothermal anomaly?

THE WITNESS: I think I have a reasonable idea. I will qualify that by saying it seems like every time we drill -- we insert drills in another well or gets new information, it's changing.

It's a dynamic process. To me it's part of the scientific process. You get some data, you build a model. And in this case, I've -- you can call it multiple working hypotheses or whatever. But you build a model and then you go out and get some more data.

You have to see if that fits the model. And if it doesn't fit, you don't throw that data out. Those data are real. You have to adjust your model and your thinking to fit the data as long as you know that those data are reliable. So it is an ongoing dynamic process that you continue forever.

I do that on any project that I evaluate or am involved with. So over the years as new wells have been developed as these geophysical surveys have been run, it changes that model. It changes the size and the scope of what we believe the resource to be.

EXAMINER BALCH: It gets bigger every time you add some data?

THE WITNESS: So far everything I've seen indicates that it's --

EXAMINER BALCH: So if you imagine the geothermal anomaly as a plume coming up, as a cylinder, what would the diameter of that cylinder be?

THE WITNESS: It's actually not a cylinder.

EXAMINER BALCH: I know that.

THE WITNESS: It's an oblong shape. I can reference --

EXAMINER BALCH: A cross-sectional area would be fine as well.

THE WITNESS: Yeah. It could be huge. And I go back to Elston, Deal and Logsdon; it's one of the exhibits here. Maybe that would be the best way to reference it, if I can find it here.

It is Exhibit 6. This is Bureau of Mines Circular 177. I am looking for a contour map.

MS. HENRIE: Page 34.

EXAMINER BALCH: There is one on 24 as well.

THE WITNESS: What was the other page number?

MR. LAKINS: Which page?

EXAMINER BALCH: 34 is geochemistry. Look at 24. 24 is heat.

THE WITNESS: This one. Page 24 is the one I was looking for, figure No. 9.

EXAMINER BALCH: Where is the Lightning Dock lease area on that map?

THE WITNESS: It would be the -- basically the center of that little bull's-eye. Now, the way I read this map, each square on there is a section or one square mile and the bull's-eye is in the eastern half of section 7. But if you started adding up the squares within those contour lines, it could be very big.

Now is that the boundary of the actual resource at great depth? Who knows.

And that gets into another --

EXAMINER BALCH: So you have a lot of groundwater data from seven different sources over 70 years. I presume you have mapped the plume, the plume that's coming off of this thing going up north. Does it fit this description?

THE WITNESS: It does. Now, these are temperatures. These -- I deal more in temperatures than I do with the waters themselves. The other factor you got to take into consideration is depth. And we know that it changes at depth.

There's another diagram in here that is a 3D diagram near the back. It is on page 40. And this is their 3D rendering of what might be going on down there. You can see the hot wells, and there's really not a good scale on this per se.

But this is where they developed their hypotheses that the actual heat source at depth is an area to the southwest of the shallow thermal anomaly. And it could be several miles down there.

So it's not a straight-up-and-down cylinder is I guess all I am trying to say. There is excellent evidence that at depth it goes to the southwest. The question is what depths are you talking about.

You're talking two, three, four kilometers, maybe miles at depth. So it is not a straight-up-and-down cylinder.

EXAMINER BALCH: These are all things that have a direct impact on the capacity of those rocks and their ability to transfer that heat to water for a sustained period of time. So I am certain that Lightning Dock, sir, has looked at this intensely and they have a feeling, a good feeling based on the science of how much heat they are dealing with. And I am not getting that information.

THE WITNESS: Right. And I'm not the person to give you the answer on that. They've had other people look at it who are more qualified than I am of that aspect of it.

EXAMINER BALCH: We don't have a geothermal person talking today or later and your case will be geochemistry and then you are going to stop.

MS. HENRIE: Correct.

EXAMINER BALCH: No one is going to talk about geothermal anomaly. So you're kind of it.

THE WITNESS: Okay.

EXAMINER BALCH: Does your nice 3D survey kind of pair up with this interpretation on page 40?

THE WITNESS: It does. It also shows that the hot wells area is -- has a lot of faults and fractures in it which is allowing the hot water to come up from depths. Like Dr. Shomaker described, it's fractured rock.

EXAMINER BALCH: The system came to equilibrium at the current rate of production in less than eight months, so there's obviously a good deal of fracturing down there. That's the dominant portion, isn't it?

THE WITNESS: Yes, I think that is.

EXAMINER BALCH: Is the surface area of the geothermal anomaly much greater than the diameter of those four wells as a whole?

THE WITNESS: Yes, in my opinion it is.

EXAMINER BALCH: And where approximately in that anomaly are they at? Are they center, east, west?

THE WITNESS: The center is basically right there in the middle of the greenhouse complex if you look at that map. So the closest two would be 63A-7 and 76-7 down to the south. They would be closest to the center of it.

EXAMINER BALCH: And you have how many miles to the edge of the anomaly, which direction of kilometers, whatever you want to give?

THE WITNESS: Probably close to a half a mile.

EXAMINER BALCH: In any given direction?

THE WITNESS: Yes.

EXAMINER BALCH: And then down plume to the north -- I guess the plume actually goes a little bit north, northwest, right?

THE WITNESS: It does. From what I have seen on temperature data, there is a westward component to it, but it's primarily to the north, northwest.

EXAMINER BALCH: Well, I guess I will shift gears. You were talking a little bit about Exhibit 5, page 6, paragraph E-3, that you didn't read into the record.

THE WITNESS: Yes.

EXAMINER BALCH: But it appears, at least on the surface, to protect the correlative rights of AmeriCulture to the thermal energy that they need --

MS. HENRIE: The energy that they need to?

EXAMINER BALCH: -- the geothermal energy, it appears to protect their correlative rights.

THE WITNESS: That is my understanding.

EXAMINER BALCH: I was wondering if I was missing something there.

THE WITNESS: No. I think that is what it was designed to do.

EXAMINER BALCH: Basically. If their heat goes down, you have to give them more heat?

THE WITNESS: That's right.

EXAMINER BALCH: And then chemistry comes in -- right? -- which I presume the next witness will discuss.

THE WITNESS: Yes.

EXAMINER BALCH: I guess I don't have anything else. Thank you.

EXAMINATION BY COMMISSIONER PADILLA

COMMISSIONER PADILLA: I'm just following up on that point. How would more heat be provided? What are we talking about? Heat for the farming operation?

THE WITNESS: Are you referring to the joint facility operating agreement?

COMMISSIONER PADILLA: Yes.

THE WITNESS: I would guess in the form of a pipeline bringing hot water to them. It would depend on what form they wanted it in. Unfortunately, that agreement is not definitive on how it would be supplied. It just says if they lose heat, Lightning Dock would supply it. Exactly in what format, I don't know.

COMMISSIONER PADILLA: I am having a little bit of an issue with the boundaries being a moving target because if it's a moving target, I don't know how we are supposed to define correlative rights based on something that's always shifting.

And I am wondering if you can pin that down a little for us. Like maybe the greenhouse complex as entering the kilometer all the way around is as close as we're going to get to a boundary, in your opinion, anyway for the...

THE WITNESS: It is difficult, and I base mine on temperature data, basically, in addition to some of the geophysical data.

I primarily first look at temperature data. That is what we are dealing with. Geothermal is heat, so I always look at the temperature data first and then see if I can refine it using geophysical or geochemical data.

And I can tell you that based on drilling and based on temperature surveys from the wells, that that thermal anomaly, as you go deeper, gets bigger. So it's also a function of the depth, how deep do you want to go? Some suggested we need to go to 10,000 feet.

It is a moving target, I understand. So to decide on the size of it, again you really need to say at what depth.

COMMISSIONER PADILLA: Getting to the issue of correlative rights being assigned to the size of the resource -- well, I guess that is more of a statement than a question.

THE WITNESS: But I understand your concern and I don't have a good answer for you on that. I know that heat is moving at depth, so do you arbitrarily pick a depth cut-off or do you arbitrarily pick a temperature cut-off and say, Okay. This is the resource at a given temperature, call it 250 Fahrenheit and draw your --

EXAMINER BALCH: Sorry to interrupt.

If you were doing this for oil, what can be technologically and feasibly achieved with today's technology so the resource boundary would be what you can get to with what you have now?

THE WITNESS: Right, okay.

EXAMINER BALCH: And there may be more that you can get to later on with some other technology, but that hasn't been discovered yet or hasn't been applied.

THE WITNESS: In my experience I mentioned Cove Fort, Utah, my direct experience with correlative rights. It was defined as the potential resource boundary. I didn't do it, but that's the way they defined it, saying, Okay, we see this as the area of --

EXAMINER BALCH: I am not sure of the technical, legal definition, but I know what I think of as waste.

THE WITNESS: Yeah.

EXAMINER BALCH: When I'm thinking of waste, I think what can you get to now with the technology we have at hand? What is feasible with that technology? That is the way I look at it.

THE WITNESS: Sorry?

EXAMINER BALCH: That's just the way I look at it.

THE WITNESS: Understood.

COMMISSIONER PADILLA: Mr. Bowers, when you testified earlier, you had several -- you mentioned several different opinions going back through the years on the reservoir capacity.

Was there no standard definition as far as temperatures, heat movement, et cetera, as to what constitutes a geothermal reservoir that we could apply to something like this? There's no uniformity in the industry definition of the term geothermal system or reservoir capacity?

THE WITNESS: Very simply it's taking, based on what you see as temperature, a volume of rock and calculating or estimating how much heat is flowing through that rock and then you can calculate out the various parameters.

It's also given in megawatts thermal or megawatts electricity. But it's basically simply an estimated volume of the rock times the amount of heat that's coming through it.

It takes into -- or should take into account the thermal conductivities of the rock.

The difficult part comes in when you are dealing with fractured reservoirs. When I started out, we had petroleum engineers that were, you know, oil and gas for years and years, and we threw in fracture permeability and nobody knew what to do early on. But there are some standard formulas that you can use to get an estimate, but they're all just estimates.

COMMISSIONER PADILLA: I guess there is no apples to apples comparison; every project differs wildly, is that...

THE WITNESS: In many ways, yes, especially geologically, even in the basin and range.

COMMISSIONER PADILLA: Based on rock characteristics, et cetera?

THE WITNESS: Rock types. Like thermal conductivity, you can estimate based on what type of rock you have. Say you got limestone. You can take published results of what the thermal conductivity of that rock type is, but you'll find a wide range.

I have done hundreds if not thousands of -- or had thermal conductivities measurements made, and there's a huge range of conductivities.

And just because it is limestone doesn't mean it is going to be X value. Just because it's an endosite, it's not necessarily X value.

So on these heat flow calculations, you estimate a thermal conductivity, unless you've actually got thermal conductivity measurements from the laboratory. So there's a lot of play in there.

EXAMINER BALCH: I assume you've taken some core samples or side wall into the lab and done that -- or somebody at Lightning Dock, right?

THE WITNESS: I haven't. But, ultimately, yes, it should be done.

COMMISSIONER PADILLA: My last question is just really curiosity. Why did Isor do a reservoir capacity estimate on this?

THE WITNESS: I don't have a full answer to that. To my knowledge and understanding, Cyrq Energy at the time -- I don't know if one of their investors was from Iceland or had dealt with the Icelandic Company, but I believe they were contracted to do so simply because they had the expertise in geothermal and it was another outside independent party, if you will, to take a look at the injection source.

COMMISSIONER PADILLA: Thank you.

EXAMINATION BY CHAIRPERSON CATANACH

CHAIRPERSON CATANACH: Just a couple. I know it is late.

With regards to the decision to drill shallow injection wells as opposed to deep injection wells, was there a geologic component to that decision?

THE WITNESS: Probably simply being that, yes, in some of the other wells we had seen some permeability in some of the shallower zones. So I am sure that played into the decision.

CHAIRPERSON CATANACH: Is there some evidence to suggest that the deep injection that there may be some permeability barriers that would decrease injectivity?

THE WITNESS: In the deeper zones?

CHAIRPERSON CATANACH: Yes, for instance, like the 55-7.

THE WITNESS: In my opinion, it's all based on proximity as to whether or not you've encountered the fractures. We know there are fractures there. There is no doubt about it. We've encountered fractures.

And at the same time we have had some deeper zones give up some fluid. There was one zone in the limestone at depth that actually produced some fluid, some hot geothermal waters.

So it's not a matter of the type of rock per se as much as it is, at least in my opinion, as to how close or can you intersect one of those fractures, which are probably nearly vertical.

So I do not see stratified, shall we say, or flows, horizontal flows, based on lithology, like limestone, sandstone, shale vs. that.

I see a very complex fractured system. And if you don't have a fracture, you don't have water going through it. But I know in my opinion that you can be literally inches away from a fracture and it can mean whether you've got a booming projection well or you've got a dry hole.

This has happened all through geothermal, especially in the western states, Nevada and California. If you miss those fracture zones, you don't get anything, but you know you're close, because you can determine that from some of the geophysical logs and from the temperatures.

I don't know if that answers your question.

CHAIRPERSON CATANACH: I am just trying to figure out, I guess, why you guys have selected to drill shallow wells instead of deeper injection wells.

THE WITNESS: I am sure part of it -- even though I am not part of the company, I am sure part of it was economic, part of it was practical. Deep wells are very expensive. That had to be a component. But I couldn't fully address that.

CHAIRPERSON CATANACH: Do you agree with Dr. Shomaker that the shallow injection wells -- that they are fractured enough that the shallow injection is going to be transmitted down to the deeper zone?

THE WITNESS: I think eventually that's what would happen, yes. Now, there may be a small component. I guess in my opinion, you know, there is -- and, again, in my opinion, there is no such thing as a totally confined system. Mother Nature just doesn't work that way.

But I think we see enough of a -- shall we say, of a convection zone that, yes, eventually those waters that are reinjected will work their way back down again. I think that is the nature of some of these fractured reservoirs like this.

But I don't have the firsthand experience on the hydrology to guarantee it or anything like that. I don't think anybody can. But I think it's a reasonable expectation.

CHAIRPERSON CATANACH: That's all I have. Anything else?

MS. HENRIE: Mr. Chairman, I forgot to move Exhibits 5 and 6 into evidence.

CHAIRPERSON CATANACH: Exhibits 5 and 6 will be admitted.

(Lightning Dock Geothermal Exhibits 5 and 6 were offered and admitted.)

MR. DOMENICI: I would like to follow up on a couple of questions that came up from the Commissioners, if that would be allowed.

CHAIRPERSON CATANACH: That will be allowed. Be very brief, please.

RE-CROSS EXAMINATION

BY MR. DOMENICI:

Q. I think you answered that the boundaries have been dynamic. And they're still dynamic?

A. Correct.

Q. And are they getting bigger or smaller or can you characterize the dynamic nature at all?

A. Without a doubt, they're getting bigger.

Q. Are they going in any particular direction?

A. Based on the data I have seen lately, I would say that they're basically following Elston, Deal and Logsdon's suggestion that it comes from the southwest, that there is an elongation to the southwest.

Q. Okay. And, then, just one other question. We just briefly saw those logs and we saw the alluvium through the logs, and the injection logs are targeting the alluvium, at least to a large extent?

A. Probably, except 76-7, which I think the alluvium there is probably less than 100 feet thick.

Q. Are there barriers in the alluvium itself?

A. In this area, not that I am aware of. But I will say in some wells out to the west, there was a clay layer; but it was down a few hundred feet and it's not consistent.

Q. Are there barriers running horizontally, running up and down in the alluvium?

A. Not that I'm aware of.

Q. So there would be nothing to prevent water from moving laterally in the alluvium, correct?

A. That is correct.

MR. DOMENICI: Thank you.

MS. HENRIE: Mr. Chairman, I just want a little clarification.

RE-DIRECT EXAMINATION

BY MS. HENRIE:

Q. When you said the boundaries are getting bigger, do you mean the boundaries of the anomaly or do you mean that our data -- we're getting more data, we are able to recontour the boundaries in a different way?

A. Yeah, I can't say the natural resource is growing or shrinking. I can say our knowledge of it is expanding every time we do something new, get new data, yeah, it's re-evaluated. Like I say, it is a dynamic process. And that picture that we're getting is getting bigger and not smaller. The resource itself has probably been the same for thousands of years.

MS. HENRIE: Thank you.

CHAIRPERSON CATANACH: This witness may be excused. What I would suggest is putting on your witness (directed to Mr. Lakins), if that's okay with Michelle. Is there any objection to that?

MS. HENRIE: No.

(Whereupon, Mr. Brancard left the hearing.)

CHAIRPERSON CATANACH: Commission Counsel has departed. Please swear in the witness.

---oOo---

AMERICULTURE CASE-IN-CHIEF

MR. LAKINS: There is sort of a procedural question, because Mr. Jackson is here both as our witness but he also signed in as himself to give a statement, just a personal statement.

CHAIRPERSON CATANACH: He is going to testify as a witness and give a statement?

MR. LAKINS: That's the procedural dilemma.

EXAMINER BALCH: I think once he's under oath, he is now open to cross-examination. He can give his opinion during --

MR. LAKINS: Very good.

EXAMINER BALCH: That is my impression of Bill. We have other lawyers, though.

MR. LAKINS: Very good.

CHARLES JACKSON

having first been duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. LAKINS

Q. Please tell us your name for the record.
A. My name is Charles Jackson.

Q. Tell us what you do.

A. Currently, I'm the Luna County Manager. From 1999 until May of last year, I was an employee in the District 3 Office of the State Engineer in Deming.

Q. What did you do?

A. From 1999 to 2005, I was a water resource specialist. And one of the responsibilities I had in that position was to be basin supervisor for the Animas Underground Water Basin. 2005 until May of last year, I was the district supervisor.

Q. I would like you to turn to Exhibit T in the blue binder, please. Are you familiar with that document?

A. Exhibit T, yes, I am.

Q. Can you tell us what that is?

A. This packet is a permit that was filed with the State Engineer's Office, which was titled A45(A), Enlarged, and all the supporting documentation that came from OCD to go with that application.

Q. What was that application to the State Engineer all about?

A. The purpose of application A45(A), Enlarged, was a request for non-consumptive diversion of water from well A45(A) -- S-6, if I remember right -- let me find that real quick -- from A45(A-S) for a total amount of water of 1,775 acre feet plus a little bit of change for the beneficial uses of aquaculture, agriculture, and non-consumptive geothermal power production.

Q. So that is a water right issued by the New Mexico State Engineer that includes geothermal power production?

A. As a non-consumptive application, it's a permit until the full amount of that water is put to beneficial use. But that document is the permit for that beneficial use.

Q. Are you familiar with the history of the documents that were processed by the OCD prior to the State Engineer's action on that permit?

A. Yes. Actually, as the Animas Basin supervisor on this application and the previous application that was filed before it, which is Application A45(A), there was a working relationship between the State Engineer's Office and the Oil Conservation Division to make sure that the water right -- if there was any impairment requirement or any impairment possibility with the water right, that that was addressed by us, but we would not review those applications until they had already received clearance from OCD to construct the well, to put the wells in place and the other approvals they had to get from OCD.

Q. Were all those approvals obtained from OCD?

A. Yes.

Q. And you talked about impairment possibility. Could you explain what you meant by that?

A. Well, with the original application that was filed, which was application A45(A), AmeriCulture actually transferred in a valid water right on the existing water right in the Animas Basin that was put to beneficial use in the 1950s.

And they transferred that right into that water source to be used for aquaculture purposes. This permit, even though it's a non-consumptive permit under state law it carries a priority date with it that by having that permit in place, then any other permit that came along behind it that asked for a diversion of any kind couldn't impair that permit.

Q. Let me ask you, if the proposed injection were to diminish the resource temperature of AmeriCulture's water permit, which would reduce their power production capability, would that constitute impairment?

A. My interpretation of the permit that was issued, I would say yes. If you look at historically what has happened in the state of New Mexico related to water quality issues when it comes to having a valid existing water right, you can look at the lower Rio Grande when total dissolved solids went up, salt leaching happened down there. That was addressed as a component of the water right.

You can't have a water right for domestic use and then something in the physical make-up of that water be changed and that right not be impaired. You can't have a water right for agriculture. The total amount of salt that's intruded in the water by other diversions have an impact on whether you can grow within that water and it not be impaired.

So I think the agency, over the course of the years I was there, started really looking at the other components of water besides just the quantity as to what constituted an impairment and what did not.

Q. So if the chemical nature of AmeriCulture's domestic drinking water supply well would change so that they exceeded drinking water standards, would that constitute an impairment?

A. The decision would have to be made by a judge. But my testimony, from everything I saw in the 15 years I was there, it would be yes.

Q. You heard some testimony about the Joint Facilities Operating Agreement?

A. I did.

Q. Had you read that document yourself before?

A. I remembered something about that a long time ago. And I remember one time, when Mr. Seawright came in to go over an application, us discussing it. But I don't remember finding it impaired this agreement.

Q. If AmeriCulture's water rights or correlative rights were impaired, is it possible for Lightning Dock to actually replace their water considering that Lightning Dock doesn't have a water right?

A. This permit addresses the physical actual water right. It doesn't address the correlative right associated with it. But if the permit was for the power production, for power generation, for growing fish, for whatever it was, and something changed in the nature of the water right that impaired that, then, I guess, there could be an attempt to replace that, but you would have to have a valid water right to replace it with.

Q. During your time at the State Engineer's Office, were you involved with any injection wells?

A. Yes. We permitted some of the injection wells that AmeriCulture had and actually did some work on -- I was at the office when Razer came in and did their original permits.

Q. And you are familiar with the basic hydrology and characteristics of the Lightning Dock Reservoir?

A. The basics, yes.

Q. In your opinion, would the proposed injection in the shallow alluvial result in that water staying in the reservoir or leaving the reservoir?

A. You know, with my staff members I used to have in the office, we used to have kind of a basic example that we would use for a clerk that was working on a domestic well or something to try to understand the basic hydrology of how water moves. And that basically was looking at, if you have a sponge and a rock, which one is the water going to move through fastest.

So you always looked at that when you were permitting domestic wells beside of a river or something where you had something constructed in an alluvial fill, because that alluvial fill is basically a sponge. Stuff moves through it really fast. With a rock, it doesn't move through really fast.

So in my opinion as an administrator for 15 years doing this, there would be a difference between reinjecting at depths where you've already reached hardened strata compared to depths where it was alluvial fill that the water would flow through really fast.

Q. Are you familiar with the flow of that alluvial area around the Lightning Dock --

A. That's always been considered. Animas is kind of an interesting character, because your ground water and your surface water there both have a tendency to flow more south to north than they do north to south because it's kind of shaped different. So everything there kind of works backwards from what you would normally think.

Q. Are you familiar NMSA Section 71-5-21(B)?

A. That's a lot of numbers. If you'll refresh me --

Q. It was HB201.

A. Yes, I am.

Q. The Water Replacement Plan. Do you have an opinion, can you elaborate about the prospect of a water replacement plan?

A. To me that plan would still require the use of a valid water right that would be senior to the water right that Mr. Seawright owns at AmeriCulture. The passage of HB201(B) was after his permits were issued. So I don't know if it would even apply to his permits. I don't know if those statutes are retroactive.

Q. I'm trying to kind of shift a little bit to go to your personal opinion. Do you have concerns about this proposed project?

A. I do. One of the reasons I switched jobs actually -- and I will be very honest about it now where I wasn't before. One of the reasons I switched jobs from the State Engineer's Office, at the time that I did, to the county was because three county commissioners knew that I had a lot more knowledge than

I was being able to use, because as an administrator in an agency you are told to stay out of things, not to make comments, not to do things. So they basically told me to come over here and say whatever you want to say.

So I think that was part of the reason, for not only with water issues but with endangered species issues, with a lot of stuff, that's part of the reason that I changed jobs when I did.

We're involved, the County Commission was involved in a water right application that was filed by the Interstate Stream Commission. It's pending right now. And it was an attempt to take a statute way beyond what it was ever intended to be used. And that was the Strategic Water Reserve. And that's another one of our newer statutes. So my commission quickly protested that and said don't get involved with that because we see big problems with it.

One of the biggest issues going on in the southwest corner of the state right now is the development of what's called the New Mexico Cap Entity and the movement forward for those four counties in the southwest corner of the state to be able to utilize provisions and benefits that were provided to the state of New Mexico under the Arizona Water Settlement Act of 2004.

Part of that is the ability for the state of New Mexico in the corner, in those four counties, to be able to divert an additional 14,000 acre feet of water from that river, those taken away from the state basically in an adjudication by the Supreme Court in 1968.

You know, I look at alluvial fill. I've sat in courtrooms with hydrologists that testified to the exact opposite all the time as to what's going to happen in a basin. And as an administrator in the State Engineer's Office, the joke was always that hydrology was a black science because it was whatever answer fit at the time.

But what I do know is when you're in an alluvial fill basin, things move pretty fast. That alluvial fill that comes out of that area of the Animas extends towards the Gila River. And my commission has some concerns that maybe at some point in this -- if everybody is wrong -- and I have not heard once today, I haven't heard one person sit here and I say, I guarantee you that that fluoride, dissolved solids or anything else won't get past point X to point Y. I haven't heard that one time today.

What I've heard is, Maybe, maybe not. And if it does and that gets into that alluvial fill and that alluvial fill moves toward the Gila River, the impacts to the state of New Mexico are gigantic. I mean, it's a loss of $180,000,000 possibly. And there's all kinds of stuff that could happen from that.

So, you know, my commission watches down there all the things that happen that can affect us locally. My county is the tenth poorest county in the nation. So the things that happen to us and the things that happen to our neighbors, we have to watch those things very close.

We have problems with economic development. We have problems with all these things. We are not real quick to go out and grab an economic development opportunity if it's going to limit us having economic development opportunities in the future. We take great concern to what we actually do bring and bite off.

And I guess one of the things of concern is what impact is this going to have five years down the road, ten years down the road on the economic viability of Hidalgo County and, as such, on the economic viability of Luna County.

Q. Do you have specific current concerns about the water injecting into the alluvial --

A. One of the things I printed out when I was looking at this -- you know, in Title 19, Chapter 14, Part 26, under the Setting Off of the Strata, Part B says, All waters of present or of probable future value for domestic, commercial, agricultural, or stock purposes shall be confined to their respective strata and shall be adequately protected by methods approved by the Division.

I forgot to talk about strata today. And I haven't heard any talk about that underground hard rock being the same strata as the alluvium. So if the water's being taken out of the underground hard rock strata, how are we following that part of the statute for putting it back into the alluvial fill. So I have concerns about that.

I have concerns about the impacts on domestic wells, about the impacts on stock wells. And until somebody can sit there and say, Absolutely, without a doubt, positively it will not move out of that little box that we're trying to paint it into, I think my concerns will last.

MR. LAKINS: I pass the witness.

CHAIRPERSON CATANACH: Ms. Henrie.

MS. HENRIE: To me?

CHAIRPERSON CATANACH: Yes, ma'am.

CROSS EXAMINATION

BY MS. HENRIE:

Q. I am looking at page 2 of T.

A. Okay.

Q. If I am reading this right, it's AmeriCulture's injection well. I know it is not a State Engineer form. What is the depth?

A. The proposed depth is 100 to 300 feet on this.

Q. Do you have concerns about this well?

A. At 100 to 300 feet -- I think part of what we looked at on this with all the data that came in with that application was the fact that this AmeriCulture well was not right over the anomaly itself; it was outside of that plume.

And so I think we looked at that, because he can impair himself. On a water right application, as everyone knows, the applicant can impair themselves. All you look at is if they can impair somebody else. And there was nobody else to impair out there past where he was at.

Q. And your concern about fluoride getting into the Gila River, I've never thought about that before. But this injection that AmeriCulture proposes is kind of in that gradient path on its way to the Gila River?

A. There was one other component that was part of this application that I remember very clearly in my conversations with the OCD when we did these, was at that time every injection well that was permitted, the waters -- if you were going to pump from that source and you were going to reinject, that water had to be returned to a location of like temperature and like chemical content, because they wanted to protect the heat in the water and they wanted to make sure that they weren't doing that.

So we passed that responsibility off to the OCD. They came back and said, This permit matches that. It takes it back to where it's like chemical content and to where it's like temperature and it won't affect the resource.

So we accepted their professional view on this and said if they say it's okay and it matches those parameters, then we're going to say it's okay, because that was their area of expertise.

Q. And then to go back to your strata concern, wouldn't this also take geothermal water and put it into -- I don't believe there is any strata out there, but it feels like you felt that the alluvium was different than --

A. I did feel that. I feel like the testimony today -- I mean I don't hear anybody saying -- when you do a well log, you change -- on a well log, when you drill a water well, the stratas are listed on a well log. Every time the type of material changes, that is considered a different strata.

And so from the time you go through that alluvial portion of the basin until you got down to whatever depth it was -- and to finish this up before I forget, I don't really remember off the top of my head what the depth was of A45(A) either, because that would have had something to do with how we reviewed this depth as well.

But every time you go through a different type of material, it was considered a different strata, because they all carry water in a different way. When you are looking at impairment, you are looking at the permeability of that rock type or that soil type, whatever it is. So each one of those listed a different strata.

So from a water rights standpoint, the alluvium bedrock or a hard rock or whatever is definitely a different strata when you're reviewing it from a water right application process.

Q. Even if they are all water bearing?

A. Yes. Because the permeability of each one is different. They are all considered a different strata, because when you do your review for impairment, you are looking at the speed at which that water is going to move in that strata because that's how you determine how quickly the impairment would happen. We look at a 40-year timeframe on the impairment, so you had to know what the permeability was.

Q. The way I've always understood the geothermal side is the strata with the confining layer between geothermal hot water versus the cold or alluvial valley fill -- and there was some sort of confining layer.

And that's what we're not seeing out there so we may have different interpretations of strata.

A. We may have. All the training I have ever had, alluvial fill and bedrock are different types of formations. And there's a definite difference there.

MS. HENRIE: I pass the witness. Thank you.

CHAIRPERSON CATANACH: Mr. Domenici.

CROSS EXAMINATION

BY MR. DOMENICI:

Q. Did you ever go into the greenhouses that are out here?

A. Yes, numerous times.

Q. Was anything growing there?

A. When I first started working at the office, I went over there and met with Mr. Burgett. You're talking about Burgett's greenhouses?

Q. Yes.

A. I met with him not too long after I started working there. At that time he was not in full production, but he did still have roses growing.

Q. What was the source of water for the roses?
A. For the growth of the roses or --
Q. For the growth.
A. He used cold water for the growth of the roses.
Q. And then the geothermal was --
A. Was used to keep the greenhouse at a steady temperature.
Q. Where did he get the cold water, if you know?
A. He had numerous wells around he used, around that facility, both for hot and for cold water.
Q. How close, if you can recall, was the closest cold water?
A. The closest hot water well was right outside of your door.
Q. No. Cold.
A. The closest cold water well, you know, it wasn't too far away from there. Distance-wise, I don't know as it's been so long since I have been on that -- it would be a rough guess. I would say maybe 400 or 500 yards -- maybe not that far. Maybe 200 or 300 yards. That would be the closest one.
His house was actually right outside the facility, so he had a domestic well right beside the house.
Q. Did you ever go in his house?

A. I did.
Q. Did you ever drink his water?
A. I actually did. I went into Mr. Burgett's house one time to talk to him and he was taking a nap, so they sat me at the table and I had a glass of water while I waited for him to finish his nap.
MR. DOMENICI: Thank you.
CHAIRPERSON CATANACH: Do you have any questions?
MS. MARKS: I do. Thank you.

CROSS EXAMINATION

BY MS. MARKS:
Q. Your testimony here today is as a fact witness, correct?
A. On the water part of it, yes.
Q. You haven't been qualified as an expert witness, correct?
A. Not here.
Q. I know the prehearing statement mentioned you may testify as an expert witness, but all your testimony is as a fact witness?
MR. LAKINS: I guess I forgot to move him as an expert.
MS. MARKS: I am unsure as to what he is an expert in. The testimony was very lengthy, and I am

confused as to which part of the testimony he was an expert and which part he was testifying as perhaps someone from Luna County -- it was very confusing to me.

CHAIRPERSON CATANACH: Do you want to qualify him as --

MR. LAKINS: Mr. Jackson testified about his experience with water rights at the Office of the State Engineer and his experience with the Animas underground basin and adjudication.

I tender Mr. Jackson as an expert in New Mexico water rights, impairment, and as well as information about the Animas Alluvial Water Basin.

EXAMINER BALCH: Is his resume somewhere in your exhibits?

MR. LAKINS: No, we did not submit his resume. We laid his foundation...

CHAIRPERSON CATANACH: And that is by virtue of his work experience with the State Engineer's Office.

MR. LAKINS: Yes, sir. I can ask him some more foundational questions about his education and more about his experience, if necessary.

CHAIRPERSON CATANACH: Do you have any objection to his being qualified as --

MS. HENRIE: Sorry. Go over that again. In?

MR. LAKINS: In New Mexico water rights, water rights impairment under New Mexico law, and his -- and information concerning the Animas underground water basin which includes the area at issue and water law.

MS. HENRIE: I guess where I am uncomfortable is I know, Tink, you were administrator and you had a lot of hands-on. But the State Engineer's Office as the hydrology bureau has lots of other professionals who are the science guys. And that is where I'm kind of getting hung up.

Knowledge of water rights, yes, absolutely. But when we talk about hydrology, then I have a little more trouble with that.

MR. LAKINS: As a fact witness concerning the underground water basin from his experience with the State Engineer, which not only qualifies him as an expert in New Mexico water rights but water rights impairment analysis.

EXAMINER BALCH: I would be comfortable with him being an expert in those two areas, but I think the rest of his testimony is more of as a fact witness.

CHAIRPERSON CATANACH: I agree. He's testified on hydrology issues and movement of water and we haven't qualified him in that regard.

We will qualify him as an expert in water rights -- what was the other one?

MR. LAKINS: Water rights impairment.

CHAIRPERSON CATANACH: Okay. We will do that.

MR. LAKINS: And I apologize. I was just trying to get done very fast.

EXAMINATION BY MS. MARKS (resumed)

Q. Mr. Jackson, did you see this Exhibit T? Did you see this letter and application while working for the Office of the State Engineer?

A. I did.

Q. Did you review this or did a hydrologist or one of the science people at the State Engineer's Office review this in a system review?

A. When the application came in, the review on the physical application itself was done by an employee who worked for me who had a degree in engineering. He was the one who did the impairment analysis on the application.

The analysis as far as water right impairment or how it would affect other water rights around it, I did the analysis on that. And then it was signed off by a licensed P.E.

Q. I believe at some point -- and I could be wrong -- I have been sick all day -- you talked about a priority right. The priority right -- I don't know where that testimony came from -- that was for water or a legal conclusion --

A. No. It's a priority date associated with the water right. When an application for a water right -- for a transfer of water right is filed or for a non-consumptive application, by state law that permit or that right to that water gets a priority date of the date it was filed if it finishes the process and the permit is approved.

So that becomes senior to any appropriation that comes after that, to any transfer that comes after that, or to any diversion that comes after that.

Q. Your testimony is with respect to --

A. To the water right.

Q. So with respect to geothermal resources, you are not making any assertion with respect to priority --

A. No. I'm talking about the physical water right that is in the well.

Q. Okay. And Ms. Henry discussed that this -- discussed the application was for injection, correct?

A. This permit, the part that came from -- because they already had the diversion well, they needed to be able to reinject because OCD was going to require it to be reinjected.

So this permit, A45(A) Enlarged, was for the reinjection well. It was the increased diversion from the primary well that they already had a permit for, but that permit allowed them to drill the injection well up to meet the requirements that OCD had under that permit to be able to put that water back into -- for it to be non-consumptive, it had to be put back into the source.

And so they had to get an injection well, so we had AmeriCulture go to OCD to get the injection well permit.

Q. Was this well drilled?

A. Yes.

Q. And they are injecting?

A. I assume so, but I haven't looked at -- I haven't looked recently. I haven't been there for a year and a half. I didn't keep track of the meter reports.

Q. So you don't know?

A. I don't know.

Q. And at this depth of 150 feet, you didn't have any concerns of it affecting the reservoir?

A. It wasn't our responsibility to have that because it was OCD review. They were the ones that said it had to be put back in an area of like chemical content and like temperature, and this was where they said that applied.

So we allowed OCD to make that decision. And once they said it met the requirements for them, then we approved the permit for the water right process.

Q. Can I just draw your attention to 71-5-2.12(B2).

A. If you will show me where it's at.

MR. LAKINS: I can put it up on the screen.

MS. MARKS: The statute?

MR. LAKINS: Yes, I can do that.

Q. If you don't mind me getting close to you, I can read it --

A. That's fine. You can bring it over here.

Q. This says a permit from the State Engineer -- I'll just jump down to 2: All diverted ground water reinjected as soon as practicable into the same ground water source in which it was diverted, resulting in no new net depletions to the source, provided that the Division shall provide to the State Engineer all information available to the Division regarding the proposed diversion and reinjection and shall request the opinion of the State Engineer as to whether existing groundwater rights sharing the same groundwater source may be impaired.

Does that seem to you as though the opinion of the State Engineer and not the OCD is needed?

A. Well, that law was passed in 2012. This permit was done in 2002. So this permit was done 10 years before that law was passed.

Q. What you previously spoke of, was that a law or was that just a policy?

A. That was the way we worked with the OCD back then.

Q. Was there a policy?

A. It was the State Engineer's policy that if there was going to be something done in a geothermal resource, that we made sure that we had -- that the applicant had the permit from OCD to do it before we worked on the water right permit.

Now, what the internal policies were at OCD or the rules at OCD, I have no idea.

Q. So we really don't have anything in writing to substantiate --

A. We have the permit that they issue for the well.

Q. No, that OCD kind of dictated and the State Engineer had no say other than --

A. In the approval of your permit?

Q. That OCD dictated what affected water, other than your testimony here?

A. I don't think I understand your question.

Q. You are saying the law changed in 2012, and I don't have an earlier copy of the law. But your testimony is referring to State Engineer policies and what OCD dictated. We don't have copies of any of these policies or perhaps oral directions --

A. No.

Q. We just have your testimony.

A. No. I talked to -- maybe John Johnson was the guy who I used to talk to up here. In the conversation I had with him, because we used to have conversations back and forth, the conversation I had with him was for them to be able to do this, that OCD would require that the injected water be returned to the same source in an area were it was like chemical content.

Because at the State Engineer's Office an injection well was always same source and it was always as close to back to the same source as possible. But because this water is different because it has different chemical content and you have the heat component to it, we allowed -- then we asked OCD, Then what would you do; what are your requirements on this?

What I was told was same source, it had to be like chemical content and like temperature. So then, once you get the directions that were given to AmeriCulture, once you get approval from OCD to do the injection well, they're going to follow their regulations to give you that. When you have it, then come to us and we'll approve it based on your having their permit.

And so that is the way this was done.

Q. So even though the State Engineer regulates water, water quality, your testimony is that OCD made that decision?

A. Made the decision on where the reinjection zone was.

MS. MARKS: I have no further questions.

EXAMINATION BY EXAMINER BALCH

EXAMINER BALCH: So a water rights expert, I have a water-rights related question. At paragraph 3 they were talking about in the Joint Facility Operating Agreement, they were going to replace the heat using a heat exchanger, and not circulating any of their water to AmeriCulture; that would be okay?

THE WITNESS: I think the heat is one component of the --

EXAMINER BALCH: So they are not taking any of their water and giving it to AmeriCulture; they are running a pipe over there with hot water in it, using the heat exchanger to warm up their water, and then their water comes back to them and they do whatever they were going to do with it otherwise?

THE WITNESS: The diversion of the water to do that --

EXAMINER BALCH: But it's in a closed loop; there's no transfer of water.

THE WITNESS: I thought we heard all day today there was no closed loop there.

EXAMINER BALCH: I think some people were saying it's closed loop and some were saying it wasn't.

I am just talking about a pipe from a well carrying hot water over there and not touching their water directly; they put a heat exchanger on it, transfer the heat to their water, and then the water in the pipe goes back to their place. So they didn't give any water away; all they gave was the heat from the water.

A. So the heat is one component of that water right, but there's also -- I mean whether it's aerated. There's a bunch of other components to it as well.

The reality is that a final decision on a water right impairment is left to the district court. As the administrator before, if they felt that their water right had been impaired and they explained, Well, the heat's been diminished, there's increased chemicals and there's increased solids, whatever, we think that that's got to go, because our water right was for growing fish and for doing these things, then my advice to them would have been to take it to district court.

EXAMINER BALCH: What do you think district court would do in that case?

THE WITNESS: I would hate to think what any judge would do because judges these days have a tendency to do lots of different things.

I think the fact that there's a pending adjudication down there and that AmeriCulture has offer of judgment for that water right would probably weigh pretty heavy in that.

EXAMINER BALCH: So we are asked to judge correlative rights. And there has been a little bit of a focus today on the potential impairment of AmeriCulture's correlative rights. I do think that Lightning Dock also has a right to produce energy from their resource. So there has to be a balance and everybody getting their fair share.

I don't know -- this doesn't really necessarily tie into water rights, but there may be some parallels.

THE WITNESS: The balance that you are trying to weigh is an interesting balance. And at some point, you know, is the decision left before a district court judge to decide which one of those two is paramount; is production of energy and heat in the West paramount or is water paramount in the West?

I think if it is put to a district court judge that way in the west, I know which one wins. Maybe that's what it comes down to.

EXAMINER BALCH: Maybe my opinion is it would shoot all the way up to the Supreme Court.

THE WITNESS: There's always that possibility, too.

EXAMINER BALCH: Sorry for bothering you.

THE WITNESS: You're not bothering me.

EXAMINATION BY EXAMINER PADILLA

COMMISSIONER PADILLA: You just talked about a heat component of a water right in a closed loop surface, closed loops in an area where hot water is piped to a heat exchanger and comes back. Are you talking about a water right tied to the geothermal process that Lightning Dock is doing or water right tied to AmeriCulture?

THE WITNESS: About a water right tied to AmeriCulture, because they're the ones that transferred in valid rights into that hot water source to be able to extract the hot water for the purposes that they had on their application.

COMMISSIONER PADILLA: I don't see the tie then between Lightning Dock sending their geothermallyregulated water through a closed loop and back, would affect AmeriCulture's water right.

THE WITNESS: If it was truly a closed loop, I think I might agree with you. But I don't know that we've heard anything today that shows it is truly a closed loop.

COMMISSIONER PADILLA: I think in this scenario it is a closed loop because you've got a surface pipe. Subsurface is, in my mind anyway, the big debate as to what this really centers on.

But if they're pulling hot water and sending it down a pipe and bringing it back -- I don't see the connection to AmeriCulture's water right in that case.

THE WITNESS: We see the application of water law in the west evolve a lot. If you look back to 1907 or you look back to 1912 or you look back to when the original water -- things like aquaculture, a lot of the beneficial uses that the State Engineer and the Legislature recognize now, they weren't there. Those are things that evolved over time as New Mexico was evolving.

A prime example, talking about what decisions a judge would make or whatever, as part of this Arizona Water Settlement Act, the San Carlos Indian tribe did not participate in that because they felt that the quality of water that they were going to get in the river was going to be diminished by the introduction of additional total solids into that water by New Mexico taking out the additional 14,000 acre feet here in New Mexico.

So in the act, there was a provision put in the act to drill a well in Arizona to pipe the water straight to them. It's a higher quality water than they ever received.

And the judge came back and said, No, that's not applicable, because there are other components to that water right, including traditional values, historical values, ceremonial values. They put a lot of other components on that water right.

It had nothing to do with just the total dissolved solids or the quality of the water or the heat in the water. It had to do with the intended use of the water that was granted to them and the way that they historically got it.

COMMISSIONER PADILLA: Let me kind of rephrase. AmeriCulture's water right is separate in my mind from Lightning Dock's geothermal rights under their leases. And I don't see the tie there. Is there any tie between AmeriCulture's water right and Lightning Dock fulfilling that obligation as outlined in the joint operating agreement or whatever that instrument is called?

THE WITNESS: I don't think that the joint operating agreement will have anything to do with that.

Their water right, that permit allows them to divert from the source where they are an amount of water each year to do all the things that are in their permit.

The replacement portion that you are talking about I think is provided in that 2012 Act. I don't know if that's retroactive to that permit or not. I don't know if you can pass a law that's retroactive to anything.

But I think if you're looking at, the permit was granted to them, the temperature of the water was a certain temperature at that time when it was granted to them, that's why they made the investment, to transfer the water right, to protect that. The quality of the water was a certain quality, whatever it was. I don't know what the measurements were for fluoride or anything else. But the measurements for the water at that time were a certain amount.

And that water right was transferred in based on those values, because they made the investment to do that at that time. So if anything changes those values and impacts their ability to do what they transferred that right in to do, I think that a court will view that as an impairment.

COMMISSIONER PADILLA: It would be up to AmeriCulture to pursue that rather than transfer heat.

THE WITNESS: That would sure be an option they would have.

COMMISSIONER PADILLA: I want to follow up on the injection from 2002, 150-foot AmeriCulture injection, and your objections to the current proposed injection in light of your, I guess, suggestion that that injection was OCD's responsibility to oversee -- was it 2002?

THE WITNESS: Yes, 2002.

COMMISSIONER PADILLA: In your mind, something has changed with the current injections or maybe it is your current position with the county that has changed your opinion where an injection at that depth in that area would now be considered a liability.

THE WITNESS: I think there's two things. On my part of this application, there was an assumed comfort in the fact that the conversation we had with OCD said that the water that was being reinjected in that area was the same chemical content as the water that was already there, the same temperature as the water that was already there. So it wasn't going to change the resource.

COMMISSIONER PADILLA: So that's not the case in the current application --

THE WITNESS: I haven't seen that in there. And the current application is for a lot more water than this application was.

COMMISSIONER PADILLA: But as far as the constituents of the water --

THE WITNESS: I have not seen --

COMMISSIONER PADILLA: -- the water makeup, I guess.

THE WITNESS: In the documents that I've looked through related to the draft conditions of approval, I don't see anything in there about like chemical content, like temperature. I don't see that stuff in there. In the draft conditions that you guys put out, I didn't see that. I didn't see anything that said, We are going to look at monitoring wells around there --

EXAMINER PADILLA: That the OCD put out?

THE WITNESS: No. I am talking about the proposed conditions that you have for this, for what you are doing right now, I don't see anything there that says like chemical content or like temperature.

COMMISSIONER PADILLA: By "you," you mean OCD?

THE WITNESS: Yes, I do. I don't see anything like that in there. And I keep hearing about the percentage of fluoride and the percentage of this, and it's like we are looking at one dot right in the middle of this area and we are not looking at all that stuff that's happening around it.

And I know for a fact that there's wells over there -- that those numbers on the fluoride, that is clean drinking water. It is potable standards for drinking water. And I don't think we're looking at that periphery stuff. And there's no provision in those conditions that protects that periphery. What happens if everybody is wrong and what happens if that plume moves? There is no provisions to protect that.

COMMISSIONER PADILLA: Let me follow up related to that. If that plume moves, you testified that your county could have a $180,000,000 impact.

THE WITNESS: There's the water settlements, $180,000,000 for the four counties. That allows the counties to take extra water out of the Gila.

And so one of the other things you look at when you are looking at the flow -- you start talking about cause of depression and how that water is going to move, you take -- Mr. Shomaker, he testified about those pressures.

And you take the pressure off of an area, it is kind of like electricity, that water moves path of least resistance quicker than it's going to move just because you want it to go a certain direction.

COMMISSIONER PADILLA: So the $180,000,000 price tag is the entire Gila settlement package?

THE WITNESS: That's what the state of New Mexico got out of it.

COMMISSIONER PADILLA: But it's not something that the county has quantified as a result of this project?

THE WITNESS: No. It is part of a federal act that was done in 2004.

COMMISSIONER PADILLA: I am just saying the county has not done a calculation based on fluoride --

THE WITNESS: No, no. It's a concern. I can't just go higher hydraulics all the time. We expect state agencies to protect us from --

COMMISSIONER PADILLA: Right. But you did testify $180,000,000 --

THE WITNESS: No. The $180,000,000 was given to the state of New Mexico by Congress to develop the diversion on the Gila River. So if we develop the diversion, we get the money. And if we don't develop the diversion or something happens to the diversion, then we don't have access to the money.

COMMISSIONER PADILLA: But it is not specifically something that has been studied in relation to projects?

THE WITNESS: No.

COMMISSIONER PADILLA: That's all I have.

CHAIRPERSON CATANACH: I have no questions. Redirect?

MR. LAKINS: I have no questions on redirect. I do move to admit Exhibit T.

CHAIRPERSON CATANACH: Any objections?

MS. HENRIE: No.

CHAIRPERSON CATANACH: Exhibit T will be admitted.

(AmeriCulture Exhibit T was offered and admitted.)

MS. HENRIE: I would like to call a rebuttal witness to Mr. Jackson which would go faster than my next real witness, my last witness.

CHAIRPERSON CATANACH: How long?

MS. HENRIE: I would say 5, 10 minutes max.

CHAIRPERSON CATANACH: Okay.

EXAMINER BALCH: Are you including

cross-examination on that?

MS. HENRIE: Okay, ten.

MS. MARKS: If Mr. Sanders is here, it's really quick follow-up to Mr. Jackson's testimony and it is short and I have a couple of questions as well in the form of rebuttal.

CHAIRPERSON CATANACH: Off the record.

(Discussion off the record.)

MR. DOMENICI: If I may, I wanted to let the Commission know I am going to need to excuse myself for tomorrow. I didn't have two days set aside for this hearing. I'm not going to ask it to be postponed or anything. I think my client will be here in attendance. And I don't expect her to necessarily participate unless she really feels the need, but I just want to let you know. So thank you for your time and for letting the Soil and Water Conservation District participate.

CHAIRPERSON CATANACH: Thank you, Mr. Domenici. We are going to hear a different case at nine o'clock. So let's schedule this for 10:00 when we will resume the hearing on this.

(Time noted 6:20 p.m.)

STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

REPORTER'S CERTIFICATE

I, ELLEN H. ALLANIC, New Mexico Reporter CCR No. 100, DO HEREBY CERTIFY that on Thursday, September 10, 2015, the proceedings in the above-captioned matter were taken before me, that I did report in stenographic shorthand the proceedings set forth herein, and the foregoing pages are a true and correct transcription to the best of my ability and control.

I FURTHER CERTIFY that I am neither employed by nor related to nor contracted with (unless excepted by the rules) any of the parties or attorneys in this case, and that I have no interest whatsoever in the final disposition of this case in any court.

____
ELLEN H. ALLANIC, CSR
NM Certified Court Reporter No. 100
License Expires: 12/31/15