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NUCLEAR REGULATORY COMMISSION

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ATOMIC SAFETY AND LICENSING BOARD PANEL

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HEARING

OPEN SESSION

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In the Matter of: : Docket No.

CROW BUTTE RESOURCES, : 40-8943-OLA

INC. : ASLBP No.

(License Renewal for : 08-867-02-OLA-BD01

the In-Situ Leach :

Facility, Crawford, :

Nebraska) :

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Monday, August 24, 2015

Crawford Community Center

1005 First Street

Crawford, Nebraska

BEFORE:

MICHAEL M. GIBSON, Chair

DR. RICHARD E. WARDWELL, Administrative Judge

BRIAN K. HAJEK, Administrative Judge

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P R O C E E D I N G S

9:00 a.m.

CHAIR GIBSON: I believe it's 9:00. I think we'll go ahead and get started.

Good morning. We are here today on Atomic Safety and Licensing Board Panel, Docket No. 8943, concerning the United States Regulatory Commission's Renewal of a Source Materials License to Crow Butte Resources, Inc. for its in-situ leach mining operation near here.

First, I would like to introduce the Board that will be conducting this evidentiary hearing.

Sitting to my right, your left, is Judge Richard Wardwell who holds a PhD in civil engineering and is a full-time Judge with the Atomic Safety and Licensing Board Panel.

To my left, your right, is Judge Brian Hajek who is a Professor Emeritus of Nuclear Engineering at Ohio State University as well as a part-time Judge with the Atomic Safety and Licensing Board Panel.

Unfortunately, Judge Alan Rosenthal could not be with us. He is serving as Special Assistant to the Board but he will be reviewing the transcript that we develop at this proceeding.

I am Judge Michael Gibson, a lawyer and a full-time Judge with the Atomic Safety and Licensing Board Panel and I also am the Chairman of this Board.

Now, I would like to have announcements of counsel, beginning first with Crow Butte.

MR. SMITH: I'm Tyson Smith from Winston and Strawn representing the Applicant, Crow Butte Resources.

CHAIR GIBSON: Counsel for the Nuclear Regulatory Commission Staff?

MS. SIMON: Good morning. I'm Marsha Simon, Counsel for the NRC Staff.

MR. CYLKOWSKI: David Cylkowski on behalf of the NRC Staff.

MS. MONTEITH: Emily Monteith, Counsel for the NRC Staff.

CHAIR GIBSON: I can't see you behind that monitor, unfortunately, so okay.

Counsel for the Oglala Sioux Tribe?

MR. REID: Hi, it's Andrew Reid from the Ved Nanda Center for International and Comparative Law representing the Oglala Sioux Tribe.

Could I have this monitor removed? We don't need it right now so that I can see Judge Wardwell.

CHAIR GIBSON: I really -- I tell you what, we'll see what we can do shortly. Okay?

MR. REID: All right, thank you.

CHAIR GIBSON: We'll take a very brief recess when we're finished with our introductory remarks and we'll see what we can do, Mr. Reid.

MR. REID: Thank you.

CHAIR GIBSON: Okay?

Counsel for Consolidated Intervenors?

MR. BALLANCO: Good morning, Your Honor, Tom Ballanco for Consolidated Intervenors.

MR. FRANKEL: Morning, Your Honor, David Frankel for Consolidated Intervenors.

CHAIR GIBSON: And, I can't see you very well, Mr. Frankel, either. So, yes, sir.

Did I miss anyone? Okay.

Next, I would like to introduce the Board's Administrative Staff.

First, we have two lawyers over here on our left, Nick Sciretta who's just finishing up a two-year clerkship with our office and with Sachi Desai who is beginning his second year with us.

Next is Sara Culler. Ms. Culler, will you hold up your hand or stand up? There you go. She's our Administrative Assistant. She's ably handled our

administrative arrangements here and, if there is anything that you need in that regard, please see her.

Our IT coordinator for this trial is Mr. Joe Deucher.

We also have two security personnel here as well as Victor Dricks who is with the U.S. Nuclear Regulatory Commission's Office of Public Affairs. Hold up your hand there, Mr. Dricks?

And if the press or anyone from the public has any need for anything, any inquiries, Mr. Dricks will handle them for you.

Likewise, our Court Reporter over here next to Mr. Deucher is Brandon Paterson.

Finally, I would be remiss if I did not acknowledge the hospitality that the City of Crawford has given us by graciously providing us with the use of this community building for this evidentiary hearing.

I would also note that all weapons are prohibited from entering this building and, in case your cell phone is not disabled, I would ask that you do that now. And, if you need to use your phone, I would ask that you please do that outside so that you do not interrupt the witnesses during this proceeding.

Now, what I would like to do, Mr. Deucher,

at this point, if you could see if you could maybe move these monitors just a little bit so that we have a better sight lines, we'd appreciate it.

While Mr. Deucher is doing that, I have a few -- a brief summary of why we're here today. I think that's important considered in the extensive interest that's been expressed about it.

About five miles southeast of here, Crow Butte conducts an in-situ leach mining operation. And, for those of you who don't know how an in-situ leach mining works, Crow Butte drills wells into a geologic formation that contains uranium then injects a solution called lixiviant through those wells that leaches into the surrounding geologic formation.

The resulting liquid is rich with minerals. It is absorbed through recovery wells and brought up to the surface where Crow Butte removes the uranium by ion exchange at a processing plant.

Most of the water used in the in-situ leach mining process is returned to the aquifer after treatment, at least until efforts are made to restore that aquifer.

That uranium containing material brought to the surface is then precipitated, dried and packaged into solid yellow cake uranium.

Now, to conduct this mining operation, the Atomic Energy Act requires that Crow Butte have a source materials license from the U.S. Nuclear Regulatory Commission.

The original license for this operation was issued in 1989. It was later renewed in 1998. And then, on November 27, 2007, Crow Butte filed an application for a second renewal of this license.

Six months later, on May 27, 2008, the NRC Staff issued a Notice in the Federal Register that advised the public of its opportunity to contest the renewal of Crow Butte's license.

Two months after that Federal Register Notice was published, three separate Petitions were filed with the Nuclear Regulatory Commission challenging Crow Butte's requested license renewal.

Filing these Petitions were the Oglala Sioux Tribe, the Oglala Delegation of the Great Sioux Nation Treaty Council and 11 individuals and organization who share a common counsel whom we will usually refer to as Consolidated Petitioners.

We held oral argument in Chadron, Nebraska on September 30 and October 1, 2008 for the sole purpose of determining whether the Tribe and these other Petitioners had standing to challenge the

renewal of Crow Butte's license and had pled admissible contentions under the Nuclear Regulatory Commission's rules.

On November 2008, this Board ruled that the Oglala Sioux Tribe and the Consolidated Intervenors had standing and had pled admissible contentions. And, though we held that the Oglala Delegation of the Great Sioux Nation Treaty Council lacked standing, we ruled that it could, nevertheless, participate in this proceeding as an interested local government body as is provided in the NRC rules.

Now, about now, those of you unfamiliar with this case may be scratching your head and asking yourself, if the Board ruled in November 2008 that a hearing was appropriate, why did it take another seven years before that hearing commenced?

Well, the answer to that is, that in most instances, Boards such as this may not hold hearings on contested contentions until after the Nuclear Regulatory Commission Staff has completed its final environmental report under the National Environmental Policy Act. And, in this case, there were substantial delays in that study.

But, at long last, in October 2014, the NRC Staff issued its environmental report and enabled

the Board to begin this hearing.

I should add that the Tribe and Consolidated Intervenors took issues with portions of the Environmental Assessment that the staff issued, proffered some new contention challenging the extent to which that Environmental Assessment was complete or inaccurate.

And so, the Board held oral argument earlier this year on those issues and the result is now the nine contentions that we have before us. Some, essentially, date back to our original oral argument in 2008, others concern new matters that were raised by the Environmental Assessment and some are a combination of two or more contentions that the Intervenors have filed.

There is one other wrinkle to this dispute that requires a bit of explanation. Shortly after it issued the Environmental Assessment, the NRC Staff renewed Crow Butte's license in November 2014 with an expiration date of November 5, 2024.

Renewing a license during the pendency of an environmental hearing may seem odd, but it is certainly provided for in the rules. And, as long as the staff concludes, as it did here, that the public health and safety will be protected.

But, it is also fair to say that when the NRC Staff renewed that license, the staff did not have the benefit of the evidence that will be adduced at this hearing.

So, once this hearing concludes, the Board will evaluate the evidence and issue a decision. The Board certainly could conclude that the staff was correct in every respect and the renewal of the license does not pose any significant environmental impact that is not adequately addressed in that Environmental Assessment.

On the other hand, the Board could conclude that there are environmental impacts that were not addressed in the Environmental Assessment and those matters will have to be addressed by the insertion of additional conditions in the license perhaps.

Another possibility would be that the Board could conclude that the Environmental Assessment contains some minor errors but that can be fixed by the evidence that we develop during the course of this week.

It is even possible, if any errors are significant enough, that the Board could conclude that the Environmental Assessment is deficient and that the

NRC needs to go back to the drawing board and clear up those deficiencies.

All of these outcomes are possible, depending on the evidence the parties have filed with the Board as well as upon the sworn testimony the Board will hear through the examination of the parties witnesses this week.

Before we proceed to asking our questions of the parties witnesses, it might be useful to explain that the differing roles of the Nuclear Regulatory Commission personnel who are here today.

The Atomic Energy Act established the Nuclear Regulatory Commission to regulate nuclear facilities in this country. The Nuclear Regulatory Commission is headed by five Commissioners who are appointed by the President and confirmed by the Senate.

The Commissioners have a large staff working for them. And, during this proceeding, we will refer to them as the NRC Staff.

The NRC Staff is represented here today by lawyers and by technical people who have spent a great deal of time reviewing Crow Butte's application over the last seven years and writing the Environmental Assessment.

That brings us back to the three of us here who make up this Board. All three of us Judges with the Atomic Safety and Licensing Board Panel are with a group that was established under the Atomic Energy Act and that acts for the Commission in contested proceedings such as this one to hear and make initial decisions as to whether a license application should be granted.

Those initial decisions can be reviewed by the Commission and can be affirmed, reversed or modified by the Commission.

Although the Atomic Safety and Licensing Board Panel is physically housed within the Nuclear Regulatory Commission, and although individual Judges receive their appointments from the Commissioners of the Nuclear Regulatory Commission, we are a fully independent entity and we are wholly and separate apart from the NRC Staff.

Rather, the NRC Staff is appearing here today as one of four parties who will be litigating the contentions.

We will certainly consider the views of the NRC Staff, but we will give them the same weight that we will the concerns that are raised by Crow Butte, the Applicant, by Consolidated Intervenors and

by the Tribe.

And, I assure you, that is what we do, to act independently and to evaluate the evidence.

If one of the parties here does not like the ruling that we ultimately make after this hearing, that party can petition to the Commissioners to review our decision.

I should emphasize that this hearing is essentially a trial and this Board and the counsel and witnesses for the four parties to this proceeding will be the only people with speaking parts during this week.

If you came here to talk about your concerns with Crow Butte's mining operation and you're not a witness, I am sorry, but this is not the forum for that.

However, under 10 CFR 2.328, this hearing is open to the public. And so, those of you in the audience are more than welcome and we appreciate your appearance here today to view these proceedings.

In addition, 10 CFR 2.315(a) authorizes members of the public who are not represented here today or are not witnesses to provide this Board with written statements which are called limited appearance statements expressing their views on the

appropriateness of renewing Crow Butte's license to operate its in-situ mine.

All such limited appearance statements will be transcribed and placed into the official docket of this proceeding.

Although limited appearance statements are not evidence, they may assist the Board and the parties as this licensing proceeding goes forward.

If you have a written statement today or if you would like to write one up, during a break in our proceedings, you can hand that statement to Mr. Sciretta or to Mr. Desai and they'll make sure it gets placed in the docket so we will have a chance to review it.

If you'd prefer to write up a statement on your computer, you can email it to our clerks using the email address that was provided in the July 13, 2015 Hearing Notice and we have copies of that Hearing Notice at the back of the room that has those email addresses. And, you can ask Ms. Sarah Culler for a copy of that.

We would ask that you send that in by the end of the week because we will be closing the record of this proceeding at that time, with a minor twist we'll talk about at the end of the proceeding.

You should note that today, we will be utilizing some technology in the hearing room that will, I hope, enable the Board and the parties to conduct this hearing more efficiently.

But, I need to apologize in advance if there are some bugs that appear as we're trying to work those out in the system.

We have digitized the documentary record of this proceeding to make it accessible and usable in a courtroom proceeding. The exhibits have been transcribed electronically to the electronic hearing docket. And that has kept the process entirely electronic from start to finish and so it allows you, the public, to have easy access to these documents on the NRC website.

Additionally, as Mr. Paterson's presence indicates, we will be transcribing this proceeding and, at the conclusion of the hearing, we will establish a mechanism for the parties to correct the transcript of any errors and that was the one little thing that doesn't end at the end of the week.

Further, we anticipate using display technology as part of our evidentiary proceedings. And, you can see the displays -- you've got the display screens there that you can see. Hopefully,

this will make the information more accessible and understandable.

Now, we have a few housekeeping matters we need to attend to.

First, we're planning to be able to conclude this proceeding before the end of the day on Friday.

Second, this proceeding will be a little different from most trials that you may have seen on TV or that you may have been a juror in or even a party.

Perhaps the most unusual aspect of this is that we are using Subpart L procedures. And, by virtue of that fact, the attorneys for the parties will not be questioning witnesses. Instead, the witnesses direct testimony has already been submitted to the Board in written form.

And the Board, itself, the three Judges here, will perform the oral examination of the witnesses.

However, many of the Board's questions will be based on suggested questions that the parties have already provided to the Board through in camera submission.

The Board has grouped the contentions in

this case in to three batches, the hydrogeology contentions, the scientific contentions other than hydrogeology and the historic preservation and consultation contention. And we will be questioning witnesses on each topic.

That is why you see so many seats here in front of us. We'll have every witness on a group of contentions seated there so we can ask questions back and forth of the parties' witnesses.

We don't know exactly how long that's going to take, but we can give you a rough estimate of the timing.

We expect the hydrogeology questions to start today and last until sometime on Wednesday; that the other scientific contentions will start on Wednesday and sometime on Thursday; and that the historic preservation and consultation contention questions will start on Thursday and run through Friday.

There is one exception to this order which I will explain in a moment.

Once we've completed our examination of the parties' witnesses on a batch of contentions, we will take a short break to allow each party to suggest any additional questions it thinks we should have

asked but did not. Those questions will be submitted privately to the Board.

The Board may or may not ask those additional questions, but the parties will certainly be afforded an opportunity to make those suggestions and, if the Board doesn't ask them, it's simply because the record is already clear.

I mentioned there would be one exception and that is Dr. Redmond, a joint witness for the Intervenors and the Tribe with respect to Contention 1, has a scheduling conflict and cannot appear at the time we had set aside for Contention 1 on Thursday and Friday. So, we will be interrogating Dr. Redmond first in just a couple of minutes.

In all other respects, we expect to proceed just as we described.

One thing to keep in mind as the hearing proceeds, it would be folly to ascribe any particular significance to the number and types of questions that the Board directs to any particular witness as compared to any other witness.

Trying to draw any conclusions about how the Board perceives the testimony of a witness or witnesses on a particular matter based on the number and types of questions the Board asks is not accurate,

as some issues may be more complex than others or simply require more questions to develop the foundation.

In questioning any particular witness or group of witnesses, the purpose of the Board's examination is to create a record to support a fair and reasonable determination of the issues that are before us for decision.

We make our decisions based upon the record of the exhibits and testimony submitted by the parties and developed in this hearing.

Another housekeeping matter that has arisen, there was a question arising about whether you can leave your stuff here overnight. The answer to that is yes, it will be locked.

But, you should know that there is a custodian who will be coming in to clean this place up and so, there will be somebody else in here after we lock the doors, will be in here before we come back in in the morning.

So, with that, you can make your own decision about what you think is appropriate.

Secondly, I've never had to talk about this in a hearing I've been involved in, but the facilities here are a little unusual. We are going to

have to have a restroom protocol.

What we would like, what we'd ask you is we will be recessing. I suspect we'll recess once or twice in the morning, for lunch and once or twice in the afternoon.

If you would please -- if you would all mind just staying where you are, let the Judges run to the restroom. We're all kind of geriatric guys anyway and, you know, we do have to go frequently. And if you will -- I promise you when we're finished with the restrooms, we'll go back to our little chambers back there and y'all -- we'll give y'all another ten minutes to go to the restroom.

But, it would just make things a little easier if you'd try to accommodate us. We'd appreciate it.

Another thing I need to tell you is, your microphones are hot. And, by that I mean they are on all the time. So, if you want to say something ugly about, you know, one of us, you ought to be sure and push the mute button there to make sure that whatever you're saying doesn't get heard by us.

Finally, when we ask a witness questions, we may ask that witness or witnesses to essentially draw something or to annotate an exhibit. Normally,

in a courtroom, back in the day when I was trying cases as a lawyer, we'd walk up and have an easel there and we'd draw something or have the witness draw it. We can't do that, we're not doing that here. Everything is electronic.

But, we have figured out a way to annotate these exhibits and I'm going to let Mr. Deucher explain to you how it is you should proceed. I would ask counsel for any witnesses who are not here to please explain that to them so that they'll know if they come on another day.

MR. DEUCHER: Good morning. Just to let everybody know, what we've done is we've established and set up an extra mouse attached to my computer. And my computer is actually what's going to be displaying the evidence in the proceeding.

What we will then do is provide the mouse to the particular witness who is interested in doing the annotation and we will be using commenting tools built into Adobe Acrobat which is the software that we will be using to display the evidence.

And, with my help, in terms of making sure that I get the right tool on for you, you'll be able to draw using the mouse over that particular area.

Your screens are tied to my screen, so

you'll be able to see it as if you were working on a computer at your desk.

CHAIR GIBSON: Okay, thank you, Mr. Deucher.

Okay, Judge Wardwell, is there anything else that I overlooked?

JUDGE WARDWELL: I'll just make one comment in regards to the monitor problem. Bear with us on that. I mean the witnesses are going to have to use those monitors to see evidence and that type of thing. And so, we will have blockages of views.

Our other alternative would have been to put us up on this stage and we felt it was just a little too high up and domineering over everyone that we didn't feel was a very comfortable type of an arrangement.

So, we brought it back down to this -- we brought our benches back down to this level. But, in the process, have created this somewhat difficult thing with the monitors.

But, just bear with us so that the witnesses can see what they need to see once we get a full table of those.

CHAIR GIBSON: Yes. And, Mr. Deucher, at some point, it would be nice if you could move this

monitor over just a little bit so I can -- because I can't see this part of the --

Judge Hajek, do you have anything else you need to raise to the parties?

JUDGE HAJEK: I have nothing else. You've done a thorough job.

CHAIR GIBSON: I assume no one has anything else they need to raise for the Board at this point.

For those of you -- oh, Mr. Reid has something. Yes, sir?

MR. REID: Yes, we would renew the objections we made before as to the jurisdiction and the authority of the Panel. They were in our opening statements, so I won't go into that.

But, we'd also renew our objection to the Board's procedure that does not allow the Elders from the Tribe to present oral testimony to the Board.

CHAIR GIBSON: Thank you, Mr. Reid. Your objection is duly noted.

I should add for the parties that those folks who are not -- weren't involved in our pretrial last week, we had a pretrial on the phone last week. We resolved a number of these evidentiary questions such as the one Mr. Reid just raised. And, we

admitted the evidence of the parties in almost all respects.

What we have before us now is the evidence that was admitted at that pretrial.

If there is nothing further, I believe we can turn to our first witness. Mr. Redmond? Is it Mister or Doctor Redmond?

DR. REDMOND: Doctor.

CHAIR GIBSON: Dr. Redmond, very well, sir.

Would you please stand up, sir?

DR. REDMOND: I'm getting there.

CHAIR GIBSON: That's okay, take your time, sir.

Could you state your full name for us, sir?

DR. REDMOND: Dr. Louis Arthur Redmond.

CHAIR GIBSON: Very well, sir.

Could you raise your right hand?

You do affirm that all the testimony you are about to give in the case now before this Board will be the truth, the whole truth and nothing but the truth, this you do affirm under the pains and penalties of perjury?

DR. REDMOND: So help me, God.

CHAIR GIBSON: Thank you, sir.

You might, yes, sir, pull that mic so we can -- everybody can hear you clearly. Thank you, sir.

Dr. Redmond, you did not submit direct testimony in this case, but you did submit two opinion letters which have been marked as INT022 and 054 and that have been marked and admitted at the pretrial last week.

I just want to ask you, first of all, sir, do you have any corrections to your testimony that is set forth in either INT022 or INT 054?

DR. REDMOND: I don't believe so, but I have not --

CHAIR GIBSON: Well, it would be unusual if you had. It's just I want to be sure we get that clear before we get started into the specific things you said, sir.

Okay, and you've not submitted any rebuttal testimony, it was just those two exhibits, correct? Okay, very well.

All right. Dr. Redmond, you have read the Environmental Assessment in this case, I take it?

DR. REDMOND: Most of it, yes.

CHAIR GIBSON: Okay. Have you read the

Bozell and Pepperl 1982 and 1987 Class II Survey Reports for the license renewal area?

DR. REDMOND: I've read the site reports for them. I've not gotten the narrative of it and I've asked for that several times. I've got the site reports and I have a lot of problems with the site reports as they sit.

CHAIR GIBSON: Okay. But, I'm talking about there was a 1982 survey that was done by two archeologists, anthropologists, Bozell and Pepperl, P-E-P-P-E-R-L, maybe I'm saying that wrong.

DR. REDMOND: Pepperl.

CHAIR GIBSON: There was one in '87 and one in '82. Are you familiar with those, sir?

DR. REDMOND: Yes.

CHAIR GIBSON: Okay, okay, very well. All right.

It appeared from reviewing the INT054 exhibit that your testimony concerned the Crow Butte's Environmental Report for the Marsland Expansion Area. Is that correct?

DR. REDMOND: Yes, part of it because, number one, I wasn't able to see that report and I wasn't able to find the qualifications for the person who allegedly did the report.

CHAIR GIBSON: Okay. You're talking about -- this was an Environmental Report that the staff did or it was one that the Applicant did.

DR. REDMOND: Oh, I'm sorry, I thought you were talking about the archeological report that was done for that area.

CHAIR GIBSON: By the Applicant's expert, and you said you haven't seen that report, sir?

DR. REDMOND: The archeological report, yes.

CHAIR GIBSON: Okay, okay.

DR. REDMOND: Allegedly, there was an archeological survey that was done in that area and I've never seen the archeological report that was done.

Let's get clear on this, we may be talking past each other.

CHAIR GIBSON: Well, do you know -- okay, let's start over and --

DR. REDMOND: Okay.

CHAIR GIBSON: -- maybe we can get there.

There is a -- there are several of these uranium mine operations in this part of the world, okay?

DR. REDMOND: Yes.

CHAIR GIBSON: There is one for Strata, there's one for PowerTech, there's one for Crow Butte at the Marsland facility.

DR. REDMOND: Right.

CHAIR GIBSON: There's one for Crow Butte that wants to amend the current area. I think it's called the North Trend Expansion Area.

And, then there's one here that is the subject of this hearing which is not any of those. And, this is just for the Crow Butte license renewal area where they're operating right now and where they want to continue to operate under this license renewal.

DR. REDMOND: Right.

CHAIR GIBSON: Okay? And, I guess, what I was having difficulty understanding after reading your reports was that it appeared to me that what you were criticizing about work that the Applicant or the staff had done was work that had been done with respect to these other facilities. And I couldn't find much that you said there about this Crow Butte license renewal area.

And, I'm just curious, sir, did I miss something? Is there something there that, you know, escaped me? Or, are these -- are you saying that

they're essentially all the same? They're all similar areas and so the archeological evidence in them would be very similar?

DR. REDMOND: No, I had gotten several things all at once and I responded to them in the same letter. And, I responded essentially in the same way because I wasn't getting --

Number one, I wasn't getting the upgraded -- the alleged upgraded reports. And I wasn't able to find out what the qualifications were of the people who were doing these surveys.

Apparently, they were people who were going out here and in Marsland, apparently or allegedly, that were looking at the areas both here and in Marsland and they were making statements about the areas being cleared and I couldn't find out what their qualifications were to make those statements.

Because, both the NHPA and the Bulletin 38, to make statements about whether the Traditional Cultural Properties were because they were essentially also saying that there were no Traditional Cultural Properties.

CHAIR GIBSON: Yes.

DR. REDMOND: And, there are qualifications for both.

CHAIR GIBSON: Well --

DR. REDMOND: And, I couldn't find out what their qualifications were.

CHAIR GIBSON: Dr. Redmond, I understand that you have concern about the qualifications of the archeologists, historians, who were looking at this information. I'm not --

DR. REDMOND: I couldn't even --

CHAIR GIBSON: I'm not disputing that that's what you're disputing.

What I'm trying to find out, sir, though, is something a little different and I must not be asking my question right.

DR. REDMOND: No, I understand --

CHAIR GIBSON: My question is this, you said in INT022 the materials utilized for the Crow Butte Expansion Cultural Resource Licenses appear to be faulted in several places.

And, what is before us today is not the Crow Butte Expansion Area, but the Crow Butte license renewal area.

So, was that just a typo or did you mean to say and the renewal area or were you only focusing on the expansion area? Because we're not talking about the expansion area here now --

DR. REDMOND: Yes.

CHAIR GIBSON: -- just the license renewal area.

DR. REDMOND: And, I understand. I don't think it was so much a typo as it was a misunderstanding on my part at the time.

CHAIR GIBSON: Oh, okay.

DR. REDMOND: And, in retrospect, I probably should have worded it differently. Okay? Because, it's my understanding that the people that were assigned to do the Cultural and the TCP Surveys were doing both the areas and I couldn't even find out if they were archeologists or historians.

CHAIR GIBSON: Okay.

DR. REDMOND: Or simply people who were sent to do it.

CHAIR GIBSON: Okay. Well, you know, it's a little hard for us to evaluate -- I hope you can appreciate this, sir -- it's a little hard for us to evaluate your testimony, your opinion, when we're not really clear what it is you're focused on.

Because the only thing that we can really entertain at this point is not any of these other facilities, it's just the license renewal facility.

DR. REDMOND: Yes, and I understand that.

CHAIR GIBSON: Okay. Let's look at, on page one and two of INT022.

You say there is no identification or accreditation of those who conducted the Class III Survey or the TCP Surveys. And I think that's what you're saying that you don't know what their credentials were?

DR. REDMOND: Correct.

CHAIR GIBSON: What specific surveys were you -- are you speaking to there?

MR. REID: Can I request that the exhibit be pull up on the monitor so that this witness can look at it?

CHAIR GIBSON: I'm sorry, Mr. Reid?

MR. REID: Can I request, if you're reading from the exhibit that it be pulled up on the monitor so that the --

CHAIR GIBSON: Yes, we can do that, sure.

MR. REID: Okay.

CHAIR GIBSON: No problem, Mr. Reid.

DR. REDMOND: Don't go hunting.

CHAIR GIBSON: And, you're basically saying these people, there's no indication these people have the credentials? This is what they need to have and there's no indication they have it, right?

Well, my question is, I just need to know what it is you're saying about this particular facility? Is it this license renewal facility you're saying what the Applicant submitted or what the staff did that you can't tell who it was responsible for that? That they had credentials?

DR. REDMOND: Mr. Frankel had sent me some information on, I can't remember what you sent me at that time, do you remember?

CHAIR GIBSON: Well, unfortunately, Mr. Frankel can't really help you out now.

DR. REDMOND: Okay.

CHAIR GIBSON: Okay? We just -- all we need to know is what it was you're really focusing on? It sounds to me like you're just not sure.

DR. REDMOND: Like I was --

CHAIR GIBSON: I don't want to put words in your mouth, but it sounds like you're just not sure whether it was this license renewal facility or not.

DR. REDMOND: I didn't hear the last part of what you said.

CHAIR GIBSON: Yes, sir. It sounds to me like you're not sure whether it was this license renewal facility or not.

DR. REDMOND: No, it was -- we were

discussing both the expansion area and Crow Butte's.

CHAIR GIBSON: Okay, okay.

DR. REDMOND: Okay?

CHAIR GIBSON: And, you know that Crow Butte is doing both the expansion and the license renewal? That's the same company, they're just doing a different thing?

DR. REDMOND: Yes, I do.

CHAIR GIBSON: But, when you say and Crow Butte, you mean this facility?

DR. REDMOND: Yes.

CHAIR GIBSON: Okay, okay, very well. All right.

Well, let's look at the -- go back to these 1982 and 1987 Bozell and -- do you know how to say that last name?

DR. REDMOND: Pepperl.

CHAIR GIBSON: Pepperl. How this surveys.

Mr. Deucher, could we pull up CBR030 to help Dr. Redmond? I'm sorry, CBR030. There we go.

This is the Nebraska State Historical Society, okay?

Now, this exhibit was issued in 1987 and it accepts the Bozell and Pepperl, or Pepperl, study as meeting that agency's requirements as well as its

professional standards. Do you see that, sir?

DR. REDMOND: Mm-hm.

CHAIR GIBSON: Okay. Now, you're not asserting, I take it, that the archeologists and the State Historic Preservation Officer who signed this letter did not do their due diligence in reviewing the credentials of these two archeologists, Bozell and Pepperl, are you?

DR. REDMOND: No.

CHAIR GIBSON: Okay. And, you're not disputing the authenticity of this letter, correct?

DR. REDMOND: No.

CHAIR GIBSON: Okay. So, are you maintaining that Bozell and Pepperl were unqualified to perform a Class III archeological study?

DR. REDMOND: I'm not disputing -- I don't hear well, I'm sorry. I didn't hear your last statement.

CHAIR GIBSON: I'm very sorry, sir, I'll try to speak louder.

DR. REDMOND: No, it's just the way you said it, I don't hear at times.

CHAIR GIBSON: I'll try to go more slowly. Okay?

Are you maintaining that the Bozell and

Pepperl, these two archeologists, are you disputing that they were unqualified to perform this study?

DR. REDMOND: No.

CHAIR GIBSON: Okay, okay. All right, very well.

DR. REDMOND: There are problems, though.

CHAIR GIBSON: Okay, and we'll get to that.

DR. REDMOND: Okay.

CHAIR GIBSON: Yes, we'll get to that, I hope. All right? And, if we don't, I promise your lawyers will provide us some additional questions to ask you after you finish. Okay? So, just at a break.

Okay. You say that not considering traditional, ceremonial or cultural properties or viewshed or landscape impacts is a direct violation of the current cultural heritage laws. Is that correct?

DR. REDMOND: Mm-hm.

CHAIR GIBSON: You'll have to say yes or no. The Court Reporter --

DR. REDMOND: Yes, yes.

CHAIR GIBSON: -- can't pick up -- okay, very well, sir.

I would like to you tell me specifically the cultural heritage laws that you claim are being

violated.

DR. REDMOND: Bulletin 38 and NAGPRA.

CHAIR GIBSON: Bulletin 38 of who's bulletin is that, sir?

DR. REDMOND: Who's?

CHAIR GIBSON: Yes, you said Bulletin 38. I'm just curious?

DR. REDMOND: The National Register Bulletin 38, Guidelines for Evaluating and Documenting Traditional Properties.

CHAIR GIBSON: Okay.

DR. REDMOND: And the Native American Graves Preservation and Repatriation Act, 1990.

CHAIR GIBSON: Very well.

Okay. In your INT002 opinion, you mention the Secretary of Interior's Standards and Guidelines as specifically defining PCPs, correct?

DR. REDMOND: Correct.

CHAIR GIBSON: Okay. And, that is Bulletin 38?

DR. REDMOND: That's where the Guidelines come from, yes.

CHAIR GIBSON: Okay. Now, is Bulletin 38 an exhibit? Let me just ask your counsel. Is Bulletin 38 an exhibit?

MR. REID: No.

MR. CYLKOWSKI: Your Honor, this is David Cylkowski for the Staff.

Bulletin 38 is an exhibit. It's NRC083.

CHAIR GIBSON: 083, thank you. Could we call that up, Mr. Deucher? Okay, there we go.

This is Bulletin 38, sir?

DR. REDMOND: Correct.

CHAIR GIBSON: Very well, thank you. We've actually got it in a digital form. That helps.

DR. REDMOND: Correct.

CHAIR GIBSON: Okay.

MR. FRANKEL: Excuse me, Your Honor?

CHAIR GIBSON: Yes?

MR. FRANKEL: When something's on the monitor, could it be not reduced so small? I'm having a hard time reading the text.

CHAIR GIBSON: I think we're constrained by --

MR. FRANKEL: Well, it's fine when it starts and then he reduces it a couple of times. And, if he could refrain from that, that would be helpful.

CHAIR GIBSON: When we get to a specific page, we'll try to let you -- well, you let me know if you can't see the display, please, Mr. Frankel.

MR. FRANKEL: I sure will.

CHAIR GIBSON: We don't want you to be hampered in any way, sir.

Okay. So, this is Bulletin 38 is NRC083. Okay? And this is what you say was the -- contains the Standards and Guidelines that for cultural heritage laws that were being violated, correct?

DR. REDMOND: Yes. It's what the Guidelines are based on, yes.

CHAIR GIBSON: Okay, okay, very well.

All right. All right, let's -- now, you also made a reference to -- on page one to the Department of Interior rules. And, I believe we found that. I don't think anybody submitted it as an exhibit. We probably ought to make this a Board exhibit. That would be the 48 Federal Register 44716. This is what you were referring to, Dr. Redmond?

DR. REDMOND: From what I can see, I believe this is it, yes.

CHAIR GIBSON: Okay, very well.

MR. REID: Your Honor, just so we're clear on the record, when you say referring to, could you identify the exhibit he has two letter?

CHAIR GIBSON: Yes, we're going to provide copies to you.

MR. REID: I'm not talking about the Federal Register exhibit but the letter, he had two letter opinions. You said on the first page and you didn't identify --

CHAIR GIBSON: Oh, I'm sorry, yes. That was in the first -- that was on 022. I'm sorry.

MR. REID: Thank you.

DR. REDMOND: Yes.

CHAIR GIBSON: Thank you for that clarification, Mr. Reid.

Now, this exhibit, we'll just call this Board Exhibit 1 for simplicity sake, right, so we'll know what we're talking about. This is 48 Federal Register 44716, correct?

It is a publication of the Department of Interior, correct?

(Whereupon, the above-referred to document was marked as Board Exhibit 1 for identification.)

DR. REDMOND: Yes.

CHAIR GIBSON: It is entitled Archeology and Historic Preservation, Secretary of Interior's Standards and Guidelines, correct?

DR. REDMOND: Correct.

CHAIR GIBSON: Okay. Now, we could scroll

to page two of this highlighted portion there about archeology. Do you see that on the board, sir, it may be highlighted on your copy as well.

DR. REDMOND: Correct.

CHAIR GIBSON: Okay. These are, as you say, the minimum professional qualifications of a principle investigator, correct?

DR. REDMOND: Of a principle?

CHAIR GIBSON: Investigator?

DR. REDMOND: Correct.

CHAIR GIBSON: Now, are there any of these minimum professional qualifications that you're asserting that Bozell and Pepperl failed to meet?

DR. REDMOND: No. This is not what I was applying to Rob or Pepperl.

CHAIR GIBSON: Okay, okay.

DR. REDMOND: This is what I was applying to the people who had made the subsequent investigations for the TCPs and the subsequent investigations here at Crow Butte and the expansion area. Okay?

CHAIR GIBSON: Very well.

DR. REDMOND: This --

CHAIR GIBSON: Thank you for that clarification. And, when you said Rob, were you

referring to Bozell?

DR. REDMOND: Oh, I'm sorry, yes.

CHAIR GIBSON: You know this person by first name, I guess?

DR. REDMOND: Yes, I'm sorry. He was a --

CHAIR GIBSON: No, it's okay. I just wanted the record to be clear, Dr. Redmond, that's all.

DR. REDMOND: Right, good. Yes, Dr. Bozell and Bozell and Pepperl.

CHAIR GIBSON: Okay, well, let me ask you, sticking with Bozell and Pepperl --

DR. REDMOND: Please, yes.

CHAIR GIBSON: -- are there any other criticisms you have based on this Board Exhibit 1 that you have in front of you of those two archeologists?

DR. REDMOND: They are highly qualified. They're -- I have no problems with anything that either did in the field. They are both -- I worked with Bozell in the field out here and I have no problems with what he did in the field.

At one time, I was the forest archeologist out here in Chadron for the Nebraska National Forest and Bozell and I and Terry Steinacher, the State Archeologist actually worked on a project out here.

CHAIR GIBSON: Okay. Okay, very well.

DR. REDMOND: Just to qualify that, I have no problems with his qualifications.

CHAIR GIBSON: Okay. You also make a reference to the project being in direct opposition to the Nebraska State Historic Preservation Plan. And, there is a rebuttal exhibit that the Staff submitted which is NRC085. Could we call that up, Mr. Deucher?

Now, this is -- are you familiar with this Nebraska State Historical Society publication?

DR. REDMOND: Yes, I believe this is what I was basing my opinion on.

CHAIR GIBSON: Okay.

All right, at the bottom of -- in your testimony, at the bottom of page two, I guess we're back in 022, you say that the Crow Butte project is in direct opposition to the specific goals, solutions and problems for cultural resources, archeology and interaction with Tribal groups and local populations that is taking place at Crow Butte.

And you say that -- which specific goals, problems and solutions are in conflict with the project?

DR. REDMOND: Can this be moved up?

CHAIR GIBSON: Yes, sir, I'm sorry.

DR. REDMOND: It just went -- that's moved, but the Nebraska --

CHAIR GIBSON: Dr. Redmond, do you need some help? We can get you what you need, you just have to tell us what you need.

DR. REDMOND: The --

CHAIR GIBSON: You have to be a little more articulate than this or that.

DR. REDMOND: -- Nebraska goals.

CHAIR GIBSON: We can't get there.

DR. REDMOND: The Nebraska goals just disappeared.

CHAIR GIBSON: You wanted to stick with Nebraska goals? We can do that.

DR. REDMOND: If it can be moved down a bit.

CHAIR GIBSON: Okay.

DR. REDMOND: Nebraska goals. Preservation.

All right, in the Nebraska goals --

CHAIR GIBSON: Yes, sir?

DR. REDMOND: -- it talks about the preservation of the lands for the -- this one -- preservation of the lands for the people, preservation of the lands for the --

MR. REID: If I may, Your Honor, I believe the goals start on page 60 --

DR. REDMOND: Something about --

MR. REID: -- on the exhibit. I believe the goals start at page 60 of the exhibit, 60 and 61.

CHAIR GIBSON: All right. We're on 60 right there.

MR. REID: Sixty-one is the goals, the next page.

DR. REDMOND: It defines the utilization of the lands for the --

CHAIR GIBSON: You have to speak into the mic, the Court Report can't pick up.

DR. REDMOND: It defines the utilizations of the lands for the traditional use of the people, all the people. And, that's not being done in the Crow Butte area in that the lands are not being utilized at least for the Oglala people.

There are traditional properties that are out there that are not accessible for the Indian peoples.

CHAIR GIBSON: Okay.

DR. REDMOND: And, that's essentially in violation of the spirit and the letter of what's being stated in the goals of the State of Nebraska.

CHAIR GIBSON: Okay.

DR. REDMOND: At least in my humble opinion.

CHAIR GIBSON: Okay. And, when you're -- when you say these traditional properties are not being protected or receive the treatment they should be receiving, you're referring back to your earlier statement about the traditional, ceremonial or cultural properties or viewshed or landscape impacts, is that --

DR. REDMOND: Correct.

CHAIR GIBSON: That's what you're speaking to, is that correct, sir?

DR. REDMOND: Correct.

CHAIR GIBSON: Very well, okay, thank you.

Dr. Redmond, I take it that you consider yourself familiar with the history of the Lakota peoples?

DR. REDMOND: I do to some extent.

CHAIR GIBSON: Okay, okay.

DR. REDMOND: Not as well as I would like. I can give you a quick thumbnail sketch, if you'd like.

CHAIR GIBSON: I won't need that. I was actually just wanted to make sure you had sufficient

familiarity that I could ask you some other questions. I don't need an exposition on that. I just have some specific questions I want to ask. Okay?

DR. REDMOND: Okay.

CHAIR GIBSON: And, if you don't have them, it's just find, I just need to know.

Mr. Yellow Thunder has previously submitted testimony indicating that there's seven sub-bands of the Lakota people, do you agree with that?

DR. REDMOND: Yes.

CHAIR GIBSON: Okay. And the Oglala are one of those seven peoples, is that correct?

DR. REDMOND: Correct.

CHAIR GIBSON: Okay. Now, in your opinion INT054, you state on the first page near the bottom that the primary Tribal use of this area was by the Sioux and Cheyenne, is that correct? That's what you said?

DR. REDMOND: Lakota, yes.

CHAIR GIBSON: Okay.

DR. REDMOND: And Cheyenne.

CHAIR GIBSON: So, can you say that they historically used this area where the Crow Butte mine is located more than other Tribes?

DR. REDMOND: Yes, especially in the

historic period. The --

CHAIR GIBSON: Just to be sure, so the record is clear, when you say the historic period, is that opposed to the pre-history period or is that something else?

DR. REDMOND: Both.

CHAIR GIBSON: I'm sorry, I don't --

DR. REDMOND: I would say both.

DR. REDMOND: Okay. So, both during the pre-history period and the historic period, that would be the time when people would have recorded in, you know, more traditional history books, that's what --

DR. REDMOND: I emphasize the historic period because it's actually documented.

CHAIR GIBSON: Okay, very well.

DR. REDMOND: And, the Red Cloud and the Spotted Tail Agency were right there.

CHAIR GIBSON: Okay, all right.

Do you know, if you don't, it's fine, I'm just curious, do you know if the Oglala Sioux Tribe used this territory for historical and cultural purposes more than the Santee Sioux Tribe?

DR. REDMOND: Absolutely.

CHAIR GIBSON: Okay. Did they use this more than the Crow Nation?

DR. REDMOND: Yes.

CHAIR GIBSON: Okay.

Now, it was the Santee Sioux Tribe and the Crow Nation who were the two Tribes that participated in the a TCP Survey of certain Crow Butte sites, correct? If you don't know, that's okay.

DR. REDMOND: From what I've been told.

CHAIR GIBSON: Okay.

But, you don't -- now, you haven't looked at that yourself, is that correct, sir?

DR. REDMOND: I haven't been given that documentation although I've asked for it.

CHAIR GIBSON: That's great. That's great. Okay.

Okay, okay, very well.

I believe that concludes what I have. Judge Wardwell?

JUDGE WARDWELL: I have no questions.

CHAIR GIBSON: Judge Hajek?

JUDGE HAJEK: None.

CHAIR GIBSON: Okay. This is what I would like to do. Since I've completed --or we've completed our initial examination of Dr. Redmond, I would ask if counsel has any additional questions that he or she feels need to be asked of Dr. Redmond, if

you would please put those on some paper.

We will take a ten minute recess and, per our restroom protocol, the Judges will run to the restroom here and then we'll go sit in our chambers for ten minutes and let y'all use the restrooms and then we'll come back on the record.

Until then, we will stand in recess. Thank you.

(Whereupon, the above-entitled matter went into closed session at 10:28 a.m.)

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(Whereupon, the above-entitled matter went into open session at 10:36 a.m.)

CHAIR GIBSON: Okay. We are back on the record. Dr. Redmond, was there, in your opinion, was there adequate subsurface testing done in connection with the Crow Butte surveys?

DR. REDMOND: No.

CHAIR GIBSON: Okay. Very well. And what, in your opinion, should have been done in that regard?

DR. REDMOND: In several of the --

CHAIR GIBSON: And I'm talking about the license renewal area now, not any of the other ones.

DR. REDMOND: The license renewal, there should have been a resurvey or a retesting on at least

six of the sites. Specifically on --

CHAIR GIBSON: When you say six of the sites --

DR. REDMOND: Yes.

CHAIR GIBSON: -- are you saying six of the sites on the license renewal area?

DR. REDMOND: Yes.

CHAIR GIBSON: Okay. Very well.

DR. REDMOND: Specifically --

CHAIR GIBSON: Be sure you don't talk about anything that might be under there. Just what it was they should have been in terms of subsurface testing.

DR. REDMOND: I didn't catch the first part.

CHAIR GIBSON: Okay.

DR. REDMOND: I was thinking.

CHAIR GIBSON: You know we just were off the record a minute ago.

DR. REDMOND: Yes.

CHAIR GIBSON: I want to be sure you don't say anything --

DR. REDMOND: Yes.

CHAIR GIBSON: -- about anything that they might find there. I'm just saying what should they have done to test right?

DR. REDMOND: They should've tested -- either put in more test pits on several of the sites or on at least two of the sites, they should have tested them, period. Because two of the sites, they didn't even test them. They simply either surface collected them or visually checked them and that was it. There were two isolated finds near several of the sites that are probably part of -- at least one of the sites and two of the sites actually may be one very large site. And if they were tested sufficiently, it may be that you could just combine those two sites together. And then on one of the sites, I think it's Site 25DW194, Bozell mentioned that the northern part of the site was outside the area. In 1987, it was, but today it's actually almost dead center in the project area. And, therefore, that part of the site should have been tested.

CHAIR GIBSON: Of the -- dead center of the Crow Butte renewal site?

DR. REDMOND: Where the project area is today.

CHAIR GIBSON: Okay. All right. Okay.

DR. REDMOND: So it -- I mean, what was done in 1987 is not sufficient for what's being done today.

CHAIR GIBSON: Because it's your testimony, sir, your opinion that the area of concern is a broader one than what was looked at in 1987 by Bozell and Pepperl, is that correct?

DR. REDMOND: Absolutely.

CHAIR GIBSON: Okay. Very well. Okay. Now, I have one other question for you. Judge Wardwell and Judge Hajek may have one, but I have one other question for you. There has been a lot of discussion in testimony about the government-to-government relationship, the nation-to-nation relationship between the United States and the Tribes, such as the Oglala Sioux Nation, and whether or not that has been respected and integrated in the design and procedures for the TCP survey. My specific question for you has to do with the issue of Tribal elders and your opinion as to the significance of a dialogue with Tribal elders and why that would be important for a TCP survey.

DR. REDMOND: To date, many companies like Cameco have attempted to act as a government in dealing with Tribes. They attempt to set up a government-to-government dialogue between themselves and Tribes when, in fact, they're not a government and they're not a government agency. They attempt to bull

their way over any type of respectful dialogue with the Tribe. And in several of the telephone communications that they've made, several of the Tribal elders and several of the Tribal chairmen have tried to make that clear. To wit, John Yellowbird Steele tried to make that clear in one conversation that this was not a government-to-government telephone call, nor a government-to-government communication. And I forget who was making the call, but she said, oh, that's been duly noted. And then the call went on for another hour.

CHAIR GIBSON: Sure.

DR. REDMOND: And that is the general way that, that's been done.

CHAIR GIBSON: Okay. Well -- very well. I guess my question really just has to do -- I appreciate the fact that there had been criticism about that. My question was a little different, Dr. Redmond, and maybe I didn't ask it precisely enough, sir. But I want to know what in your estimation is the benefit of having a dialogue with the Tribal elders in terms of a TCP survey? Not whether it was done, not whether it should have been Cameco versus the government. I just want to focus on this question. What is the benefit that would be derived

from the involvement of those Tribal elders in the TCP survey?

DR. REDMOND: The benefit is that they bring the knowledge of the tradition, first of all. When they come, they bring their families and the cooperation of their families. And when they bring the cooperation of their families, they bring the cooperation of the entire Tribe with them. The elders lead their separate tiyospayes, their separate extended families and that brings these separate groups in. And when that happens, it brings -- it's kind of like a tidal wave. And if you get several families coming in, it shows the other families that you have a good heart --

CHAIR GIBSON: Yes, sir.

DR. REDMOND: -- and as it shows that you have a good heart, more people will begin to come in. And they'll begin to share and they'll begin to show you where things are. And as more and more people come in, you'll begin to understand what you're dealing with on the ground.

CHAIR GIBSON: Very well. Okay. Thank you, sir.

DR. REDMOND: Does that make sense? Did it make sense to you?

CHAIR GIBSON: I understand what you're saying, sir. Yes, I do understand what you're saying. Okay? I mean, you made your point and we needed to hear that point, so we wanted to know your opinion. You also testified earlier a little bit about pre-history and history. And I just want to make sure, when you say the historic period, are you really referring to the period of time that would have been memorialized in a history book or something, writing about it as opposed to something that happened before there was writing and recording of these things that happened? Or are you talking about something else? I just want to make sure so that we're clear. When we review this transcript and you say, during the historic period, that we know that about which you are speaking.

DR. REDMOND: No. I'm talking about the conventional idea of the historic period when it begins to be written down.

CHAIR GIBSON: Very well. Okay. Thank you. The Oglala Sioux Tribe is the largest of the Lakota Tribes, is that correct? Or do you not know? That's fine. It's correct? Okay.

DR. REDMOND: I can ask my cousin.

CHAIR GIBSON: No, it's okay. We

appreciate it. I think your expert -- that may have gone beyond your expertise. Which is fine. On which you could rely on hearsay. Judge Wardwell, you have anything else?

JUDGE WARDWELL: I have no questions.

CHAIR GIBSON: Judge Hajek?

JUDGE HAJEK: I have no questions.

CHAIR GIBSON: Okay. Dr. Redmond, you are excused and I wish you well on your other events that you've got to take care of this weekend.

DR. REDMOND: Thank you.

CHAIR GIBSON: Yes, sir. All right. At this point, we will have the witnesses for Contentions A, C, D, F, and 14, please come and sit at the witness tables. As you are setting up, if I could ask that the person that you each feel will be answering most of the questions to sit kind of in the middle in front of a microphone, that would be appreciated. I know many of the -- much of the testimony was supported by all of the witnesses here and I'm going to ask that each party designate kind of a lead person to direct things, recognizing that you can always go back and get assistance from anyone else. But if you can kind of designate one person to be the lead person for the questions that I have, that would be useful. And to

have that person near a mic would be the most appropriate way to do it.

MR. REID: This is Andrew Reid for the Tribe. While they're getting set up, can I ask a question of the Board, please?

CHAIR GIBSON: Yes. Yes, Mr. Reid.

MR. REID: I had, and maybe it's because I misunderstood the procedure, I thought that from what I read from the Board's Order that they were going to be taken up in sequence from each one of those Contentions. And because of that, I instructed our expert, Charmaine White Face, not to come until tomorrow. So she's not here today because she's not on one of the early Contentions in that Order. Hopefully, you'll allow her, if this goes on until tomorrow, allow her to testify and sit in at that time.

JUDGE WARDWELL: We will occupy all of today and all of tomorrow and part of Wednesday on this. When I get to the part, if I do, where I'm having some questions for her, I'll just postpone those until she arrives tomorrow. And I don't believe we'll get to those today anyhow, so I don't see that as a problem.

MR. REID: Thank you very much. I'll take

her name card off the table so you're not confused.

CHAIR GIBSON: I didn't hear what you said, Mr. Reid, I'm sorry. The last thing.

MR. REID: Just taking her name card off the table so you're not confused and you don't --

CHAIR GIBSON: Okay.

MR. REID: -- think that she's sitting up here.

CHAIR GIBSON: Thank you.

MR. REID: Okay.

CHAIR GIBSON: Thank you.

MS. SIMON: Your honor, I'm sorry. Marcia Simon for the staff. I believe Dr. Fuhrmann is having a little trouble seeing over that monitor. Is there any way we can try to adjust that? Maybe lower it or -- thank you.

DR. FUHRMANN: That works, thank you.

JUDGE WARDWELL: You could also move a little bit to the side of the table if you wish also. Not the monitor, but yourself. Both items move, both yourself and the monitor, so you can do one or the other.

CHAIR GIBSON: Very well. Okay. This will just take a couple minutes, but we're going to have to go through this in order. We'll start with you on the

far right. Would you please stand and raise your right hand, state your full name, sir?

MR. SOLIZ: Bryan Soliz.

CHAIR GIBSON: Do you affirm that all the testimony you are about to give in this case now before this Board will be the truth, the whole truth, and nothing but the truth? This you affirm under the pains and penalties of perjury?

MR. SOLIZ: I do.

CHAIR GIBSON: Okay. Let's go to the next one there. Sir, would you please state your full name for the record?

MR. LEWIS: Robert Lee Lewis.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in this case now before the Board will be the truth, the whole truth, and nothing but the truth? This you affirm under the pains and penalties of perjury?

MR. LEWIS: I do.

CHAIR GIBSON: Please state your full name for the record, sir.

MR. BEINS: Wade Alan Beins.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in the case now before the Board will be the truth, the whole truth, and

nothing but the truth? This you do affirm under the pains and penalties of perjury?

MR. BEINS: Yes.

CHAIR GIBSON: Would you please state your full name, sir?

MR. SPURLIN: Matthew Sean Spurlin.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in the case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MR. SPURLIN: Yes.

CHAIR GIBSON: Would you please state your full name, sir?

MR. TEAHON: Larry Teahon.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in the case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MR. TEAHON: I do.

CHAIR GIBSON: Please state your full name, sir.

MR. FUHRMANN: Mark Fuhrmann.

CHAIR GIBSON: You do affirm that all the

testimony you are about to give in the case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do under the pains and penalties of perjury?

MR. FUHRMANN: I do.

CHAIR GIBSON: Please state your full name.

DR. STRIZ: Elise Striz.

CHAIR GIBSON: Please raise your right hand. You do affirm that all the testimony you are about to give in the case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

DR. STRIZ: I do.

CHAIR GIBSON: Would you please stand up, sir? Would you please state your full name?

MR. BACK: David Back.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in the case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MR. BACK: I do.

CHAIR GIBSON: Yes, sir. Would you please raise your right hand, state your full name?

MR. LANCASTER: Thomas Lancaster.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in the case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MR. LANCASTER: I do.

CHAIR GIBSON: Okay.

MS. WHITE PLUME: Wioweya Najin Win, a.k.a. Debra White Plume.

CHAIR GIBSON: Okay. Could you set your water down for a second so you could raise your right hand?

MS. WHITE PLUME: I'm raising my right hand.

CHAIR GIBSON: Okay. You do affirm that all the testimony you are about to give in the case now before this Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MS. WHITE PLUME: Yes, sir.

CHAIR GIBSON: Okay. Thank you. Yes?

MS. MCLEAN: Linsey Mary McLean.

CHAIR GIBSON: Please raise your right hand. You do affirm that the testimony you are about

to give in the case now before this Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MS. MCLEAN: I do.

CHAIR GIBSON: Yes, sir.

DR. LAGARRY: Dr. Hannan Earl LaGarry.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in the case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

DR. LAGARRY: I do.

CHAIR GIBSON: Yes, sir. Would you please state your full name?

MR. WIREMAN: Mickel Wireman.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in the case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MR. WIREMAN: I do.

CHAIR GIBSON: Please state your full name, sir.

DR. KREAMER: David Kenneth Kreamer.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in the case now before this Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

DR. KREAMER: I do.

CHAIR GIBSON: All right. Very well.

MS. SIMON: Your honor, I'm sorry. We have two witnesses here who didn't get sworn yet. They're behind the four at the table.

CHAIR GIBSON: We have one more witness, I'm terribly sorry.

MS. SIMON: We have two.

CHAIR GIBSON: Two more witnesses. Okay. Can you please raise your right hand, sir, and state your full name?

MR. CAO: Tianqing Cao.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in this case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MR. CAO: I do.

CHAIR GIBSON: Thank you.

MR. GOODMAN: Nathan Goodman.

CHAIR GIBSON: You do affirm that all the testimony you are about to give in this case now before the Board will be the truth, the whole truth, and nothing but the truth? This you do affirm under the pains and penalties of perjury?

MR. GOODMAN: I do.

CHAIR GIBSON: Did I miss any other witnesses other than the one that will be showing up later? Very well. Okay. Judge Wardwell?

JUDGE WARDWELL: Thank you, Judge Gibson. A couple items I want to discuss before we get into the questioning just so we know what we're doing here and why we're doing it to a certain degree or how we're going to do it is probably a better way to state that. But we've got a lot of stuff to cover in a relatively short time between now and Wednesday. I am going to ask questions of many of you and I'm going to preface it by usually referencing usually your own testimony and it usually is a direct quote. So just listen to that quote just to refresh your memory and you should remember, of course, what that is, it's your testimony, so that it precludes us from having to take the time to pull that up.

I'm only going to pull up very selected exhibits where I want to reference something specific

on it. If at any time you feel a real need to see an exhibit, then fine, let me know and we'll try to accommodate that. But I don't want to do it for all the questioning because we may have a lot of snow to remove when we leave the area by the time we get done.

If I ask a yes/no question, I would appreciate a yes/no answer. I know sometimes that's difficult, but likewise try to adhere to that as best you can. Mainly because I think they're simple and more than likely my next question will go to something you probably wanted to add to that yes/no question. In all cases, make your answers as crisp and direct to the question that I asked as you possibly can. If you start elaborating beyond what I intended, I will probably stop you. Please don't take that as me being rude. I don't mean it to be that. I'm just trying to make sure we're moving this along. It's not being rude. If it's rude to anyone, it's me because then I probably didn't ask the question correctly and I want to make sure we get back on to the question I have.

Keep in mind, you've all submitted all your testimony. We've read it all. We've looked it all over. So we know what your positions are. These are clarifying questions that I want to make sure we're pinpointing down that I want a response to. And

so there's no need to repeat stuff that you've already said in your testimony that isn't related to that question. Trust us, we know your testimony. And if you do that, I think we'll move along quite nicely.

I think Judge Gibson talked about it earlier, I'd like to reemphasize it again. It may seem like we're focusing on certain witnesses. That's just inevitable. If anything, don't feel slighted if you're not asked much, because what you can take home from that is that your direct testimony was very clear. If there was clarity in everyone's testimony to the degree we felt we needed to establish a record and make our own decision, we wouldn't have any questions and we wouldn't have to deal with an oral hearing. Well, that's not the case. So don't -- I just want to make sure you just don't feel slighted if you seem like you're not there -- not participating.

I would ask that no one raise their hands because you've got a burning thing you want to ask in addition. We are the judges of what we need to have for information. If we feel a need, we will ask those clarifying questions. And likewise, don't interrupt and ask whether you would have the chance to clarify something. Please don't do that. It'll just interrupt the proceeding. Write it down on a note to

yourself and provide it to your counsel so that they can then provide it to us at the end to consider for asking ourselves.

And that's the best way to do it. And things will move smoothly if we do it that way. We won't wait until the very end of all these Contentions to ask for those written questions. We're going to break it down because otherwise we'd get all slumped and have no idea where we are by the end of this. I will mention that some of my questions may be very specific and require you to look up something in the testimony to a very specific question. Just let me know that and we will hold that in abeyance while you look it up during the break and then we'll start each session when we come back in with catching up on all of those specific points that we happen to have that we decided to delay while you get the information that you really need.

I didn't anticipate you to memorize all of the exhibits. So I certainly see that, that'll be a need. And I'll ask the law clerks if they could to keep kind of track of that because I'll forget what those are too. Especially if it happens right early on as we start and then an hour and a half later when we break I completely forgot that we want to tidy up

those little housekeeping things of those things that have been postponed.

I'm going to start off asking a lot of general hydrogeologic questions. They pertain to all these groups of Contentions. They won't be specific to any one Contention because it really provides either background or direct information for all of them. And then near the end, I'll get to those actual Contentions. But that probably won't be until tomorrow afternoon or even Wednesday that we talk about a specific Contention. It's just general hydrogeologic information that applies to all of them. And that's where I'll be starting off.

And because of that, as I said, if possible, I'd like to have a designated person that I start off that questioning with. And then, certainly, I'll break away and ask others in regards to addressing that. Or if you as the lead person can say, well, that will be best handled by this person, that's the way to pass it off from what we'll call the team captain, if we will, here for this round of general hydrogeologic questioning. Because in most cases, all of you people, and I know that two of the parties, that you kind of back most of the questions anyhow, you're all listed as that.

And if I'm asking the captain a question that isn't within their purview, then feel free to pass it off before you start answering to any one of your panel members and that's fine. I think that's the easiest way to get through this. So if I might, I'll start with Crow Butte. Is there one lead person that would be -- and that's you Mr. Beins? Beins, is that --

MR. BEINS: Mr. Beins.

JUDGE WARDWELL: Did I pronounce that right?

MR. BEINS: Yes.

JUDGE WARDWELL: Say it --

MR. BEINS: Beins.

JUDGE WARDWELL: Beins?

MR. BEINS: Beins. Like Heinz ketchup. Beins.

JUDGE WARDWELL: Beins. Okay, good. And is that a Mister or is it a Doctor?

MR. BEINS: Mister.

JUDGE WARDWELL: Okay. For NRC, is there --

MR. BACK: David Back.

JUDGE WARDWELL: Mister or Doctor?

MR. BACK: Mr. Back.

JUDGE WARDWELL: Okay. And for both the Consolidated Intervenors and the Oglala Sioux Tribe, is there one who would --

DR. LAGARRY: Dr. Hannan LaGarry.

JUDGE WARDWELL: Okay. I think we're ready to get ready. Anything else from the Board members before we charge on in of introductory stuff? Okay. Let me start off. Crow Butte's Exhibit 045 dealt with some testimony, Page 4 of 60, you state that the area of review for the application is 2.5 miles. My question is, where is that area of review defined and what is its legal significance and why is there any difference between that and the license area, the LA? See how well my system works? The very first question. But fine, that's the way to do it, just pass it off. That's great.

MR. TEAHON: That's part -- that's identified in --

JUDGE WARDWELL: Oh and one other thing, sorry. When you do start asking questions, if you could, just state your name. I think it's -- last name is fine. Just state your last name before you answer so then if it is passed off, we'll be able to get that correct on the transcript.

MR. TEAHON: Teahon. That's defined in the

license application as the area of review, the 2.5 miles.

JUDGE WARDWELL: So did you as Crow Butte designate that distance or is that some type of guidance that you get from the staff is this area of review?

MR. TEAHON: That's part of NUREG 15.69 requirement.

JUDGE WARDWELL: And why -- is there a reason for -- what's the significance of that difference between that and just the license area?

MR. TEAHON: I'm not familiar with the background on setting that area for review. It's just the guidance that we follow when setting up the license renewal.

JUDGE WARDWELL: Thank you. In your License Renewal Application, and that's Exhibit 011 of Crow Butte, on Page 2-127, in regards to the Pierre Shale, you state that the, and I quote, the black marine shale is an ideal confining bed with measured vertical hydraulic conductivity in the area of review of less than two times ten to the minus nine centimeters per second. That's what was stated in the License Renewal Application, so I may have kind of deked out, Dr. LaGarry, but I actually have a question

for you in regards to this. I didn't pick up much in the testimony from the Consolidated Intervenors in regards to the Pierre Shale. And I was wondering if you assume that you do not have much of an issue in regards to potential migration into that particular body?

DR. LAGARRY: That's correct.

JUDGE WARDWELL: So you agree that the integrity of the lower confining unit, the Pierre Shale, has not really been contested in this proceeding and is, therefore, not an issue?

DR. LAGARRY: That's correct.

JUDGE WARDWELL: Thank you. Back to Crow Butte. Referring to a figure that, if you can, and the one I offer as a recommendation is in the License Renewal Application, which is Exhibit 011, Figure 3.1-5, Page 317, would be a good example except that particular figure was blank. But the title was intriguing and that's A Typical Well-Field Layout. And that was the heart of my question is, can you refer us to a figure and if not, then at least describe the general pattern and spacing of injection wells and production wells used at this facility?

MR. BEINS: Certainly. Wade Beins with Crow Butte. Our well-field design is based typically

on what we call a seven spot well design where you have six injection wells laid out across the ore body in hexagon patterns. And then the seventh spot or seventh well is located central to those six injection wells. Typically it's 75 feet between injection well to producing well.

JUDGE WARDWELL: And that's -- the 75 feet is the radius from the production well to the injection well?

MR. BEINS: That's correct.

JUDGE WARDWELL: And what does that end up to be about spacing around the seven wells without me doing my math in my head which probably I couldn't do anyhow, so I just won't bother.

MR. BEINS: Each production pattern roughly is about 14,000 square feet per pattern.

JUDGE WARDWELL: And would you know the distance, lateral distance, between the injection wells approximately?

MR. BEINS: And that distance is about 75 feet, yes.

JUDGE WARDWELL: So it ends up about the same? Okay. And is there a reason this is blank on your exhibit, that page?

MR. BEINS: I do not know the answer to

that.

JUDGE WARDWELL: Thank you. Can you also describe the general pattern and the spacing of monitoring wells for the ore body and the upper confining unit used at Crow Butte in the license area?

MR. BEINS: I'm sorry. Could you repeat that please?

JUDGE WARDWELL: Yes. Can you describe the general pattern and spacing of any additional monitoring wells for excursions or anything else that you happen to have around those production units?

MR. BEINS: Certainly. Around the Crow Butte ore body itself, located 300 feet out approximately from the mining well-field is the production monitor ring. These producer or production monitors are screened in the same interval as where the mining takes place. The monitor ring is 300 feet away from the active mining well-field and the distance between the individual monitoring wells is approximately 400 feet, no more than 400.

JUDGE WARDWELL: NRC's Exhibit 010 is their Environmental Assessment. And on Page 32, and also shown on the License Renewal Application, which is Crow Butte Exhibit 011 at Page 225, is the CBR facility lies within the watersheds of White Clay

Creek, Squaw Creek, and English Creek, which are all small Southern tributaries to the White River. I now will deke out Dr. LaGarry again by looking to him and say, do you agree with that representation that's presented in the Environmental Assessment and in Crow Butte's License Renewal Application that those are the creeks really surrounding or going through the license area that also discharge into the White River?

DR. LAGARRY: I'm going to send this over to one of our hydrologists.

JUDGE WARDWELL: Fine.

DR. KREAMER: Dr. Dave Kreamer. That's basically correct, but there are a couple additional small creeks. Those include Saw Log Creek --

JUDGE WARDWELL: Say it again? Saw Log?

DR. KREAMER: Saw Log Creek. Some unnamed creeks in the area. There are several reservoirs in the area, including McDowell Number One Reservoir and Squaw Creek Reservoir.

JUDGE WARDWELL: Okay. Thank you. Crow Butte, do you --

CHAIR GIBSON: Just one second, Judge Wardwell. Could spell the name of the first creek you said just a second ago?

DR. KREAMER: It's Saw Log, like you saw --

CHAIR GIBSON: S-A-W L-O-G?

DR. KREAMER: Yes.

CHAIR GIBSON: Two words?

DR. KREAMER: One.

CHAIR GIBSON: One word?

DR. KREAMER: Yes.

CHAIR GIBSON: Okay. I just wanted to be sure the court reporter got it.

DR. KREAMER: No, I'm sorry, it is two words.

CHAIR GIBSON: It is two words? Okay, good. I wanted to be sure the court reporter got it. Okay, thanks.

JUDGE WARDWELL: And I find you can get pretty close to these mics without any feedback, so try to get as close as you can. But I recognize they're kind of fixed in place and -- do the best you can. Crow Butte, did you have any comments on those additions in regards to surface features that are running through the license area?

MR. BEINS: No additional comments, sir.

JUDGE WARDWELL: Thank you. The NRC's EA, again it's Exhibit 011 at Pages 31 to 32, and I quote, as described in the staff's EA, the closest boundary of the Pine Ridge Reservation is at least 30 miles

from the northeast boundary of the license area. Dr. LaGarry, do you agree with that approximate distance between the Pine Ridge and the northeastern boundary of the license area?

DR. LAGARRY: I do.

JUDGE WARDWELL: Thank you. Dr. LaGarry, with no dates or page numbers for that matter on your reports, I just want to verify that your Exhibit INT003 is your 2008 report?

DR. LAGARRY: I don't see it on the screen, but I did do a 2008 report, yes.

JUDGE WARDWELL: And to your knowledge, is it designated INT003?

DR. LAGARRY: As best I can tell, yes.

JUDGE WARDWELL: And how about INT013 for your 2015 opinion?

DR. LAGARRY: Okay.

JUDGE WARDWELL: And how about INT043 for your 2015 report on lineaments?

DR. LAGARRY: Correct.

JUDGE WARDWELL: Okay. Thank you. Just curious on, is there are a reason you don't like to date your reports or paginate them? For any reason that I should know? Any --

DR. LAGARRY: No.

JUDGE WARDWELL: -- significant reasons? Okay.

DR. LAGARRY: No.

JUDGE WARDWELL: Just want to make sure there isn't some hidden meaning there.

DR. LAGARRY: None.

JUDGE WARDWELL: Thank you. Let's get into talking about some of the strata that are beneath the site. Dr. LaGarry, would you agree that the geologic strata in the license area are mostly associated with sedimentary processes?

DR. LAGARRY: That's correct.

JUDGE WARDWELL: And what is the difference between a consolidated and an unconsolidated geologic material?

DR. LAGARRY: Geological materials become consolidated either through compaction or cementation. So a consolidated material has a condition of what's called indurated, which means it's hard. An unconsolidated sand, like beach sand, one can work with one's hands and it crumbles away.

JUDGE WARDWELL: So in my simplistic mind, and that was an excellent answer I thought, my simplistic mind is consolidated rock-like material and unconsolidated more soil-like material?

DR. LAGARRY: Generally speaking, although the sedimentary bedrock, the geological formations, in this area can be both consolidated and unconsolidated. And this creates issues for, say, soil scientists and whomever. When one thinks of bedrock under the land surface, one automatically assumes that it's consolidated or indurated. But the nature of the sedimentary rocks in this region is such that they may be loosely consolidated, poorly indurated, and in places one can work them with one's hands.

JUDGE WARDWELL: Okay. Thank you. And I think I did confuse you on that. I didn't mean soil in the agricultural aspect, but more in the engineering aspect if you will, of --

DR. LAGARRY: Okay.

JUDGE WARDWELL: -- being just what you described. Thank you.

DR. LAGARRY: We have an addition.

MR. WIREMAN: Yes, just a quick one. Mark Wireman. We also use a term called semi-consolidated. Which really does kind of refer to some of these rocks, particularly at the outcrop, where the rocks are both consolidated in part and sort of not so consolidated in other parts. So that's a term that's commonly used.

JUDGE WARDWELL: So, Dr. LaGarry, if I might ask you, and again, I would hold off on offering additional testimony, again, just to -- a given strata may have a name, but it may easily vary from consolidated to unconsolidated as you spatially go amongst horizontal and vertical distances of that geologic named strata. Is that what you were saying earlier also?

DR. LAGARRY: That's correct.

JUDGE WARDWELL: Yes. So it can easily vary between this unconsolidated and consolidated material in and out all the time through that same strata?

DR. LAGARRY: That's correct.

JUDGE WARDWELL: In regards to your testimony in Exhibit 003, that 2008 report, on Page 2, you list the regional geologic features from the youngest to oldest to be the following, and I would like you to listen and see if there's any errors at the end that I have from my list. I think you start off with the modern river alluvial as being the upper-most material. The Ogallala Group being the next, and I have here in my notes the river alluvium, either you said this or I said it from my own notes, I'm not sure which, designated as an Aquifer Four. I

don't know whether you gave it that name or I gave it that name, just numbering it. But --

DR. LAGARRY: I did that.

JUDGE WARDWELL: Okay, good. So I'll continue with that numbering scheme. The Ogallala Group, I think you named the Aquifer Three. The Arikaree, did I pronounce that correct?

DR. LAGARRY: You did.

JUDGE WARDWELL: Oh, hey, good. Because it's always hard for me to change after reading all this testimony and pronouncing it that way to myself and when I'm usually wrong with pronunciations, I end up going back to mine anyhow for the rest of the proceeding, so it's good that we're consistent together anyhow. The Arikaree Group is the lower part of Aquifer Three, I think is the way you designated it. And the Ogallala being Aquifer Three, the upper part of it. The Brule Formation being Aquitard Two. The Chadron Formation being Aquitard One. And now, probably the most interesting one, the Chamberlain Pass Formation as Aquifer One, which is the ore body, I believe. And then the Pierre Shale being the Aquitard Number One.

DR. LAGARRY: That's correct.

JUDGE WARDWELL: All those are correct?

Great, thanks. In NRC testimony, Page 41, and in the NRC Exhibit 024, Page 212, and in the CBR Exhibit 016, Pages 216 to 224, Crow Butte resources and staff have the strata as such, and I'll ask to have clarifications later on. And I've put down here some thicknesses for each of those strata, which I've taken from the Crow Butte testimony in 001, Page 11, A34, and the Crow Butte License Renewal Application, Page 2-107, Figure 26-2, which has been called up here. And correct me if I'm wrong for NRC and then I'll ask CBR the same thing, so just giving you a heads up so I don't have to repeat the whole column hopefully when I get done.

But you start off with modern river alluvium, the Arikaree Group, which you state is south of the license application, and I think you've designated it about 200 to 400 feet in thickness. You then mention the middle and upper Brule Formation, 200 to 400 feet in thickness. The lower Brule Formation, 200 to 300 feet. The middle and upper Chadron Formation, which is 120 to 250 feet thick. The Basal Chadron Formation, which is the ore body, of 10 to 80 feet in thickness. And the Pierre Shale, which is 1,200 to 1,500 feet in thickness. Is there any glaring errors for that generalization that I think I

basically took off of this exhibit, Mr. Back?

MR. BACK: No.

JUDGE WARDWELL: And, Mr. Beins?

MR. BEINS: No.

JUDGE WARDWELL: Heinz, Beins?

MR. BEINS: Beins.

JUDGE WARDWELL: I'll get it. Do you mind if I say Heinz first before I say Beins? We'll just pretend it's --

MR. BEINS: Yes, if that suits you, that's find.

JUDGE WARDWELL: Pretend that's your first name. Heinz Beins. It's hard to do multitask up here, trust me.

MR. BEINS: That's perfectly fine.

JUDGE WARDWELL: And do you agree that the modern river alluvium and the Arikaree Group and the middle and upper Brule Formations you consider to be aquifers? Albeit, they may not be high-producing ones, but they are generally aquifers as opposed to an aquitard?

MR. BEINS: That's correct.

JUDGE WARDWELL: And that the lower Brule would be more of an aquitard?

MR. BEINS: That's correct.

JUDGE WARDWELL: And the middle and upper Chadron would be also an aquitard?

MR. BEINS: That's correct.

JUDGE WARDWELL: And the Basal Chadron would be an aquifer?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: Mr. Back, do you agree with that generalization --

MR. BACK: Yes, I agree.

JUDGE WARDWELL: -- of what they are? Dr. LaGarry, do the Brule and the Chadron make up the White River Group? So if we see that phrase, is that what we're talking about?

DR. LAGARRY: The White River Group consists of, at the base, the Chamberlain Pass Formation. Over which lies the Chadron Formation. Over which lies the Brule Formation.

JUDGE WARDWELL: And do you have any issues with the associated approximate depths that were presented on this as I just described all of these in the license area?

DR. LAGARRY: Without the benefit of subsurface information of my own in that area, it's about right.

JUDGE WARDWELL: Thank you. NRC testimony,

Exhibit 001, at Page 55, its answer for F.4, the staff testifies that the cross-sections provided in Figures 2.6-4 to 2.6-11 of the License Renewal Application provides the best depiction of the stratigraphy at and in the vicinity of the Crow Butte ISR facility. And I believe those are on Page, of the License Renewal Application, are on Page 2-11 to 2-125 and you'll see up here is the first Figure 2.6.4 of those cross-sections. So I think I'll start off with Mr. Beins if I might. Do you agree that these strata were sedimentary processes also as Dr. LaGarry's opinion?

MR. BEINS: I do.

JUDGE WARDWELL: And the question I have is, how do these sets of cross-sections, of which we only see the first of, I don't know, a half dozen or so that were there on the pages to 2-125, how do these relate to those presented in your Exhibit CBR24, which is also shown here? That's the first page of 24, showing the location of the cross-sections and then you go on to show various cross-sections looking like this. So they look different and they're in a different exhibit. How do these cross-sections relate?

MR. BEINS: These cross-sections relate, your honor, by --

JUDGE WARDWELL: By these, you mean 24? Or the ones that --

MR. BEINS: The ones that are on the screen right --

JUDGE WARDWELL: Okay.

MR. BEINS: -- now --

JUDGE WARDWELL: That's 24.

MR. BEINS: -- relate to the ones that were on previously in that they show the geologic structure of the region from the area north of Crawford here in the area of our North Trend Expansion Area crossing the White River fold feature heading southeastward to the main license area of Crow Butte.

JUDGE WARDWELL: So would you say that 24 was related more to the North Trend Expansion Area and spilled over a little bit to the license area? Or were they made for that purpose? Or what else could you use to describe the difference between these and the ones in the license application?

MR. BEINS: Both of these sets of cross-sections were used to define the regional geology of the area. This particular one shows the geophysical logs on the cross-sections and with our picks of those individual sedimentary strata that are present.

JUDGE WARDWELL: And by picks, you mean the points at which you say there's a change in geologic materials?

MR. BEINS: Yes. The contact between different sedimentary units.

JUDGE WARDWELL: Thank you. Does the Brule vary from an aquitard to an aquifer?

MR. BEINS: Yes, to some extent. Within the Brule, there are sandy channels that we monitor at the Crow Butte mine site in our shallow monitoring wells. And that particular sand channel is bounded then below and to some extent laterally as well by impermeable or lesser permeable clays as well.

JUDGE WARDWELL: And I guess maybe this would be a good time for the sake of our vast audience here, would you define the difference between an aquitard and an aquifer?

MR. BEINS: An aquifer is a sedimentary structure that is capable of producing usable amounts of water. An aquitard is going to resist the ability of water to move through that particular substrate.

JUDGE WARDWELL: So are you saying none of us poor hard-scrabble woodsmen from the north country of New York have any aquifers because we don't have many sedimentary strata there?

MR. BEINS: Well, my apologies to you. Certainly in hard rocks --

JUDGE WARDWELL: Strike that question. We are talking about sedimentary here. That's what's important.

MR. BEINS: We don't have a lot of igneous rocks in Nebraska.

JUDGE WARDWELL: Thank you. Isn't hydrogeologic jokes fun? They are. They really are great. Right, Dr. LaGarry? Do you have any comments on the Brule varying from an aquifer to an aquitard?

DR. LAGARRY: It's broadly recognized by the State of Nebraska and the geological community that works in Nebraska that the Brule Formation is an aquifer where it has a lot of joints and faults, a feature called secondary porosity. And in areas where the secondary porosity of the Brule is prevalent, the boundary of what's called the High Plains or Ogallala Aquifer, it's adjusted downwards to accommodate that.

JUDGE WARDWELL: Thank you. Back to Crow Butte, if I might, Mr. Beins. Back to your license application, 011, Joe if we can go back to -- there you go. And -- yes. Let me start with this one. This is the first one in the series and let's look at the next one, Joe, if I might. There's always a blank

page between each one. They're significantly different appearing looking cross-sections. What allowed you to make the one earlier the way it looked and why is this one looking like it's looking?

MR. BEINS: Okay. I believe, sir, that this particular cross-section that's on the --

JUDGE WARDWELL: That's 2.6-5, correct?

MR. BEINS: Yes. 2.6-5 was a cross-section that was submitted with the original license application for the Crow Butte mine site. So we're looking at a depiction here of our understanding at the time that the original Crow Butte permit was submitted back in 1988, 1989 time frame. The previous cross-section was a cross-section that was prepared more recently and, therefore, it looks a little bit different. Is really the only reasoning why the two show a little different structure on the cross-sections.

JUDGE WARDWELL: So it's mostly because of the advance of our abilities to make fancier looking diagrams? Is that what --

MR. BEINS: Exactly.

JUDGE WARDWELL: -- you're -- thank you.

MR. BEINS: And more data.

JUDGE WARDWELL: On two of the drawings, if

we can go back to the previous one, 2.6-4 on Page 111, and I'll also reference that 2.6-10 on Page 123 also, show a line at the uppermost part of the cross-section with a little colored-in upside-down, well, I don't know if it's an upside-down triangle, it's a triangle on its point. What is that line?

MR. BEINS: That line shows the potentiometric surface of the Basal Chadron sandstone, the Chadron Aquifer.

JUDGE WARDWELL: And what does that line represent physically?

MR. BEINS: That line represents the potentiometric head or the level that the Chadron water table, if you were to penetrate that Basal Chadron sand with a well, it shows the water level that, that aquifer is capable of raising the water table to.

JUDGE WARDWELL: And that -- looking at that line at the left-hand side of this figure being above what appears to be the ground surface line, what does that indicate?

MR. BEINS: That indicates, sir, that in that particular area covered by that cross-section, that we do have artesian flow to the surface in wells that are uncapped. And so you would have a flowing

well in those areas.

JUDGE WARDWELL: And that off to the right where it falls underneath that line, that wouldn't be the case. Is that correct?

MR. BEINS: That's correct.

JUDGE WARDWELL: Where is the license area on this cross-section? Do you have -- is it to the right?

MR. BEINS: The licensed area that we're talking about for the renewal is to the far right of this.

JUDGE WARDWELL: So as far as this cross-section is concerned, there is not artesian flow within the license area itself?

MR. BEINS: There is not.

JUDGE WARDWELL: From the Basal Chadron only?

MR. BEINS: Correct.

JUDGE WARDWELL: Why does the line end where it ends?

MR. BEINS: I do not know the answer to that, sir.

JUDGE WARDWELL: Mr. Deucher, if you could go ahead to get to Page 123, 2.6-10, I just want to take a look at that again before I -- I think it's the

very last page, I'm almost -- yes, second to the last page. I think the last page is probably blank. Yes, that's what I thought. The same thing has happened here. And you would say that the licensed area is to the right-hand side of this?

MR. BEINS: Yes, it is, sir. It's likely that we don't have a lot of wells right through some of that area perhaps.

JUDGE WARDWELL: And so, in some of these sheets of data that represent each data point it looks like that created this cross-section, looks like graph paper with some lines on it. What are those?

MR. BEINS: Those are geophysical logs. As we drill each test hole across the area, we run an instrument down the hole, down the bore hole. It takes readings of the resistivity, the self-potential, and the gamma radiation that's present within the bore hole. This is a computer printout of those particular scales.

JUDGE WARDWELL: So that's one of the fancy things you were able to do with this next one is put things like that on this diagram? That's why this looks different?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: Dr. LaGarry, do you have

any comments on anything you've heard that you would like to object to or any differences in any interpretation of these diagrams that were talked about from Crow Butte's standpoint?

DR. LAGARRY: Well, your honor, the characterization -- I mean, part of one's training as a scientist is to use the most up-to-date information and be as accurate as possible. So the outdated use of Basal Chadron or Chadron A --

JUDGE WARDWELL: Okay, can I interrupt you right there?

DR. LAGARRY: Please.

JUDGE WARDWELL: I got about probably 15 minutes of questions on that topic.

DR. LAGARRY: The outdated terms?

JUDGE WARDWELL: Yes.

DR. LAGARRY: That's it.

JUDGE WARDWELL: Yes. Really, we want to get -- other than that --

DR. LAGARRY: Other than that --

JUDGE WARDWELL: -- there wasn't -- just basic formation of how these cross-sections were made and where the potentiometric surface is and whether --

DR. LAGARRY: That's all fine, thank you.

JUDGE WARDWELL: Yes, great. Yes. We will

get to that.

DR. LAGARRY: Okay.

JUDGE WARDWELL: And there's no -- don't feel bad about bringing that up either, Dr. LaGarry. I will, as you can tell, I'm not shy from stopping you. So also -- any witness. If you have a need to say something when I ask that, go ahead, but don't be surprised if I stop you likewise if we're going to cover it later. CBR, your testimony, again, Exhibit 001, Page 11 A34, states that Crow Butte recognizes that within these continuous geologic units, lithologic heterogeneities are present. However, the overall interpretation of lateral continuity is not affected by these local lithofacies variations. CBR, if I might ask you -- before I ask you that, could you define some of those terms in that statement of yours? Like heterogeneities, and the lithologic and lithofacies?

MR. BEINS: Certainly, the heterogeneities that we talk about there, we're talking about is this a nice uniform unit? If we're talking about a sandstone, is it a nice evenly sized, well-rounded sandstone all the way through across the site? So --

JUDGE WARDWELL: By heterogeneities you mean is it different in lateral distance --

MR. BEINS: Correct.

JUDGE WARDWELL: -- as you move from point to point?

MR. BEINS: Correct. And then in regards to the different lithofacies, we're looking at a fluvial river system where you have both sand channels being deposited in other areas where that sand channel's been deposited away from that area. You're going to see finer grain material, just like you would see in a modern day river setting with the flood sediments, the clays, deposited in one area whereas the sands are deposited in another. And we do see some of those changes across the site. However, for the most part, across the Crow Butte site, we're able to map and follow these particular sand channels across the width of the area there.

JUDGE WARDWELL: I think that's a good definition of the lithofacies variations. What is a lithofacies? Faci?

MR. BEINS: I would have to say that's that contact zone or that area where you see that gradual change from a sand over into a clay.

JUDGE WARDWELL: Dr. LaGarry, anything you want to add to those definitions?

DR. LAGARRY: A lithofacies is the product

of a specific subdivision of a depositional environment. So you might have a channel lithofacies, a flood plain lithofacies. But the term facies is a genetic term that talks about the character of what it is you're talking about.

JUDGE WARDWELL: Great. Thank you. Back to you, Mr. Beins. While your statement says that you recognize these units -- there's some variation in the geologic units and that the continuity isn't affected by local presence of sandier materials, if I can just put it in more common terms, but wouldn't a gap in the upper confining unit that consisted of all these types of materials, all sand material, or an extensive fracture network through the upper confining unit be of concern to the operation of the facility?

MR. BEINS: It certainly would be a concern to the facility.

JUDGE WARDWELL: Thank you. Crow Butte, in your testimony on Page 13, A37, and that's again CBR Exhibit 001, I probably don't have to say that anymore when I talk about your testimony, but you discussed bore hole logs and data. Do any of the bore hole logs show an absence of the upper confining layer?

MR. BEINS: They do not.

JUDGE WARDWELL: So it is continuous across

the whole area as far as your boring logs are concerned?

MR. BEINS: It certainly is.

JUDGE WARDWELL: Thank you. I'm on a roll, so you can stop me -- this is the time to stop or hold your peace for another 15 to 20 minutes.

CHAIR GIBSON: High noon.

JUDGE WARDWELL: I know, that's what I said. Well, it isn't -- it is high noon, yes.

CHAIR GIBSON: Do you want to go ahead and --

JUDGE WARDWELL: It's fine by -- this is a good stopping point if you want to stop at noon.

CHAIR GIBSON: All right. If you'll give us a few minutes, we'll run to the restroom, then you all can do as you please and we're going to go recess for -- what? We're just going to recess for lunch. Is that okay?

JUDGE WARDWELL: For how long?

CHAIR GIBSON: And we'll -- what do you all need? An hour? Forty-five minutes? Hour and 15? What do we need? I just need a --

DR. LAGARRY: Probably an hour because some of the places to eat are a little bit far away.

CHAIR GIBSON: All right. Let's go with an

hour then. Everybody okay with that? All right.

(Whereupon, the above-entitled matter went off the record at 11:58 a.m. and resumed at 1:01 p.m.)

CHAIR GIBSON: Very well. Back on the record.

JUDGE WARDWELL: Okay. Next block of questioning will deal with the nomenclature for the Basal Chadron versus the Chamberlain Pass. And I'll start with you, Dr. LaGarry, if I might. Do you agree that the only real difference between your strata profile and CBR's is the nomenclature for the aquifer that overlies the Pierre Shale?

DR. LAGARRY: Your microphone's not on. Or at least it wasn't just now.

JUDGE WARDWELL: I think it was on, I wasn't speaking into it.

DR. LAGARRY: Oh, okay. No, that's not correct.

JUDGE WARDWELL: Okay.

DR. LAGARRY: I mean, the nomenclature labels a basket, right? And so the name carries -- it's a way of talking about the basket that all -- what we know about a rock unit is in the basket, right? And so, it wasn't just a name change. The name was changed because the rocks were demonstrably

mischaracterized when they were called Basal Chadron. A separate depositional environment, a separate episode of earth history, different volcanos, different environments, different time, different distribution. So the name Chamberlain Pass Formation, which was first proposed in 1994 and then applied to Nebraska in 1998, is just a label on the basket that includes everything that is that formation. So, it's not a nomenclatural issue, it's a conceptual issue.

JUDGE WARDWELL: And let me ask NRC, do you agree with Dr. LaGarry's statements?

MR. BACK: Maybe from a depositional environment, but in terms of the properties that are most important to performance of the mine, it's immaterial what the unit is called.

JUDGE WARDWELL: But if in fact there is a difference in even the assumptions by how it was formed, by naming it a certain name doesn't it give it a certain connotation associated with that?

MR. BACK: Not really in the sense that it's all of the field investigative work that defines the actual properties of the unit. Say we didn't call it anything, say we called in Unit X, we would go out and do the investigative work and that's what would define the properties of the unit.

JUDGE WARDWELL: Thank you, Mr. Back. Crow Butte, in your testimony, 001, Page 10, H32, and Page 56, Answer to 101, you state that, quote, stratigraphic nomenclature aside, nothing in the naming conventions for the geologic units in Nebraska or at the Crow Butte facility changes the interpretation of the physical or hydrologic features of the rock units.

And I just call your attention to something that kind of states that it is a little bit more than that in your subsequent testimony on, again it's Exhibit 001, Page 32, A64, where you state that the primary difference in renaming of the ore body from Basal Chadron Formation to Chamberlain Pass Formation relate to the assumptions regarding the thickness of the ore body as influenced by its depositional history and that the thickness distribution of the Basal Chadron's sandstone is determined by the paleotopography. That is the eroded surface of the underlying Pierre Shale where exposed prior to the deposition of the Basal sandstone layer. So isn't that a reason more than just a nomenclature change to have a different designation of it to make sure that any reader is clear in regards to what you consider to be the depositional history?

MR. BEINS: The fact that the Basal Chadron sandstone has different thicknesses because of the eroded nature of the Pierre Shale still does not change the overall characteristics that are present within that Basal Chadron sandstone. We're able to map those units across the mine site and see the very nature of that fluvial system. The actual name change from Basal Chadron Sandstone to the Chamberlain Pass Formation does not change the physical characteristics of that particular sand body. So, no.

JUDGE WARDWELL: So do you disagree with Dr. LaGarry that in fact the basket of materials, as he described it, has a different general characteristics and engineering properties that differ based on the now present understanding of the volcanos and the sedimentary process by which they were formed as they would influence those particular properties?

MR. BEINS: I do disagree with that, yes.

JUDGE WARDWELL: Thank you. Dr. LaGarry, do you agree that the varying depositional conditions associated with the eroded surface of the Pierre Shale is one of the primary reasons for the name change?

DR. LAGARRY: The primary reason for the name change was that the channel facies of the Chamberlain Pass Formation, formerly known as Chadron

A or Basal Chadron, was considered a separate rock stratum from the overbank mudstone facies. The overbank mudstone facies was considered to be part of the underlying Pierre Shale.

And so what was done in this -- along with the name change and the redefinition of those rocks, was that the history of the rocks were reinterpreted and it was recognized that the flood plain and channel facies were in fact the same thing, the same basic rock type. And so the expectation was that somehow the channels had a distribution separate from the flood plains. And subsequent work by Evans and Terry in 1994 and then later by Terry in 1998 demonstrated that the flood plains and the channels were intermingled, interstratified, and not the sequential, cyclic, separate character that the Chadron A carried with it.

JUDGE WARDWELL: Thank you. Crow Butte, in your License Renewal Application, that's Exhibit 011, Section 2.6.2.2, you state that you did not use the previous thickness assumptions, but rather as stated in your testimony in 001, Page 32, Answer 64, that, quote, the Crow Butte determined the thickness of the Basal Chadron sandstone at the mine site based on the lithologic and geophysical characteristics and that

these determinations are independent of any assumptions regarding the thickness of the unit based on the overlying units. And I'll ask you that, are these lithologic and geophysical characteristics that you talk about associated with the geological modeling that you did?

MR. BEINS: Those particular characteristics, sir, are based on the numerous drill hole data set that we have on site. To date, we'd drilled over 10,000 individual bore holes on the site. That's about 4,000 exploration and development holes and then an additional 6,000, over 6,000 wells that we've installed there. For every one of those drill holes or bore holes, we have completed a lithologic analysis of the drill cuttings that are captured during the drilling process, as well as the geophysical log for each hole. That's what we base that up on.

JUDGE WARDWELL: And do you have an exhibit that shows the location of these drill holes?

MR. BEINS: We do. I'm not sure what the exhibit --

JUDGE WARDWELL: Is it --

MR. BEINS: -- number --

JUDGE WARDWELL: Is it Exhibit CBR056?

MR. BEINS: That sounds correct. Yes, sir.

JUDGE WARDWELL: Thank you. Dr. LaGarry, if one was to incorporate your understanding of the Chamberlain Pass as representative of what that ore body is like, is there -- and with that understanding of that, and if one was to characterize both the hydraulic and physical attributes of that ore body, does it really matter what we call it?

DR. LAGARRY: Use of the current concepts demonstrates due diligence.

JUDGE WARDWELL: I'm sorry, say that again?

DR. LAGARRY: Use of current --

JUDGE WARDWELL: Could you get a little closer --

DR. LAGARRY: Use of current concepts in science demonstrates due diligence, right? So -- okay. So you have to -- were it me, I would take the new stratigraphy, the new concepts surrounding the stratigraphy, the new concepts of the tectonics that produced that stratigraphy, and those would change the context in which I was doing my analyses and just how I thought about what it was, all the subsequent information I would gather about it, right? And so it's difficult to determine what the level of difference would be.

Because in my career, and I built my career using the latest stratigraphy, and so that's the inherent bias I come to these proceedings with. I don't have, any longer, or perhaps never had, the inherent bias that came from not having had that. So it's difficult to say. But there's a lot of things. We recognize that the Chamberlain Pass Formation had a much longer, more varied, more chemically reactive history than it was previously assumed when everybody called in Chadron A.

JUDGE WARDWELL: And we as a Board have to balance what was used in the past with regards to how we approach and write our decision. And do you understand the need or the advantage somewhat to maintain what has been used at this particular site historically to avoid any confusion when we really are referring to the same deposit? By using the Basal Chadron nomenclature as opposed to the Chamberlain Pass?

DR. LAGARRY: Provided the due diligence has been performed, I understand that, yes.

JUDGE WARDWELL: Okay. Thank you very much. Staying with and exploring the Basal Chadron, Chamberlain Pass Formation more and, again, if I use the phrase Basal Chadron, I do mean the Chamberlain

Pass also and recognize that, let's talk about the characteristics of that somewhat. And I'll go to Crow Butte again in your License Renewal Application, Figure 2.6-3, Page 2-109. And, Mr. Deucher, was the CBR056 the one that you believe was proprietary? Okay, good. So we're past that. So if you can call up Figure 2.6-3, Page 2-109, I'll ask Mr. Beins, is the license area oriented northwest to southeast direction and is the geologic section through the license area shown on the cross-section NW-SE as presented in the License Renewal Application Figures 2.6-11, Page 2-125?

MR. BEINS: That particular cross-section --

JUDGE WARDWELL: Yes, this shows a plan view of the cross-section going down through the middle of it, does it not?

MR. BEINS: Yes, it does.

JUDGE WARDWELL: And then the cross-section, if we can go to the next -- I believe that's -- is that the cross-section for it, 2.6-11? It's the northwest-southeast cross-section?

MR. BEINS: I believe that's correct, yes.

JUDGE WARDWELL: And so does the orientation of the license area correspond to the

orientation of the Basal Chadron Formation, Chamberlain Pass Formation?

MR. BEINS: The orientation of this cross-section runs along the length of the permitted area which lies upon top of the buried river channel that laid down the Basal Chadron sandstone, yes.

JUDGE WARDWELL: And that's where the ore resides --

MR. BEINS: That's correct.

JUDGE WARDWELL: -- in your mining operations? And does the Basal Chadron consist of only sandstone or does it also include some of the unconsolidated sand layers that we talked about before in the license area?

MR. BEINS: Essentially, the entire sand interval of our production zone, it's unconsolidated sediments. They're loose, they're not cemented together and all. They're interbedded with some clay layers, clay intervals. As the channels meandered back and forth across the valley floor, it would lay down a layer of sand as it's over in this area. Back on one side of the river valley, it would lay down clay sediments in the flood plains back on the other side of the valley, the opposite side. Then over time, that channel would meander back across the

valley floor depositing new channels and additional clay intervals. And so what we end up with at the site is a series of stacked sands, one on top of the other, with clay interbeds in between them.

JUDGE WARDWELL: Thank you. Dr. LaGarry, would you like to comment on that representation of that deposit?

DR. LAGARRY: Mr. Beins's characterization is accurate to the degree that you would find interbedded sand and clay. And the only thing I would add is that they pinch out, they thin and they thicken in three dimensions.

JUDGE WARDWELL: Great, thank you. Intervenors Exhibit 009, Page 2, it's termed the Peterson letter, I quote, uranium mineralization in the Crow Butte area is directly and primarily controlled by near-vertical faults cutting through the area and that the Crow Butte area faults not only exist, but they control mineralization and that the uranium mined by Crow Butte occurs within the faults themselves. That mining could open these faults, providing a passageway for aquifer impacts from uranium laden solvents.

Crow Butte's Exhibit 045, testimony, Pages 9 through 11, in answer A23, counters this argument

providing a detailed description of a classic roll-front formation of the Crow Butte uranium deposit as verified by detailed drilling, cutting observations, and geophysical surveys, concluding that, quote, no specific evidence is referenced to support the contention that the ore is present within inferred faults or within the current licensing area.

NRC's Exhibit 030 at 280 to 81, the staff maintains that based on a comprehensive analysis of over 2,000 uranium exploration bore holes and mineralogical analyses of the sediments, the Crow Butte uranium trend has been unequivocally described as a roll-front deposit. And they reference Figure 8, Page 281 of the NRC Exhibit 030. And this is the schematic shown from that, where it's a map showing the roll-front locations in and near the CBR license area.

Dr. LaGarry, in your 2008 opinion on Page 4, which submitted the Peterson letter I believe, contended that the uranium mine at CBR cores within the faults themselves and is not a roll-front deposit. Have you submitted any evidence that helps support your case that it's within the faults and not a classic roll-front deposit to counter the evidence provided by the staff and CBR? In the license area

alone, of course.

DR. LAGARRY: In the license area alone, no. Because over the length of my geological career, the license area has been off-limits having proprietary data and unavailable to a university researcher. So, within the license area itself, I have no data and no evidence. I've never worked there. However, outside the license area, this area is well known for geothermal activity and there are mineral veins infused in faults and fractures and folds across the region.

JUDGE WARDWELL: Have you read the evidence that they submitted in regards to their justification that the ore deposit is a roll-front deposit? And, if so, do you have any reason to dispute their conclusions in regard to the roll-front deposit?

DR. LAGARRY: I don't. However, it's plausible that both conditions exist at the site. This area has a well-described and long-known network of fractures that I've opined about. And so without specific studies directed at determining so, it would -- the only thing I have is the Peterson letter that describes these. And in one of my most recent opinions, I believe I showed a map displaying the faults he was referring to in that letter.

JUDGE WARDWELL: If in fact the Chamberlain Pass, Basal Chadron is primarily unconsolidated, would these joints and fractures necessarily exist within a deposit such as that?

DR. LAGARRY: Yes. Because geological histories vary. It's entirely possible that the sands were consolidated once upon a time and are no longer consolidated. Meteoric water can dissolve weak carbonate cements. It's entirely possible that subsequent to the deposit being formed at any point in its history some of the local earthquakes could have faulted and fractured it. Even in unconsolidated sediment, you can find joints, faults, and fractures that provide preferred conduits for fluids.

JUDGE WARDWELL: Thank you. In regards to the extent of the Basal Chadron, NRC's testimony, again Exhibit 001, Page 32, Answer D4, staff testified that the Basal Chadron sandstone tends southeast from Crawford and that it is the result of the sandstone being deposited by a major drainage feature that was a west to east through flowing valley about 25 miles wide entering present-day Nebraska in northwest Sioux County and turning southeast in western Dawes County. And they reference the NRC document Exhibit 024, Page 212 for some additional information. And, Dr.

LaGarry, would you agree that the Basal Chadron, Chamberlain Pass is a paleochannel sedimentary formation that fills a channel in the Pierre Shale?

DR. LAGARRY: In part. It also follows this incline that leads South from the Black Hills. But its orientation is as the Crow Butte geologists say it is. The best available map of that is from a publication by Swinehart and others in a publication from the University of Wyoming. It shows a northwest-southeast trending paleovalley with tributaries that enters Nebraska from the northwest and heads towards the North Platte River to the southeast.

JUDGE WARDWELL: Thank you. In regards to your discussion or, let's say, critique of the staff and Crow Butte's use of a layer cake methodology for characterizing the geology at the site, is it my understanding that this position of yours is based on separate layers of geologic material of which have constant thicknesses so that the interfaces are all horizontal? Or could it be -- or when you refer to the layer cake methodology, are you referring to the one layer cake I made where the interfaces were not very horizontal and were quite disturbed in fact? Which is it for your interpretation, for us

understanding your interpretation of your criticism in regards to the layer cake methodology?

DR. LAGARRY: Okay. So the term layer cake in this particular area of North America has specific connotations. Which came out of geological work done in the 1930s, 1940s, 1950s and early 1960s, in which it was assumed that the rock layers were of uniform thickness, uniform lithology or constituency, and spread out in all directions. So the best way to characterize it was you could take the earth and cut into it and it would look like layers of an onion. Okay. So then the main change that happened following the advent of plate tectonics and recognizing uplifts locally was that we now have an idea that the rocks are a hodgepodge because of the interplay between the various things that form rocks. And that rather than being uniform layers, the expectation now is that they're discontinuous and pinch out and local.

JUDGE WARDWELL: And even if they didn't pinch out and were local, if one was to not assume that the interfaces are horizontal and spread out the same way in all one location and are not uniform in thickness, would you characterize that as a non-layer cake model? I.e., would varying thicknesses and varying surface elevations of the top of the geologic

strata under discussion?

DR. LAGARRY: That would depend on details of how the geological history was interpreted. It could go either way.

JUDGE WARDWELL: Okay. Thank you. In NRC's Exhibit 023, Plate 1, which is PDF Page 3, is a USGS map that shows the extent of the Basal Chadron, Chamberlain Pass. And I guess I'll ask NRC, this is that diagram that I just referenced. And you'll see a topographic map, contour lines typical of a topographic map, and two questions for that, if I might. What are the units of the numbers on the contour lines? And what does that topographic map indicate?

MR. BACK: Your honor, these are thickness. So this is the thickness of the Basal Chadron. It's called an isopach map and they're in feet.

JUDGE WARDWELL: In feet?

MR. BACK: In feet. And so when you --

JUDGE WARDWELL: Is that listed anywhere there?

MR. BACK: My eyes aren't good enough to pick it up. And that's why as you move west, that Chadron Arch prevented the sand from getting deposited further east. As you move east and you see a zero --

JUDGE WARDWELL: That's fine. You've --

MR. BACK: Yes.

JUDGE WARDWELL: You've answered my question.

MR. BACK: Yes.

JUDGE WARDWELL: So it's a thickness map of the Basal Chadron, Chamberlain Pass.

MR. BACK: Yes.

JUDGE WARDWELL: And you agree there's nothing wrong with calling it the Chamberlain Pass, is that correct?

MR. BACK: No, I have no --- no.

JUDGE WARDWELL: And if we were starting from scratch today, you would probably use that designation, is that correct?

MR. BACK: Absolutely.

JUDGE WARDWELL: And, Mr. Beins, you have the same --

MR. BEINS: I agree.

JUDGE WARDWELL: Okay. So it's a thickness of that ore deposit that we're dealing with?

MR. BACK: Yes.

JUDGE WARDWELL: And --

MR. BACK: Your honor? It's not a thickness of the ore deposit. The ore --

JUDGE WARDWELL: I mean, of the -- I'm sorry. That was my --

MR. BACK: Okay.

JUDGE WARDWELL: Thank you.

MR. BACK: It's the thickness of the Basal Chadron.

JUDGE WARDWELL: It's the thickness of the Basal Chadron, yes. And so, the lines that are labeled zero, is that the lateral extent of the Basal Chadron?

MR. BACK: Yes, your honor.

JUDGE WARDWELL: Okay. And, Joe, are you able to with your arrow point along those zero lines? Do you see where they are? Yes, you're -- you got them right. Yes. So here they are roughly on the left-hand side that he's tracing. And you can go quicker than that, we know you won't get it perfect. Good enough. And then on the other side -- yes. So those are the extent of the Basal Chadron?

MR. BACK: Yes, your honor.

JUDGE WARDWELL: Dr. LaGarry, do you have any reason to dispute that?

DR. LAGARRY: None whatsoever.

JUDGE WARDWELL: Thank you. You made several conclusions based on this plate, Mr. Back, and

your testimony on Pages 32 to 33, Answer D4. And I think I'll just go ahead and read them. These are quotes from that. You state that from this plate, the Basal Chadron sandstone is not present beyond about five miles north and east of Crawford. Number two is that, you didn't number them, I'm adding the numbers, because the sandstone pinches out, the Basal Chadron sandstone aquifer is not present between Crow Butte facility and the Pine Ridge Reservation or at the Pine Ridge Reservation.

The third item you mentioned was the remainder of the Chadron Formation between the pinch out of the Basal Chadron sandstone and the Pine Ridge Reservation is described as low permeability siltstones and mudstones, which will not transmit appreciable flow, as discussed by Wyoming Geologic Association and referencing NRC Exhibit 030 at Page 279. And then, lastly, that there's at least a 25 mile barrier to flow within the Chadron Formation that separates the Basal Chadron's sandstone aquifer in the license area from any aquifers that supply drinking water at the Pine Ridge Reservation. And, Dr. LaGarry, do you have or have you submitted any evidence or have any evidence that would contradict those conclusions that NRC made?

DR. LAGARRY: Yes. I mentioned earlier that modern concepts of stratigraphy do not preclude the possibility of complex surfaces on which deposits form. So while it is absolutely true that in the subsurface data that we're looking at here on the screen is most likely accurate, unless I were to redo it myself and review it, the Chamberlain Pass Formation as described by Evans and Terry in 1994, and then later by Terry in 1998, occurs in a semicircle around the southeast and northern flanks of the Black Hills. So the Chamberlain Pass Formation occurs at the land surface on the Pine Ridge Reservation and in the butte tops north of the Black Hills in the Belle Fourche and Harding County areas.

So while it's true that this particular drainage in this particular area deposited Chamberlain Pass Formation as it's depicted here, this is not it's complete aerial extent. You can drive around north of the Pine Ridge Escarpment in the Badlands areas and find it as the bases of the Badlands outside this map area. In fact, I've published and presented at national conferences a couple of papers along with students where we talk about the broad aerial extent of these rocks. They occur as far east as Springview, Nebraska and as far north as southwestern North

Dakota.

JUDGE WARDWELL: Thank you very much. NRC testified on Page 21, Answer C-5, that, quote, as demonstrated in the cross-sections provided in Figures 2.6-4 and 2.6-11 of the License Renewal Application, and that's the same as -- and that's referencing Pages 2-111 to 2-125 that we talked about before, the Basal Chadron sandstone does not outcrop anywhere in the license area or in the proposed North Trend Expansion Area site northwest of the license area. And these cross-sections indicate that the Basal Chadron sandstone is located 200 to 700 feet below the ground surface. And, again, do you have any evidence that within the license area, Dr. LaGarry, that isn't a correct statement?

DR. LAGARRY: For the license area, that's a correct statement.

JUDGE WARDWELL: Thank you. Dr. LaGarry, in your testimony, Exhibit 003, Page 3, and that's your 2008 opinion, you allege that the White River alluvium can receive containments from waters transmitted through the Chamberlain Pass Formation where it is exposed at the land surface. And assuming what you said is correct that the -- you also have no information to believe that the Basal Chadron outcrops

to the surface or to the modern river alluvium anywhere along White Clay Creek, Squaw Creek, English Creek, or the White River, is that correct?

DR. LAGARRY: In the 1990s, I along with the Nebraska Geological Survey mapped the Chamberlain Pass Formation under White River alluvium 12 to 15 miles north of Crawford at a small community called Horn.

JUDGE WARDWELL: And how far, say, and in what direction from the town of Crawford was that?

DR. LAGARRY: That would be north.

JUDGE WARDWELL: North approximately how far?

DR. LAGARRY: Twelve to 15 miles.

JUDGE WARDWELL: Okay. You said that. Thank you. Staff also state that they are only aware of two reported field observations of outcrop of the Basal Chadron sandstone. Both of which are located in the Whitehead Creek and northern Sioux County, referencing NRC Exhibit 021 at 7 to 8, which is approximately 12 miles northwest of the city of Crawford. And so that sounds like the area you were speaking of?

DR. LAGARRY: I'm familiar with the one that they cite. There are in fact others. However,

the one that they cite is one of them.

JUDGE WARDWELL: Great, thanks. Crow Butte Exhibit 008, Page 20, Answer 33, in regards to the MODFLOW groundwater model used in the model-based restoration plan, you state that, quote, the groundwater flow model was calibrated to premining conditions using water level data collected prior to the mining activities in January 1983. And I guess I would ask you, what is the source of the premining water levels and where are they documented?

MR. LEWIS: This is Lewis at Crow Butte. That data comes from a map that was in the LRA report, I believe, showing the --

JUDGE WARDWELL: Say again? Can you get a little closer to your microphone just so I can hear you a little bit better?

MR. LEWIS: I'm sorry. There was a map that was put together, I believe it's presented in the LRA, which showed the groundwater elevations in the Basal Chadron Formation prior to development.

JUDGE WARDWELL: And who prepared that map and do you have an exhibit number for that map? And if you need to look it up, then we'll defer it to later.

MR. LEWIS: It would have been Crow Butte's

contract. I'm just not certain which one.

JUDGE WARDWELL: And do you believe it's in the License Renewal Application?

MR. LEWIS: I do.

JUDGE WARDWELL: Would you be able to come up with some page numbers by --

MR. LEWIS: I could --

JUDGE WARDWELL: -- and we'll --

MR. LEWIS: -- at the break.

JUDGE WARDWELL: -- get that at the next break? And do you recall offhand without being able to see what that map looks like, what the original flow direction in the Basal Chadron through the North Trend Expansion Area and the license application area was prior to any mining in 1983?

MR. LEWIS: Can you repeat that please?

JUDGE WARDWELL: What were the flow directions in the Basal Chadron prior to mining?

MR. LEWIS: Generally toward the northwest.

JUDGE WARDWELL: Towards the northwest? Okay. Thank you.

MR. LEWIS: That would be across the current license area.

JUDGE WARDWELL: Across the license area, what do you mean? You confused me with that

statement.

MR. LEWIS: The groundwater flow direction across the current license area is generally towards the northwest.

JUDGE WARDWELL: So that would be along the long axis of the --

MR. LEWIS: Yes.

JUDGE WARDWELL: -- license area?

MR. LEWIS: That's correct.

JUDGE WARDWELL: Okay. When you said across, I was picturing it --

MR. LEWIS: The reference for the groundwater elevations, that was Page 232.

JUDGE WARDWELL: Of the License Renewal Application?

MR. LEWIS: Yes.

JUDGE WARDWELL: Let's, if we can, call that up, Mr. Deucher, I'd appreciate it.

MR. LEWIS: It's of the -- 232 of the PDF.

JUDGE WARDWELL: That's fine. We can handle that. Yes. So is that what you're referring to?

MR. LEWIS: Yes.

JUDGE WARDWELL: And that's the limit that -- those are the wells that are defining this and the

values that are defining the preoperational levels?

MR. LEWIS: To my knowledge, those were the available data prior to the development, yes.

JUDGE WARDWELL: And you had no other data before you got a license to -- what did you use to support your license application at that time in regards to premining groundwater conditions? I mean, I look at that and convince me why that's not somewhat sparse in regards to data.

MR. LEWIS: I understand, sir. This was the data that was presented in the original Crow Butte license application. It was based off the availability of existing wells across the area there as well as a few regional wells that Crow Butte installed as well to support their position on this.

JUDGE WARDWELL: And so the only wells we're talking about are the ones that have an actual elevation number next to them? And is that elevation number the potentiometric level in that well?

MR. LEWIS: Yes, it is.

JUDGE WARDWELL: So we're talking, one, two, three, four, five points within the license area and three outside of it, is that correct?

MR. LEWIS: I believe that's correct.

JUDGE WARDWELL: Mr. Back, any idea of how

the staff accepted such an unambitious effort for this initial mining effort?

MR. BACK: Your honor, absolutely. There's a lot -- there's more regional data than is presented here in the license area. Actually down in Marsland, there's additional data there. There's data here. And conceptually, what the hydrogeologists have felt is that the water is actually moving from the northwest, you know how we talked about the Basal Chadron going down, it's moving from the southeast to the northwest. To those discharge areas that we talked about. So it fits into the conceptual model that --

JUDGE WARDWELL: What discharge areas are those?

MR. BACK: Well, where the Basal Chadron outcrops, that's conceptualized as a discharge area. And so --

JUDGE WARDWELL: And that would be to the northwest? That --

MR. BACK: To the --

JUDGE WARDWELL: -- 12 miles northwest.

MR. BACK: -- northwest.

JUDGE WARDWELL: Okay.

MR. BACK: That's exactly right. And so it

fit into the whole conceptual model that -- we had data from Marsland, which is on the other side of the Pine Ridge. The Pine Ridge does not act as a hydraulic divide for the Basal Chadron. And it just all moves to the northwest, to the discharge area. And so, conceptually --

JUDGE WARDWELL: And you're saying that's what you had available in 1983? Or that's what you have now?

MR. BACK: Sir, I can't answer 1983, I can only answer for the most recent licensing.

JUDGE WARDWELL: I know. I was sorry. I confused you, I think. My question was --

CHAIR GIBSON: Could I just ask one question, Rich? I don't want to --

JUDGE WARDWELL: Yes.

CHAIR GIBSON: I just want to be sure, you mentioned Marsland a second ago. You're talking about now, you're not talking about in 1983, right?

MR. BACK: No. Absolutely not.

CHAIR GIBSON: Okay.

MR. BACK: I'm just saying, when this data came in with the most current licensing, it was putting together a conceptual understanding because, I know you don't want me to get into it, but the flow

has actually reversed in the Basal Chadron through time. So we have a good understanding of what's going on.

JUDGE WARDWELL: Presently?

MR. BACK: Presently.

JUDGE WARDWELL: But my questioning was, what did you have -- I'm interested in getting as much a picture of what the premining conditions were in the Basal Chadron, in the license area, and so far, this is what's been presented to me as the justification for original licensing between '83 and, what was it, '88 or '89. What other information did you have at that time and is that --

MR. BACK: I think --

JUDGE WARDWELL: -- available to us?

MR. BACK: Dr. Striz is going to add something.

JUDGE WARDWELL: Thank you.

DR. STRIZ: Thank you, your honor. What happens is the application comes in with preoperational --

JUDGE WARDWELL: Can you pull that --

DR. STRIZ: Oh, I'm sorry.

JUDGE WARDWELL: Yank right on it.

DR. STRIZ: Okay.

JUDGE WARDWELL: Grab right on to her and pull it right up.

DR. STRIZ: It comes in with preoperational data --

JUDGE WARDWELL: Yes.

DR. STRIZ: -- that the applications --

JUDGE WARDWELL: Sure.

DR. STRIZ: I can't speak to exactly what happened because I didn't work on that license renewal that far back. But the application comes in with the preoperational data and what they do is they use the available sites. Because we're not -- we don't want them to put in a lot of wells and disturb a lot of the site if they can avoid it. And so they use what's preoperationally available and they bring it into us. But then, once they're licensed, they go in and they do the pumping tests and further characterization in the mine units to truly characterize and to see if that very intensive information within the license area refutes what the original preoperational data was. And that's the process that we use today.

JUDGE WARDWELL: Okay, thank you. So then that conclusion is this is what we've got available for preoperational?

DR. STRIZ: Typically we don't have a

tremendous amount of water level data for characterizing the groundwater flow field preoperationally. But then it is done after licensing based on that and they can see whether it refutes what was determined with the preoperational licensing.

JUDGE WARDWELL: Thank you. In your license application, Crow Butte, at 2-185 to 191, Figure 2.7-4b to 4d, shows potentiometric contours of the Basal Chadron, the Chamberlain Pass Formation from 2008 to 2009. Were these maps prepared using the data from the 11 wells in Table 2.7-6, Page 2-195 of your License Renewal Application? Or were more wells than that used to derive this potentiometric contours that existed from 2008 to 2009?

MR. BEINS: This particular map, your honor, represents the monitor well ring within the production zone. So we're looking at however many well points are on there. I'm going to say it's 175 wells, somewhere in that neighborhood.

JUDGE WARDWELL: So each of the dots are a well?

MR. BEINS: Each of those dots are a well that we had water level data available upon. Because these water levels were taken during a time period where the mine was in operation, you can see that the

flow pattern has changed significantly from that 1982 map. On this particular map, those flow directions have changed because we're required to maintain an inward hydraulic bleed on our well-field. And so, as we begin to pull a little more water out of the Basal Chadron than what we're putting back in, in our injection wells, we create a cone of depression within the mining units there.

And so as we begin to do that, you can see that the north end of the mine, we've actually reversed that flow direction from the northwest back towards the southeast. And then the southern two-thirds of the mine is still flowing primarily northeasterly. So that's the difference between those two water level maps.

JUDGE WARDWELL: And I let you ramble beyond what I asked, but that's because the next two questions were asking that very thing about --

MR. BEINS: My apologies.

JUDGE WARDWELL: -- the groundwater sinks and the general flow. So let me say it again to make sure I heard you correctly because this is what I have down here. Is it safe to say that the flow is southeast along the North Trend Expansion Area beneath the White River to the northwest section of the

license application and then turns northeast towards sinks caused by the mining activities?

MR. SOLIZ: Just to be sure it's clear, it's on the --

JUDGE WARDWELL: Just introduce your name before you answer.

MR. SOLIZ: Bryan Soliz, Crow Butte. Yes, just to clarify, that southeasterly flow is on the north end of the -- on the project site, yes. Within the license area.

JUDGE WARDWELL: And what would it be beyond that northwestern corner of the license area as it's coming under the White River and the southeast corner of the North Trend Expansion Area?

MR. BEINS: Yes. At the North Trend Expansion Area, the flow is also southeasterly there.

JUDGE WARDWELL: Thank you. And Dr. LaGarry, or any of your cohorts, would like to comment on what they heard about the direction of flows?

MR. WIREMAN: Mike Wireman. I was a little unclear about the North Trend Area direction of flow. Was that back to the southeast?

JUDGE WARDWELL: Their testimony as I heard it was that it was towards the southeast in that lower part, the southeast corner of the North Trend

Expansion Area.

MR. WIREMAN: So, I would --

JUDGE WARDWELL: Is that correct, Crow Butte? Did I paraphrase you correctly?

MR. BEINS: I'm sorry, your honor. Could you repeat the question there?

JUDGE WARDWELL: I doubt it.

MR. BEINS: Okay.

JUDGE WARDWELL: I'll ask you again. What is the flow in the southeast corner of the North Trend Expansion Area as it approaches the White River and beneath that towards the northwest corner of the license area?

MR. BEINS: The flow at North Trend there in the southern portion of North Trend is to the southeast towards the current license area.

JUDGE WARDWELL: And do you have any evidence to refute that statement --

MR. WIREMAN: No. Because --

JUDGE WARDWELL: -- is it Mr. Wireman or Dr. Wireman?

MR. WIREMAN: Mr. Wireman. Yes.

JUDGE WARDWELL: Mister, okay.

MR. WIREMAN: I've seen no potentiometric surface data for wells in the North Trend area. So

that hasn't been made available to us. I take that to mean that the operation of the northwesternmost mine unit is affecting the potentiometric surface in the Basal Chadron as far northwest as the proposed extension. That's how I would interpret that. But I have seen no data because that's not the matter of this proceeding.

JUDGE WARDWELL: And --

DR. KREAMER: May I say something as well? Dr. Dave Kreamer. Nor have we seen any measurements at all as to if there's been any change in discharge to the White River region due to the reversal in flow.

JUDGE WARDWELL: Mr. Beins, did you present any of that information in your License Renewal Application to demonstrate the flow conclusions that you've reached here that are presented in 2.7-4b?

MR. BEINS: I believe we did present that, sir, but I'll have to get back to you with that figure number.

JUDGE WARDWELL: Thank you.

JUDGE HAJEK: Judge Wardwell, can I jump in here with a question? Okay. So what I'm understanding this Figure 2.7-4 Bravo to be is a moment in time. Is that correct?

MR. BEINS: That's correct.

JUDGE HAJEK: Okay. So prior to mining, before mining, what was the direction of flow?

MR. BEINS: Prior to the mining time period --

JUDGE HAJEK: Back in 1983, let's say.

MR. BEINS: Yes. Prior to mining, the direction of flow was to the northwest.

JUDGE HAJEK: To the northwest? Okay. And then with -- in terms of this particular figure being a capture of a moment in time, that moment in time would be affected by which mine units were currently in operation. Is that correct?

MR. BEINS: That's correct.

JUDGE HAJEK: And so in this particular moment in time, which specific mine units were in operation?

MR. BEINS: Let's see, I believe it would have been Mine Units 2, 3, 4, 5, 6, 7, 8, 9, and 10.

JUDGE HAJEK: Well, that's too many. You're only --

MR. BEINS: A number of those were --

JUDGE HAJEK: You're ND2 --

MR. BEINS: -- in restoration.

JUDGE HAJEK: -- permit only gives you five mines. I thought I heard more than five being --

MR. TEAHON: This is Teahon from Crow Butte. Yes, we had five mine units in restoration. Those would be Mine Units 2, 3, 4, 5, and 6. And then we had Mine Units 7, 8, 9, and 10 in production.

JUDGE HAJEK: Okay.

MR. TEAHON: So we had five in restoration and four in production.

JUDGE HAJEK: Okay. We're going to get into this again, I'm certain. But this moment in time then, and this is 2006 through 2008 --

JUDGE WARDWELL: No, this is, I believe it's March of 2008, isn't it?

JUDGE HAJEK: I have March of -- oh, is that 8?

JUDGE WARDWELL: Well, Crow Butte, what is it?

MR. BEINS: I believe it's 2008, sir.

JUDGE HAJEK: 2008? Okay. So it's one month in 2008?

MR. BEINS: That's correct.

JUDGE HAJEK: So, in 2009, a year later, then this direction map would have been different, is that correct?

MR. BEINS: It would have been slightly different just because flow rates change somewhat over

time as we turn wells on and off. However, the same mine units that were in operation at this moment in time would have also been in operation in 2009.

JUDGE HAJEK: Okay.

MR. BEINS: And until we turned on some additional mine units there --

JUDGE HAJEK: And just to clarify, the term in operation, you are including both restoration and mining --

MR. BEINS: Yes, I --

JUDGE HAJEK: -- activities in, in operation?

MR. BEINS: -- am.

JUDGE HAJEK: Is that correct?

MR. BEINS: Yes.

JUDGE HAJEK: Okay, thank you.

JUDGE WARDWELL: Moving on to the upper Chadron, lower Brule. Dr. LaGarry, do you agree that the upper confining unit consists of both the upper Chadron and the lower Brule?

DR. LAGARRY: Yes.

JUDGE WARDWELL: And CBR, do you -- Crow Butte, you do also? Do you mind if I call you CBR occasionally?

MR. BEINS: That's perfectly fine.

JUDGE WARDWELL: Okay.

MR. BEINS: Yes, we agree with that.

JUDGE WARDWELL: Can I just call you CB?

(Laughter.)

JUDGE WARDWELL: You do agree?

MR. BEINS: I do agree.

JUDGE WARDWELL: Staff, I assume you agree too?

MR. BACK: Yes, we agree.

JUDGE WARDWELL: Thanks. Looking at the extent of that upper confining unit, Crow Butte's testimony, Exhibit 01, Page 20, Answer to 47, you state that the thickness of the upper confining layer ranges from approximately 100 feet along the northeast boundary of the area of review, and to refresh our memories that area of review is two and a half miles around the license area, is that correct?

MR. TEAHON: Yes, sir. It's around the permit area. From the permit boundary out two and a half miles around from the permit boundary.

JUDGE WARDWELL: So you take that little license area --

MR. TEAHON: Yes.

JUDGE WARDWELL: -- and you draw lines two and a half miles away from that?

MR. TEAHON: That's correct.

JUDGE WARDWELL: Okay. To over 500 feet in the immediate vicinity of the well-field area. And the thickness of the upper confining layer ranges from 200 feet on the north to 500 feet on the south. My first question is, is this well-field area the license area or is it some specific well-fields that you are in production in, when you use the term well-field area?

MR. TEAHON: The well-fields are all inside of the permit boundary, the license boundary.

JUDGE WARDWELL: So it is the license area you're referring to here?

MR. TEAHON: Yes, sir.

JUDGE WARDWELL: Is that correct?

MR. TEAHON: Yes, sir.

JUDGE WARDWELL: Thank you. And in your thickness estimates, well, in all your distance estimates that I just quoted on from Page 20, A47, are you referring to both the Chadron and the lower Brule in regards to the location and thicknesses of those?

MR. BEINS: I believe so, sir.

JUDGE WARDWELL: And what evidence did you use to derive these thicknesses?

MR. BEINS: Those thicknesses are derived

from, again, the large number of geophysical bore holes that we have present at the site. With each drill hole, taking that geophysical data and then interpreting that to get that thickness.

JUDGE WARDWELL: Thank you. Intervenors Exhibit 047 on Page 6, Mr. Wireman, you state that in regards to the Brule Formation, the hydraulic properties of the Brule Formation, both the upper confining unit and the overlying aquifer should be estimated based on more appropriate, more empirical methods, which use data from outcrops, that's fracture frequency, orientation, and aperture width. That's a quote. Does that --

MR. WIREMAN: Yes.

JUDGE WARDWELL: -- ring a bell to you?

MR. WIREMAN: Yes, it does.

JUDGE WARDWELL: Considering I assume you wrote that?

MR. WIREMAN: Yes, I did.

JUDGE WARDWELL: Could you explain to me how mapping sections or structural features of the Brule Formation at an outcrop area can possibly represent what that same formation is like when it's several hundred feet underground and saturated with water and the stresses associated with all the

materials above it?

MR. WIREMAN: Yes. That statement, first of all, was made in light of the knowledge that there's been no direct testing of the upper Brule. In other words, there's been no pump test done in the upper Brule, getting timed draw down or timed distance data with which you can then estimate hydraulic conductivity and transmissivity. In the absence of that, one of the techniques that is used is to go to an outcrop of the formation, measure aperture width of fractures, orientation of fractures, density of fractures, and then there is an algorithm that one can use to estimate transmissivity.

I will readily say, it is an estimate. It is never to be used alone. But it is a piece of evidence and a line of evidence that can be used if you have no data from a real pump test. So it was made in that context. But it is a method that's used. It's used more commonly in fractured igneous and metamorphic rocks and mountainous terrains. And it's commonly used there to get those estimates of a sort of a large area transmissivity hydraulic conductivity.

JUDGE WARDWELL: But in this application as you're suggesting this should be used, I guess I'm still a little confused on why it would provide any

useful data because I would estimate that those fractures would be in -- the spacing of them and the distances and everything under all that effort would be completely different and, likewise, they may not be even open down there. How does that really provide even any modicum of information in regards to trying to define the properties of this upper confining unit?

MR. WIREMAN: It provides one technique for estimating hydraulic properties of the rock. That's all it does. And as I said, using it alone is really not a good scientific decision to make. But in the absence of any other information, it does provide one number. And if there are other numbers, it can be compared. So it has limited use, I don't disagree with that.

JUDGE WARDWELL: As I interpret your first statement -- your statement to my first question is a better way to word it, that you would agree that a pump test would be the best way to do it and far superior to measuring these structural features at the surface?

MR. WIREMAN: Absolutely.

JUDGE WARDWELL: Thank you. The next group of questions kind of looks at the characteristics of the upper Chadron portion of this aquitard and

specifically characteristics of the clay/siltstone/mudstone that's been reported here. And I'll start off with Crow Butte's testimony on Page 21, Answer 48, you state that the sediments overlying the mined aquifer have not undergone complete lithification (a process by which sediments are converted into rock) as observed in cores and drill cuttings during drilling investigations. And I'd like to first ask, where is the data to support this position in any of the testimony that we have before us?

MR. BEINS: I'm not sure that we presented that data in a table format necessarily for the core that we've collected on the site. However, the site specific core data is what we do present as we present the hydraulic conductivities of some of the various units that are there.

JUDGE WARDWELL: Is it your position that the entire upper Chadron is an unconsolidated material composed of very fine grain silts and clays as opposed to a more rock-like material that would be generally characterized -- that may be characterized as a siltstone or a mudstone?

MR. BEINS: The upper Chadron is primarily unconsolidated clays, however there are a few layers

that are much more dense and compacted, lithified so to speak. I know based off doing some of our drill data that we've done, lithology-wise, and being out at the drill rigs as they're drilling through it, you get varying penetration rates at times in certain zones or layers, in certain areas of the mine.

JUDGE WARDWELL: And is the term mudstone and claystone and siltstone always exclusively used to refer to a consolidated material? Is it always used for a consolidated material?

MR. BEINS: Perhaps a better term would be semi-consolidated.

JUDGE WARDWELL: Have you reviewed all of the drilling data that's been in the license area and are able to reach a conclusion that every drill hole encountered either the clays that you talk about, the unconsolidated material, and/or consolidated mudstones or claystones or siltstones?

MR. BEINS: While I haven't been present, employed at the mine site during the entire time span there, certainly during the time period that I have, which is over 20 years there, probably been there for over 12,000 of the drill holes. Every hole that we've drilled on the site has encountered the upper Chadron and the middle Chadron clays, yes.

JUDGE WARDWELL: Were you involved with the preparation of your License Renewal Application?

MR. BEINS: Yes, I was.

JUDGE WARDWELL: Do you count on that clay layer to be present or siltstone, claystone layer to be present everywhere in order to reach the conclusion that in fact the upper -- in order to reach the conclusion in part that there is no direct communication between the Basal Chadron and the upper-lying aquifers?

MR. BEINS: I not only count upon it, sir, but it's confirmed by our cross-sections that show that it's present.

JUDGE WARDWELL: If in fact fractures were present in that upper confining layer, would they be restricted to only the stone type materials or would they also exist within the clay structure?

MR. BEINS: While we at Crow Butte realize that there may be some joints and fractures in the Brule portion, the upper Brule Formation and everything, we don't feel that those fractures extend at depth down into the lower Brule and into the Chadron Formation. And so, because of the plasticity or the plastic nature of those sediments, any fracture that is present there, if there were to be movement,

is likely to seal itself off. The clays that we're talking about have a high percentage of montmorillonite clay in it. As those become wet, they tend to swell.

That's something that we see on quite a few occasions with our drill data. If we open up a drill bore hole and for whatever reason if we're not able to get that particular hole logged within typically three, four hours, those clays will begin to swell and they will seal the hole off. So any fracture or feature that's present there that could open up is likely going to seal itself off, again, because of the plastic nature of the sediments, as well as the swelling clays that are there.

JUDGE WARDWELL: But would you anticipate those sections that are more consolidated into mudstones and claystones to have that same plasticity?

MR. BEINS: No, sir, they would not.

JUDGE WARDWELL: They would transmit those types of fractures, would they not?

MR. BEINS: The fracture may extend through that feature, yes.

JUDGE WARDWELL: And you used the phrase become wet. Isn't everything under water there now?

MR. BEINS: To an extent.

JUDGE WARDWELL: In the upper confining unit?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: I mean, so there's no wetness to be gained anywhere. It is saturated now, is it not? Do you have any reason to believe it isn't saturated?

MR. BEINS: No.

JUDGE WARDWELL: Dr. LaGarry or your team, would you like to comment on that interpretation of the upper confining unit in regards to its consolidated nature, the plasticity associated with it, and the self-healing properties specifically?

DR. LAGARRY: Well, I've never been able to get onto the license area to examine those rocks specifically. Everywhere else that those rocks occur at the land surface, they are full of joints and fractures and ancient mineralizations that have occurred over the last several million years. These are published in a reference that I used in my latest opinion. I believe it's Number 3, the one from -- the second one in 2015, where I cite Harmon Maher from the University of Omaha Nebraska. I presented a paper in which he showed plates of these joints and fractures in a Chadron Formation shot through with

mineralizations. The Nebraska State Gemstone and State Rock is called the Nebraska Blue Agate. It's one such mineral filling within the Chadron Formation.

JUDGE WARDWELL: If for the sake of argument there were unconsolidated clays down there as opposed to a mudstone or a siltstone that likely were observed in what you just described, would you not believe that those clays would have some of the plasticity referenced and the self-healing properties if in fact either a fracture tried to transmit itself through it or was created by some other external force like an earthquake?

DR. LAGARRY: In my experience, meteoric water, like rain and stuff, hits the surface of outcrops, caused the sediments composed of hydrophilic clay and so it'll absorb the water and puff up, just like Mr. Beins explained. However, when I dig below that, usually it's a six to eight inch layer of what's called popcorn weathering, it produces the gumbo that's famous locally, the mud that everybody dislikes. But you can dig through that and then you can get to rock. So, I mean, in my experience, once you dig past the weathering surface, you get into hard consolidated rock that's full of joints, faults, and fractures.

JUDGE WARDWELL: Thank you. Back to Crow Butte. With no evidence that the materials are not saturated, so that we assume it is, wouldn't there be minimal conditions that support any swelling of the clays? Because isn't swelling associated with the clays now absorbing some type of water that it didn't have before?

MR. BEINS: That would be true, yes, sir.

JUDGE WARDWELL: Thank you. It was brought up and also stated in your License Renewal Application, Page 2-127 to 128, that the Chadron Formation is primarily composed of 44 percent montmorillonite and, quote, is light green-grey bentonitic clay grading downward to green and frequently red clay. And I assume the basis for this is the drilling that you've performed there that allows you to designate and gave it this type of classification?

MR. BEINS: Part of it's based, yes, sir, on drill cuttings and observations on lithologic logs as well as some core data.

JUDGE WARDWELL: What is the other 56 percent? If it's only 44 percent, that says less than half of it's clay. And why would you call it a clay if it was only less than half percent clay?

MR. SPURLIN: This is Matt Spurlin with Crow Butte. Given the heterogeneous nature --

JUDGE WARDWELL: Can you speak into your mic a little bit and --

MR. SPURLIN: Yes.

JUDGE WARDWELL: -- your name again?

MR. SPURLIN: This is Matt Spurlin with Crow Butte. Given the heterogeneous nature of any formation, you're going to have alternating lithologies. The takeaway is that there are a predominance of silt and clay interbeds in the upper confining unit there. So you can find potentially high sand content units. But when you think of the general thickness across the site that on average is 300 feet of upper confining materials, there's a predominance of low permeability silts and clays that in essence are more than 100 feet of clay materials within that zone.

JUDGE WARDWELL: And do you agree with staff's EA, Exhibit 010 again on Page 26, which states that the clay unit is approximately 25 feet thick? Just the clay unit of the upper confining unit?

MR. SPURLIN: Are you referring to a clay unit within the upper confining zone?

JUDGE WARDWELL: Well, that's where I was

going to go next. I was going to ask staff where they wanted to it, but I happened to word it this way and so I will strike that question, go to staff first, and then come back to you. Staff, what did you mean in your EA on Page 26 that the clay unit is approximately 28 feet thick? If I got that correctly.

MR. BACK: That's on Page 26 of the actual EA or on the redline or the red numbered 26?

JUDGE WARDWELL: No, it's on -- I thought they were actually the same in the EA, but I believe that's the page -- well, I don't know.

MR. BACK: And are we talking about the middle Chadron now being 28 approximately?

JUDGE WARDWELL: Let me get back to you on that so I can make sure I got my reference correct.

MR. BACK: Okay. In the --

JUDGE WARDWELL: I will find that.

MR. BACK: -- meantime, we'll check too. Because --

JUDGE WARDWELL: Yes.

MR. BACK: -- pretty much --

JUDGE WARDWELL: I have that, that you have claimed that the clay unit, not the upper confining unit, but just the clay portion of it was 28 feet. And I was curious on how you got that number. And

then I was curious on whether Crow Butte agreed. So it's Page 26, but PDF -- oh, it's PDF Page 26, Page 13. Section 2.5.1. And why don't you just go ahead and look that up and we'll get back to you --

MR. BACK: Okay.

JUDGE WARDWELL: -- after the break. Because I assume we'll take a break here shortly. I can't read all that, you've got to -- let me just finish this line of question and then take a break. Yes. And then we'll come back to that. Back to Crow Butte, it is correct that not the entire upper confining unit consists of this dominance of clay, is that correct?

MR. SPURLIN: That is correct.

JUDGE WARDWELL: And is the clay at a certain location within the upper confining unit? And, if so, where is it generally found? Lower, middle, upper, whatever?

MR. SPURLIN: There is a clay unit that is formally referred to in the recent nomenclature as the upper interior paleosol. It's referred to as the red clay horizon in the License Renewal Application. This particular paleosol is clay sized particles, which is relatively uniform across the site, present above the production zone. And generally --

JUDGE WARDWELL: It's above what?

MR. SPURLIN: Generally immediately above the Basal Chadron sandstone.

JUDGE WARDWELL: So it's in a lower part of the upper confining unit?

MR. SPURLIN: It's in the lower part of the upper confining unit and on average, it's 25 feet thick.

JUDGE WARDWELL: Twenty-five feet thick?

MR. SPURLIN: Right.

JUDGE WARDWELL: Okay. As opposed to the 28 that I had written down or that I thought staff had told me to write -- that I got from staff --

MR. SPURLIN: That's in the right ballpark.

JUDGE WARDWELL: -- in their EA.

MR. SPURLIN: Yes.

JUDGE WARDWELL: What is the upper confining unit composed of above that clay layer?

MR. SPURLIN: The remainder of the upper confining unit above the upper interior paleosol, also known as the red clay horizon, is interbedded silts and clays that are of varying composition. But we also have samples from those zones that have more than 50 percent clay in it, indicating there are competent clay intervals in there.

JUDGE WARDWELL: And do any of these transition into a claystone, siltstone, mudstone?

MR. SPURLIN: Can you --

JUDGE WARDWELL: Or is it all unconsolidated material?

MR. SPURLIN: It's all unconsolidated material onsite. It's the age of the unit that calls into question these confusing terms for well-lithified versus non-lithified units, claystone versus clays. Onsite, as Dr. LaGarry indicated earlier, the history of the Basal Chadron sandstone as well as the Chadron can go through different stages of cementation and non-cementation. Within the current licensed area, that section of the Basal Chadron sandstone and the upper confinement is currently unconsolidated.

JUDGE WARDWELL: Say that last sentence again?

MR. SPURLIN: The upper confinement zone, which is what we're talking about, I'll specify, is predominately unconsolidated to semi-consolidated materials. There are stringers of more lithified materials in there that are of very minor thickness.

JUDGE WARDWELL: And then how do you differentiate between that and that lower portion that you also call unconsolidated clay? Is it --

MR. SPURLIN: The geophysical logging at the site has distinct signatures that call up, say, the Basal Chadron sandstone from the overlying clay materials. The distinguishing of silt and clay materials is pretty subtle on a geophysical log, but the sampling done at the site has shown that there's a predominance of silt and clay material in that upper confining zone. In particular, the upper portion.

JUDGE WARDWELL: But it seemed like your License Renewal Application spent a lot of time talking about and promoting this red clay layer. And I don't hear much difference between that portion of the upper confining unit that differentiates the behavior of that material from the red clay unit.

MR. SPURLIN: There may not be much behavioral difference just in terms of clay size. There's a color --

JUDGE WARDWELL: How about water transmission, which is what we're really interested in?

MR. SPURLIN: Right. It's more permeable than the lower red clay, which is 25 feet thick, just because it's more heterogeneous. It's not a 100 percent thick section of clay materials.

JUDGE WARDWELL: What testing have you done

to demonstrate this difference in conductivity?

MR. SPURLIN: We've --

JUDGE WARDWELL: Hydraulic conductivity?

MR. SPURLIN: Yes. We've collected samples throughout the upper confining zone which have been reported, hopefully, in the license renewal. Samples have been collected and we've done particle size distribution tests --

JUDGE WARDWELL: And it was reported where? I didn't hear your whispers.

MR. SPURLIN: It's in --

JUDGE WARDWELL: Probably why you whispered.

MR. SPURLIN: I asked for confirmation. We have to find where they're located in the LRA, in the license renewal. And we'll get back to you on that.

JUDGE WARDWELL: Okay. Let's do that too.

MR. SPURLIN: Okay. In terms of the testing, we've collected soil core samples and submitted them for particle size distribution analyses to confirm that we have the presence of low permeability materials in there that would act as an aquitard. And the results of that sampling has indicated a predominance of clay dominated materials.

JUDGE WARDWELL: Okay. In your testimony

on 045, which I believe is your Reply, Page 32, Answer 56, quote, the red clay marker horizon is laterally persistent across the region and has been observed in drill cuttings as well as the geophysical logs from all across the permit area. And could you explain quickly again the difference between the red clay layer and the green-gray clay layer? Is it just a matter of small subtleties and mineralization? Or is there some overriding behavioral difference between those two materials that would influence the hydraulic connection between the Basal Chadron, Chamberlain Pass and the upper aquifer?

MR. SPURLIN: From a hydraulic standpoint, there would be subtle differences, if any. It's primarily the color difference.

JUDGE WARDWELL: What does the phrase laterally persistent mean? That doesn't give me a warm fuzzy feeling if I really want to prevent any of my upward migration of --

MR. SPURLIN: Sure.

JUDGE WARDWELL: -- anything.

MR. SPURLIN: That would be equivalent to saying laterally continuous.

JUDGE WARDWELL: But it wasn't used. Would you be able to exchange laterally persistent with

laterally there everywhere?

MR. BEINS: Not within the license area, I would not.

JUDGE WARDWELL: Not within the what, sorry?

MR. BEINS: Not within the license area, I would not have a problem saying that.

JUDGE WARDWELL: You believe it is a continuous layer across the entire license area?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: Thank you. This is probably a pretty good time to break. This is a good time for everyone else?

CHAIR GIBSON: Stand in recess. We'll --

JUDGE WARDWELL: Start off with a couple pieces of information and then --

CHAIR GIBSON: Yes. And hopefully we'll get the other information straightened out. And per our protocol, we'll go use the restroom, then you all can have it.

(Whereupon, the above-entitled matter went off the record at 2:30 p.m. and resumed at 2:42 p.m.)

CHAIR GIBSON: Back on the record.

JUDGE WARDWELL: We've got some questions to be answered. What were they?

MR. BEINS: One of those, Judge Wardwell -- Wade Beins here from Crow Butte. The question had come up about the potentiometric surface direction at North Trend. That is shown in Figure 2.7-4E of the license renewal. It is page 240 or, I believe page 685 on the PDF.

JUDGE WARDWELL: And that direction is?

MR. BEINS: The flow direction is to the southeast, towards the current area.

JUDGE WARDWELL: That was during -- that was in what time frame?

MR. BEINS: I believe that was taken back in 2004. I would have to check on it to make sure.

JUDGE WARDWELL: The only thing is -- during mining operations.

MR. BEINS: During mining operations, yes.

JUDGE WARDWELL: Correct, okay.

JUDGE HAJEK: I'm sorry. Can you give that page number again? I'm really having a hard time hearing.

MR. BEINS: The page number for that one is page 240 and 685 on the PDF. Excuse me it is page 240 out of 685 on the PDF.

JUDGE HAJEK: Thank you.

CHAIR GIBSON: That makes a little more

sense.

MR. BEINS: Yes.

JUDGE WARDWELL: And did we have another question? Were you going find something, Mr. Back?

MR. BACK: We did, Your Honor. It was the source of the assumption of the 28-foot thickness. And we are going to have to dig a little more.

JUDGE WARDWELL: Try just what I said, 3.4.1.5 page 26.

MR. BACK: Oh, no, we have that, Your Honor.

JUDGE WARDWELL: Oh, okay.

MR. BACK: The reference for the later is Terry, for the later part of that sentence. And so we need to get that original reference.

CHAIR GIBSON: In regards to my question of what is the basis for that number.

MR. BACK: Yes.

JUDGE WARDWELL: Yes, I see. Yes, that's right. Okay, thanks.

CHAIR GIBSON: Did you say it was Terry?

MR. BACK: Yes, the later part.

CHAIR GIBSON: Is that the same Terry to which Mr. LaGarry has been referring several times?

MR. BACK: Your Honor, I believe so.

CHAIR GIBSON: The same publication?

MR. BACK: I don't -- there were several publications, so I am not sure.

CHAIR GIBSON: Okay. Well, okay. It just might be useful to get that provided to all concerned. I don't know whether you can work with Mr. LaGarry and you all can try to sort that out. But just for purposes of making the record clear, it would be good if we knew the publication and we had a copy of it and everybody had a copy of that. Would that be possible?

DR. LAGARRY: I will gladly do that.

CHAIR GIBSON: Thank you, Dr. LaGarry. Okay. Back to you, Judge Wardwell.

JUDGE WARDWELL: Okay. In your license application, Crow Butte, page 2-131 in regards to the upper confining unit, you state that the measured vertical hydraulic connectivity of the upper confinement is less than one times ten to the minus ten centimeters per second.

My question to you is what were those tests and calculations that were used as the basis for the derivation of this hydraulic conductivity value and how was it determined and where is the data supporting this value in your license application.

MR. BEINS: That was before my time, Dr.

Wardwell but my understanding is that it is based on core data that was gathered and compaction tests run upon that data.

JUDGE WARDWELL: But did you say you were involved with the preparation of the license renewal application?

MR. BEINS: I was, yes.

JUDGE WARDWELL: Yes, and this is where this number was I quoted from. So, that wasn't before your time, was it?

MR. BEINS: The collection of the core and the testing that was done predated my employment there. But yes, that was the number that we have used in the original license and have continued to use for the site.

JUDGE WARDWELL: You use the phrase it was a compaction test. That seems like a strange name for the test that might be run on this to determine hydraulic conductivity. Do you know what was involved with that test?

MR. LEWIS: This is Lewis with Crow Butte. We talked about the reconsolidation of the material for this testing. And we will have to look into the details of how that testing was done. I suspect it was a falling head permeameter, this type of testing.

JUDGE WARDWELL: What type of test again?

MR. LEWIS: A falling head permeameter or similar, after recompaction of the sample. That is my suspicion but we need to dig into that and verify that.

JUDGE WARDWELL: Okay, do that. And also look to see what the name of the test was, whether compaction is the right word or consolidation is the right word or settlement is the right word or something like that would be useful.

NRC, in your review of the license renewal application, did you inspect any of the cuttings or coring that was done or did you just take their word for it that that clay layer was there?

MR. BACK: Your Honor, we took their word for it that that layer was there. We did not actually --

JUDGE WARDWELL: I'm sorry?

MR. BACK: We did not actually inspect the core. We took their word for it that it was actually there.

JUDGE WARDWELL: Back to Crow Butte, when we talk about coring this, is it the same -- coring this clay, is the same as coring rock or is it a different type of stuff or how would the samples be

preserved if they were preserved?

MR. BEINS: The coring that we are referring to is done with a drill rig, where we go in and remove a sample of the clay that is present. We use a split tube Randolph-type core barrel. It gives us about a two-inch sample in diameter.

JUDGE WARDWELL: Mr. Wireman, in your testimony Exhibit 047, I believe, page 2, you state that an approximate characterization program to quantify the secondary permeability of the upper confining unit and the upper aquifer. The parameter that controls groundwater flow -- which is a parameter that controls groundwater flow in these formations, has not been completed. CBR and NRC define the upper confining unit as including the middle and upper members of the Chadron formation and the lower member, parenthesis, Orella, of the Brule formation.

And my question to you is do you claim that all the materials of the upper confining units are rock and not soil-like unconsolidated strata?

MR. WIREMAN: No, I do not claim that.

JUDGE WARDWELL: Okay. So, you are not disputing the presence of the high percentage of clay in these materials?

MR. WIREMAN: I don't dispute that there

is clay in these materials, no.

JUDGE WARDWELL: In your reference to the secondary permeability, are you referring to the potential faults, fractures, cracks, whatever we want to call them that might exist within this upper confining unit that Dr. LaGarry has referenced earlier?

MR. WIREMAN: You know, there is at least two types of what I would call preferential flow areas or volumes --

JUDGE WARDWELL: If you could get a little closer and speak a little higher, it just helps me.

MR. WIREMAN: Obviously, a portion of this rock that is highly fractured and highly jointed would have a secondary porosity associated with it and some degree of secondary permeability, depending on the connection of the porous zones.

Also, if you have sand or silt lenses within a clay or claystone, those become, in a sense, preferential flow pass because they have higher permeabilities, the water will want to go there.

So, I look at it as a preferential flow through an overall low permeability rock mass or rock unit and these preferential flow paths can be comprised of dense fractures, open vaults, or lenses

in areas of higher permeability materials such as silt or sand.

JUDGE WARDWELL: Well, wouldn't those lenses have to be continuous to some outlet area to really influence the permeability? Just a lens of sand encapsulated within a clay layer wouldn't seem to me to add much to the overall hydraulic conductivity transmissivity of that layer, would it?

MR. WIREMAN: That's correct. Permeability is simply connecting up porous zones so you can move water between them.

JUDGE WARDWELL: So the lenses would have to be continuous is what I am saying, in order for it to be influential, wouldn't it?

MR. WIREMAN: Being continuous would be one way, you are correct, for that to happen. Another way might be to sand lenses are relatively higher permeability, silt lenses could be connected by fractures.

JUDGE WARDWELL: Right.

MR. WIREMAN: So, there are other ways to do that. But you are correct in that they would have to be connected.

JUDGE WARDWELL: So, it is pretty much this fractured area that is the predominate issue in

regards to secondary permeability that we are dealing with at this site?

MR. WIREMAN: Based on my review and my reading of all this, I would say yes, that dense fractures sets in areas of dense fractures would likely comprise the dominant secondary porosity, yes.

JUDGE WARDWELL: Dr. LaGarry, would you agree with that also?

DR. LAGARRY: Yes, I do.

JUDGE WARDWELL: Okay, great. Thanks.

Mr. Wireman, what would you suggest to be a program to help quantify what is the secondary permeability at a site such as this?

MR. WIREMAN: First of all, I would go back to maybe a different type of core, so that you could look at the rock in boreholes and cores and be able to have what are called oriented cores or cores that haven't been rotated and moved, where you can actually look to see if the fractures are there. That is one way.

Secondly, would be to do a series of pump tests in this, either the Brule aquifer or the Brule upper confining unit, where you know there are sand lenses, based on either domestic wells or based on other types of information you have and then pump

those. Do a standard time drawdown or distance drawdown data and plot that data out. That gives you some idea about the connection of a sandy portion of this Brule, if you screen -- And if you continue to get a low slope and you continued have less drawdown, that you can look to see if there is connection and how far out that goes before you stop, before you run into rock that isn't giving you any more water.

But the key here is you can't just do it in one place. We have all heard how heterogeneic this rock is, siltstone, clays, sands. So, doing it in one place doesn't represent a very large portion of this rock.

So, a series of tests across the appropriate areas, with tide and drawdown data, calculating hydraulic conductivity and transmissivity and then seeing how that varies, what the ranges are, and what the distances are before you reach some kind of a boundary. That is what I would suggest.

JUDGE WARDWELL: I think I have got a pretty good understanding of the pump tests that you are referring to and advocating. How successful would this orientation of the coring be successful in regards to that? Is that considered a fairly -- I assume it is fairly much more expensive to do it that

way than it is just normal coring, in order to get that orientation.

MR. WIREMAN: You are absolutely correct. It is very expensive. And I am not necessarily advocating that as a sole method. It is expensive. And in these types of rocks, it is not as successful as it would be in truly hard indurated rock. So, it is not something -- I would go to the pump test first, I absolutely would, and do those.

And if I may, the reading I have done seems to indicate that there is some knowledge in the Brule about where these sandy areas are. There are some domestic wells out there. The work that Crow Butte has done has identified some areas where there is silt, maybe not sand, but not clay. And that would guide you as to where you might want to do these tests.

JUDGE WARDWELL: Thank you.

I think I would like to turn to staff now and explore a little bit more similar stuff I did with Crow Butte and that deals with your testimony on page 111, answer 14.6, where you testified that because of saturated clays and these formations are not brittle, if they are subject to an earthquake large enough to generate small fractures in these layers, the layers

would self-heal and not undergo any permanent changes in secondary porosity.

But as a siltstone or a mudstone or a claystone, wouldn't these materials be more brittle than they would be plastic?

MR. BACK: I'm going to hand this discussion off to my colleague.

JUDGE WARDWELL: Sure.

MR. CAO: Can you repeat the question again?

JUDGE WARDWELL: Yes. In your testimony you talk about basically the self-healing characteristics of the upper confining unit, specifically the clays associated with it. But yet, you describe them as siltstones, mudstones, and claystones and that connotes to me a certain brittleness associated with those types of materials, such if they did fracture due to an earthquake or any other loading or had cell fractures from their initial formation, why would they necessarily heal similar to what a clay deposit might heal?

MR. CAO: Your Honor, first if the earthquake is not large enough, the stress created by the seismic wave is very low, even those unconsolidated, like you said, the siltstone, the

sandstone, these cracks probably were not being opened or expanded or creating new cracks.

JUDGE WARDWELL: Yes, but let's take for assumption that somehow it cracked. Let's forget about how it cracked. Let's say the cracks are there.

MR. CAO: Okay.

JUDGE WARDWELL: Why would they heal if it was a brittle type material, like a mudstone, sandstone -- I'm sorry -- mudstone, siltstone, or claystone seems to convey to me.

MR. CAO: Those under pressure, the cracks can close. So, it is kind of healing.

JUDGE WARDWELL: But if they close, there would still be a space between them. I mean they are not going to heal completely compared to what they were before. Won't you have a larger secondary conductivity associated with those fractures?

MR. CAO: It can close to pretty tight and probably the transmissivity is negligible.

JUDGE WARDWELL: And what evidence do you have of that or have you submitted in that area?

MR. CAO: I think that evidence from seismological point of view, we don't have any evidence. It is they hydrological evidence is provided in our testimony.

JUDGE WARDWELL: Okay, thank you. Looking at the Brule formation, NRC testimony page 29 answer D3, you cite your EA and that is Exhibit 011 of Section 3.4.1 that the lower portion of the Brule formation consists of interbedded siltstone, mudstone, and claystone with occasional sandstones, while the upper Brule formation includes browns, siltstones, and sandstone members. Aren't all of these materials considered consolidated materials?

MR. BACK: Your Honor, when we read the literature, that is how it is classified, as sandstones, and mudstones, and siltstones. However, when we hear the descriptions of people actually taking the logs, then it becomes clearer that a lot of this is unconsolidated. So, we have to go -- since we are not physically observing, we have to go with what we are actually reading.

JUDGE WARDWELL: And would you characterize this as getting less and less clay-like and more and more sand-like as you proceed vertically upward in the upper confining unit, especially in regards to the Brule formation?

MR. BACK: Your Honor, that would make sense, in terms of how the hydraulic conductivities change as you move further upward.

JUDGE WARDWELL: And does the Brule, in fact, end up to be kind of a poor aquifer near the upper surfaces of that?

MR. BACK: Where it is fractured in the secondary permeability, that tends to be where more water is derived, yes.

JUDGE WARDWELL: Thank you.

Dr. LaGarry, could you describe the formation of the Brule and your characterization of it, at least from a regional, if not the site-specific because of your lack of access to that, necessarily, but on a regional basis describe that formation?

DR. LAGARRY: Sure. Sure, I'm the most recent one to publish on that.

The Orella member of the Brule formation is restricted to synclines extending south from the Black Hills. It is a river system. It has channel sandstones and overbank siltstones, and minor amounts of clay.

JUDGE WARDWELL: May I interrupt, quickly?

DR. LAGARRY: Pardon?

JUDGE WARDWELL: Can I interrupt quickly?

DR. LAGARRY: Please.

JUDGE WARDWELL: Good, because I had already anyhow but thank you for allowing me to.

(Laughter.)

JUDGE WARDWELL: Would you consider those blank stones, whatever you want to put a preference in front of them, to be consolidated materials?

DR. LAGARRY: Yes.

JUDGE WARDWELL: And while I think of it because I keep forgetting to ask this question, what is the difference between a mudstone and a siltstone or a claystone? I understand siltstone from claystone and sandstone from siltstone from claystone. I don't know what a mudstone is.

DR. LAGARRY: Mudstone assumes nearly equal amounts of silt and clay.

JUDGE WARDWELL: Okay, thank you. Now proceed with the Brule.

DR. LAGARRY: Okay. So, the lower part of the basal member, lower member of the Brule is fluvial valley fill, consisting of channel sands, overbank sands, overbank silts, and minor amounts of clay.

That grates upwards into a widespread upper part of the Brule, which consists of silt-sized volcanic ash that fell from the sky back then. It is thick and it is widespread everywhere. Both of those members, the lower Orella and the upper Whitney members of the Brule are calcium carbonate cemented.

They are semi-consolidated.

JUDGE WARDWELL: So, you like that term, also, semi-consolidated.

DR. LAGARRY: Well, it is a relative term. I mean to me, they are rock. But to somebody who did geology in the Rocky Mountains or the Adirondacks, or wherever, it might not seem like rock to them. But it is soft rock.

JUDGE WARDWELL: The best rock you have got out here, eh?

DR. LAGARRY: Well, I like it. I've spent my career on it.

JUDGE WARDWELL: In regards to the lower portion of the upper confining unit, where it gets more clay-like, do you agree it gets more clay-like at the lower levels?

DR. LAGARRY: Yes, the Crow Butte geologist is correct when he said it is originally called the interior paleosol. This is one of the -- remember in my earlier comments, in my earlier testimony, I stated that the Chamberlain Pass formation was combined the basal Chadron sandstone with a rock unit or some sediment assumed to be with the Pierre Shale that contribution from the Pierre Shale is that red clay.

So, it used to be thought that it was the red clay, then the sand in its geological history. But then Evans and Terry in '94 and then Dennis Terry in '98 published evidence that showed that the red clay and the white ore bearing sand are, in fact, intermingled.

And so the red clay consists of devitrified volcanic glass. Devitrified, it means it has been converted from glass into clay. The overlying Chadron formation is partly devitrified volcanic ash. It is only between 40 and 60 percent converted to clay.

Because it was volcanic ash and converted to clay and it is dominantly clay in a lot of places, it carries the name claystone.

JUDGE WARDWELL: Would you agree that it has some self-healing properties, should it be cracked or --

DR. LAGARRY: Not in my experience at all.

JUDGE WARDWELL: Thank you.

Then let me go back to NRC in regards to where I think we were before I went back over to Dr. LaGarry. And that is in your same statement there on page 111, answer 14.6, in regards to self-healing properties, what is the mechanisms by which it would

self-heal? Why is Dr. LaGarry in error in regards to not understanding your concepts of that mechanism?

MR. BACK: Your Honor, when we looked through all of the information and we understood that there are a number of faults and joints in the area, if these faults and joints are so pervasive and the fractures and joints do not self-heal, then the basal Chadron would not remain confined. And so, to us, it just seems to make sense that if they don't self-heal, you would interconnect the aquifers, since there are so many faults and joints in the area to where there had to be another mechanism and, just from deduction, it seemed to make sense that they self-heal.

JUDGE WARDWELL: So you are saying that this clay layer self-heals because the basal Chadron doesn't indicate any indications of communication with the upper layers and, therefore, you can use this clay layer to demonstrate that there is no connection with the upper layers.

Is that a bit of circular reasoning?

MR. BACK: No, Your Honor. The reasoning is this, is that there is, we know from multiple lines of evidence, that there is not an intercommunication between the basal Chadron and the overlying units. And so, if the system has been faulted and fractured

as much as other geologists are indicating, then all these fractures and faults would have had to have self-healed. Otherwise, there would be intercommunication among the aquifers.

JUDGE WARDWELL: So you believe those fractures were there in the clay at some point and you were counting on this self-healing as the mechanism by which the demonstration of no communication takes place between the strata.

MR. BACK: Your Honor, we don't' have evidence that there has been this faulting, certainly not within the licensed area to communicate the different aquifers.

However, you asked what the process was for this self-healing. In our testimony, we say it is the large volumes of clay that largely the montmorillonite that acts to self-heal. And when they are drilling these units, in my experience, things have been pretty dry as you are going through and actually drilling. But if you introduce a fluid because now if the hypothesis is that fluids are going to be moving up these fractures, that would introduce the water and the clays would self-heal. And we have seen that on other sites.

JUDGE WARDWELL: You use a phrase dry but

is not that layer saturated? I mean it may not have any free water while you are sampling it but wouldn't fine-grained materials like a clay would hold that water in? It wouldn't necessarily let it out. So, that is not surprising, is it?

MR. BACK: Well, you would be surprised at how dry things can look when you are drilling through a really tight clay.

JUDGE WARDWELL: Did you take a -- did you know if they took a water content sample of that to see how much water was actually in this dry material?

MR. BACK: No, Your Honor, I don't know.

JUDGE WARDWELL: Well, Butte, have you ever alleged any dry material at the site in your logs that you have reviewed?

MR. BEINS: We do not have that data, sir. We drill using a direct rotary method. So, we are already introducing some fresh water into the formation and that is likely part of why we suffer the swelling clays in our drill holes is you are introducing a fresh water constituent into the formation there that interacts with those clays that causes them to react differently than they do from the little bit of water that is tied up there to begin with.

JUDGE WARDWELL: In any of your core samples, did any of the water contents indicate that that material is dry?

MR. BEINS: No, sir.

JUDGE WARDWELL: Thank you.

JUDGE WARDWELL: So, back to NRC. Just to make sure, I want to fix this point, that you don't have any direct indications or hypothesis mechanism by which this healing would take place. It is mostly derived from the observations of its performance in the field. Is that a fair assessment?

MR. BACK: That is a large part of it. However, in our testimony, we do talk about the large clay content and if it is wet, it is going to self-heal.

JUDGE WARDWELL: And by what mechanism?

MR. BACK: Well, for one thing, there would be a smear zone to begin with. I mean we know that when plates move across one another, they create a smear zone. More often than not, a faulting creates a no-flow boundary, rather than enhancing flow. And so, that would be one mechanism.

JUDGE WARDWELL: Thank you.

Crow Butte, in your license renewal applications, pages 2-173 to 2-179, Figure 2.7-3A to

3E provide potentiometric contours of the heads in the Brule formation.

My first question is how many wells were used to derive these maps, similar to the question I had when we were talking about the potentiometric contours in the basal Chadron.

MR. BEINS: I believe that, again, this is one of those maps that we generated from the limited amount of data that was present. In the early days of the project, as we were beginning to do the licensing for the project, the data would be shown -- or the wells that are shown with elevation, attached to them are the wells that were sampled.

JUDGE WARDWELL: Is there a reason -- it is interesting that this is the same time frame, '82 to '83, if read that correctly, '82 to '83 that we had the other ones for the basal Chadron that showed, I think, a total of six wells all kind of in one line, almost, which, to me, kind of dictates the flow of direction because that is the line the wells were oriented in.

Here, I don't know for sure, but I see a lot of elevation numbers scattered around and, certainly, a contour map, which the other one wasn't a contour map. It was just a list of elevations.

Why wasn't a similar contour map drawn for that pre-mining condition? It seems to me that is really the important one.

MR. BEINS: I'm not sure why that was.

JUDGE WARDWELL: And so this shows that the regional water level in the Brule, pre-mining, was towards the northwest. Is that correct?

MR. BEINS: Correct. It was flowing up towards the northwest towards the White River.

JUDGE WARDWELL: And you don't have a table of these wells with the elevations on them, do you, that show the number of wells that were located? I was wondering about the 12 wells that are shown on Table 2.7-5 on page 2-184 of your license renewal application. I was wondering if those were the only wells used or the wells used at all in deriving these maps, of which this is only the first of them.

MR. BEINS: I would have to look into that further.

JUDGE WARDWELL: Why don't you look into that and get back to us at the next break?

Yes, and also to follow up on that, look to see if they were used for the subsequent years of the other maps that are shown after this one.

MR. BEINS: Yes, sir.

JUDGE WARDWELL: That is from pages 2-173 to 179 of your license application.

And staff, do you agree that the flow in the Brule is towards the northwest?

MR. BACK: Yes, absolutely.

JUDGE WARDWELL: And the same thing, Mr. Wireman, would you agree that that is -- you have no reason to dispute that?

MR. WIREMAN: Well, in my reading of the license application, and I noted this in my notes and I think in my testimony, there were four or five different directions of flow given and they range from northwest to north to northeast and east north. So, one of the points I have made is it is all confusing to me.

If the flow is changing, spatially or temporally, that needs to be explained. Why is that happening? This map shows pretty consistent northwest flow from the very southeast end all the way to the northwest. So, I was confused about the different descriptions of flow directions.

JUDGE WARDWELL: And you believe these different descriptions were given for the flow in the Brule formation or was it in the basal Chadron, or are you unsure?

MR. WIREMAN: It was in the Brule.

JUDGE WARDWELL: Okay, thank you. And do you have a reference for those other directions that you were referring to?

MR. WIREMAN: I believe I do.

JUDGE WARDWELL: You can get back to us, if you want to have some time. No problem.

MR. WIREMAN: I do have a page number.

JUDGE WARDWELL: Sure, no problem. We are just getting to the limit of things that I can remember that we have to get back to.

CHAIR GIBSON: Maybe we could shoot for getting that done. We will take one more break later this afternoon. Maybe you could have that -- make sure and have that to us when we come back from that break.

MR. WIREMAN: Absolutely.

JUDGE WARDWELL: Okay, and --

MR. WIREMAN: I have that now, if you would like it.

JUDGE WARDWELL: I'm sorry?

MR. WIREMAN: I do have that. I found it.

JUDGE WARDWELL: Okay, great. I putzed along long enough to give you the time to get it, huh?

MR. WIREMAN: I found it, yes.

JUDGE WARDWELL: Age is wonderful, isn't it?

MR. WIREMAN: Well, I'm there.

JUDGE WARDWELL: I'm with you.

MR. WIREMAN: This is my notes, north, northwest for the -- Brule is east-northeast on page 2153. The SER, page 22, says groundwater flow in the Brule is the northwest. And then there is a couple others that I would have to find but I don't see them in my notes.

JUDGE WARDWELL: Okay, well get us your full list at the break. No problem with that.

MR. WIREMAN: I will.

JUDGE HAJEK: Is this in your testimony?

MR. WIREMAN: It is mentioned in my testimony that there were three or four different flow directions given. I don't know that I put the reference --

JUDGE HAJEK: I'm sorry. What you are reading from, is that the testimony?

MR. WIREMAN: No. No, it's not. It is my notes. But I will find it.

JUDGE WARDWELL: In regards to that Brule formation, I think on your testimony, Exhibit 070 page 2, you state that the hydraulic properties in

groundwater flow in the Brule aquifer is not adequately characterized. There is no water table potentiometric map for this aquifer. The direction of flow is apparently not known with certainty as it is reported to flow in numerous directions in various reports and technical documents.

Do not the maps presented in Crow Butte's license application on pages 175 -- 2-173 through 2-179, and those are Figures 2.7-3A to E, of which this is the A version of it, provide those potentiometric contours that you are seeking?

MR. WIREMAN: They provide some of them. I would like to see some maps of much smaller areas that try and deal with these different flow directions that are described in the application because the concern I have is that there is some kind of a -- the water table, the upper Brule, is more of a water table than a confined aquifer, and that that water table surface is being changed for some reason. It is being modified, due to pumping, due to whatever.

So, by drawing these water table maps for smaller areas in more detail, that would help explain those differences a little better. That was the point of my comment.

JUDGE WARDWELL: And could you say again

your concern in regards to this water table? Are you concerned that the Brule or the basal Chadron is not confined or -- I couldn't hear that.

MR. WIREMAN: I'm not prepared to say that but I think it is important to explain why the direction of groundwater flow differs. That was my point. And I can't say why it changes. I don't know.

But it appears to differ, depending, locally, where you are and that could be due to a variety of things. It could be due to domestic well pumping. It could be due to the fact that it is near a stream and it is discharging. I mean there is a variety of things but it should be explained.

JUDGE WARDWELL: Thank you.

Crow Butte Exhibit 045, which I believe is your reply, I think, either that or your original testimony, page 31 answer 55, and I quote: The upper confining units do not contain recoverable quantities of water and, therefore, there is no water to monitor. If a well was installed in the upper confining layer, the only water it would likely register would be water used during installation and development.

My question to you is just because it is low hydraulic conductivity, why does that preclude the presence of water to monitor? Which is what I

interpreted your statement.

MR. BEINS: That particular formation does not produce enough water to really be measurable, using our methods.

JUDGE WARDWELL: But if there is, if it is saturated, I believe you stated it was -- well, you stated it was, would not eventually water equilibrate into a well?

MR. BEINS: To define it as being truly saturated, perhaps is an overstatement on my part. It is damp. Certainly over a long period of time you may be able to get enough water into the well to be able to see some sort of a response there but it would be a very difficult thing to measure and take a long time.

JUDGE WARDWELL: So, wouldn't it be better phrased that the recovery would be so slow that it would not be responsive to different aquifer tests, that would be a better way to say than just saying no water?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: Because that gets back to my concern with this dry statement. When you have got an aquifer below and an aquifer above, I have a little hard time understanding why the stuff in the middle

ain't wet -- ain't saturated. And if you can explain that to me, fine. But if not, then it says it is there and saturated and yes, it may be so tight that water can't flow and that makes sense.

MR. BEINS: Certainly, it is a very low permeability zone, yes.

JUDGE WARDWELL: And likewise, when you are trying to quantify the retention capabilities of this particular zone, especially in regards to its confining properties, wouldn't you want to take some extra steps to be able to define how much it is able to separate out the communication between the basal Chadron, Chamberlain pass and the materials above it?

MR. BEINS: Certainly. And that is what we have done with our aquifer pumping tests. We have had four tests on the site. All of the tests have demonstrated --

JUDGE WARDWELL: We will get to those. We have got probably a half of day on those -- no, we don't, but we have got some time on those tests. So, we will look at those tests.

Could you not also put in other devices besides a standpipe well to measure the water pressure at locations and not use something that requires a volume of water to enter it in order to measure these

types of things?

MR. BEINS: I believe that we did such a test during one of our aquifer testing periods, where we installed just a small diameter well and put a piezometer downhole and monitor that for a time period on the upper confinement that showed that there was zero drawdown during those pumping tests.

JUDGE WARDWELL: Again, we will get into that. But couldn't you also send an electronic device down there, you don't even need the standpipe, so that it is measuring the pressure directly? Could you not?

MR. BEINS: Yes.

JUDGE WARDWELL: And to the best of your knowledge, that has not been done.

MR. BEINS: No, sir.

JUDGE WARDWELL: And in regards to that, in addition to the pump tests, were there any other hydraulic tests performed in the field, like I think someone mentioned earlier a rising-head/falling-head test. I guess there are some things like packer tests and slug tests, and all kinds of different things people play around with in the field, if they are given enough budget, which I assume Crow Butte has infinite budgets for your operation.

Are there any others besides the pump

tests? And we will talk about the pump tests in detail. I am just curious as to whether there were any other types of tests that were performed on Brule specifically, not only the Brule but the upper confining unit, specifically.

MR. LEWIS: Your Honor, this is Lewis, Crow Butte.

Testing of low permeability materials is very difficult when the don't yield a sufficient amount of water. You could introduce a fluid into the formation through pressurized tests.

You asked me if there were other things that could be done. You could introduce a fluid under pressure and try to measure pressure fall, that type of thing. Those tests can be of very long duration. And typically, often the packer itself leaks more than the formation and the data is very difficult to obtain with those kinds of conditions. It is also a very expensive way to go about testing.

But if the formation, itself, is not yielding water sufficiently, it is very difficult, other than core samples, which we mentioned there was some core testing done, to really quantify the permeability, other than through aquifer testing and that type of regional analysis that might give you

some additional information on the vertical permeability of the formation.

JUDGE WARDWELL: So, I guess your answer is no, you haven't.

MR. LEWIS: No, we have not.

JUDGE WARDWELL: Thank you.

JUDGE HAJEK: Excuse me, Judge Wardwell.

Dr. LaGarry, do you agree with what Mr. Lewis just said, these tests are very difficult and very expensive?

DR. LAGARRY: I'm a stratigrapher, not a hydrogeologist, but I am sure one of my fine colleagues could answer that.

MR. WIREMAN: He is correct. It is more difficult to do hydraulic testing of low permeability materials. That is true but there are methods out there. There are standard methods that have been developed by EPA and USGS and others that can be used to do that. It takes longer but it is the same principle. You are still looking at the rate of which water either moves out into rock or comes out of rock over time. And that is related, the slope of that is related to the hydraulic conductivity.

JUDGE WARDWELL: So what types of tests would these be? Could you give some examples in how

would you be able to measure those changes in a very low hydraulic conductivity material?

MR. WIREMAN: I'm sorry, I didn't understand.

JUDGE WARDWELL: Sorry, I think I had my fist in my mouth. My mother always said don't speak with your fist in your mouth.

Could you give some examples of specific tests that could be run on low hydraulic conductivity materials that would require the equilibration of water because of the length of time it would take to yield any types of results?

MR. WIREMAN: Well, I would have to dig around to find specific methods but you can do slug testing. You can use air and inject air out into a formation and then there is similar behavior with air that gets rid a little bit of the long time for water to either come into the hole or leave the hole. Slug tests, which are kind of quick and dirty but they give you a little information if you can measure it.

So, the real problem is the length of time and that is the cost because you have got personnel out there having to wait and you are paying them by the hour but the methods are kind of the same.

JUDGE WARDWELL: But for instance, in your

slug test example, I can envision the change in the water level that might occur with that. But then wouldn't it take quite a long time for that to get to equilibrium, to the point that you may lose more from evaporation than you would from the movement into the formation, possibly?

MR. WIREMAN: I don't know about the evaporation but certainly it would take time. But you know you can now put transducers there and get every 30 seconds a water pressure reading with a transducer and convert that to water level. And you don't need -- you can get some information on the sort of early portion of those curves, the early time of either injecting or pumping and you can do some analysis of that early portion. It is not as good, as long -- you know we like conventional 72-hour pumping time to kind of become convention over time. But the real concern is the longer you do it the better. And so, it takes time.

So, there is no real shortcut but with transducers, which you don't need people out there to measure the water level, it can do it for you, and so you can sit in there and wait.

So, again, he is basically correct. It does take longer. It is a little more expensive. But

the data it gets is the same data and you can use that data to derive estimates of these hydraulic properties.

JUDGE WARDWELL: Okay, thank you.

DR. KREAMER: If I could just follow up. Dr. Dave Kreamer.

JUDGE WARDWELL: No. No, I think I have got enough information.

DR. KREAMER: Okay.

JUDGE WARDWELL: I don't think I need more. If you need more, fine.

CBR, is there any reason why you didn't do some of these other tests that Mr. Wireman was talking about?

MR. BEINS: We felt that the pump testing that we did was sufficient to demonstrate the confinement, as well as looking at the different water quality that is present and looking at the different water levels that are present between the Brule and the Chadron aquifer. Yes, those particular examples in with the 20 years of operational experience, as we have monitored the overlying aquifer and the underlying aquifer -- or the production aquifer, we feel that it demonstrates the confining properties are present there.

JUDGE WARDWELL: Staff, if I might turn to you. In your review of this license application, what comments did you have and how did you reach the conclusions that you did in the EA that this zone was adequately characterized when you reviewed this particular section of the application?

MR. BACK: Yes, in agreement with what was just said, the aquifer test within the unit would provide the best data. For example, slug tests would give you horizontal hydraulic conductivities, rather than vertical hydraulic conductivities. If you were to inject air, now you are dealing with air permeabilities, which you would have to have relative permeability curves to back out what the permeability to water is.

So, I mean, there really, in terms of a straightforward test, with putting, monitoring points above the pump zone, it is, in my experience, the best way to do this.

JUDGE WARDWELL: What about the suggestion that Mr. Wireman made in regards to setting individual instrument at a given point in the aquifer that measures the pressure right there, that measures it at points in time?

MR. BACK: Your Honor, that is what was

done in the basal Chadron is I believe they did use transducers. But what was most important out of all of this were the wells that were put above the basal Chadron because that is actually measuring the confinement. The aquifer properties coming out of the basal Chadron, out of the pump test, are far less important than what does the confining aspects of the units look like.

JUDGE WARDWELL: I think that is what we are talking about now. I'm not -- I didn't mean to imply that was a basal Chadron. I was interested in how did you resolve that the upper confining unit was adequately characterized to demonstrate that it is providing that retention capability, that confinement that you attribute to it, in regards to conclusions you have reached in your assessments.

MR. BACK: Your Honor, you we looked at how the tests were designed. They put the monitoring point immediately above the pumping well, which would be the most likely place for effects to be felt through the confining unit. We looked at the actual pressure curves. There were no signs of leakage during the actual aquifer test. Now, they did do some consolidation tests that it looked like there might be some leakage. So, that looked good. And then no

boundary conditions were hit, meaning recharged boundaries or no flow boundaries. So, that is how these tests are done and interpreted.

JUDGE WARDWELL: What was this consolidation test you were talking about?

MR. BACK: Well, in the license application, they mentioned a consolidation test for looking at permeability of the confining unit. And I mean we would need more information than a single test, as was alluded here. It is not a very good way to get that data.

And so in that test, though, as part of the test, they said well, it looks like there might be some leakage in this laboratory test that might indicate leakage but then it wasn't seen at a field scale. And the field scale is what is most important to us.

JUDGE WARDWELL: Thank you.

Mr. Kreamer, I will ask you. Do you have any suggestions for field tests that might be more appropriate that would assist Mr. Back?

DR. KREAMER: I'll lean forward so you can -- it almost went down my throat.

I have slight disagreements with what Mr. Back said. Slug tests don't only measure horizontal

permeability. If you vary the screen size to a small screen size, you can get more vertical. And so there are ways that you can adjust a slug test over time to get vertical permeability and horizontal permeability.

JUDGE WARDWELL: You don't mean that you would install a flexible screen size that could be varied, a variable screen size. You mean you would have to predesign to put a set small screen size --

DR. KREAMER: Yes, if you put smaller screen size. A large screen size will have more horizontal flow into it. A small, it will be more vertical. There will be more of a vertical component with that adjustment.

I think what was said about the pumping tests that were done is a valid statement, although I disagree with his conclusion on the pumping tests. In viewing the pumping tests --

JUDGE WARDWELL: Can I ask you to reserve that?

DR. KREAMER: I shall.

JUDGE WARDWELL: I almost did with him, too.

DR. KREAMER: I shall reserve it.

JUDGE WARDWELL: I want to now not spend any more time on the pumping test because we are going

to cover that in detail.

DR. KREAMER: I shall reserve that. But the only modification I would make is the tests we have been talking about can be modified by screen size and other factors to make them give us more data.

The disadvantage of a slug test is it is a small area. It is small in the region. It is not a regional thing. It just tests what is around that particular piezometer or well. And you have to do more of them to get a regional sense.

JUDGE WARDWELL: And I believe I heard Mr. Wireman say that, in fact I think I almost asked him and Dr. LaGarry, too, I think, but anyhow, I seem to hear that the pump tests are the way to go to get the larger area stressed enough to define larger areas of this behavior. Would you agree with that also, Mr. Kreamer?

DR. KREAMER: I would agree with that. They mention a compaction test where you get a disturbed sample and then you try and recompact it to the original properties and then you test that for permeability. But, obviously, that has some shortcomings because your recompaction has got to be along the lines of reality. And we have not seen the methodologies for that.

JUDGE WARDWELL: Thank you.

Now looking at the upper most aquifer, the alluvium, the Ogallala, the Arikaree, and the upper Brule. NRC's testimony exhibit 001, page 41 answer D-13 and also page 45, answers to F-4; Crow Butte in your license application, the Exhibit 011 at 2-99 staff and Crow Butte testified that the Ogallala group is not present on the CBR site and are only found several miles south.

Dr. LaGarry, do you agree with that or do you have any information to say that the Ogallala is in fact beneath or in that strata that is in the license application?

DR. LAGARRY: Within the license area, I don't know. I have never been able to get access to map. Although, the NRC statement that it is present to the south is correct.

JUDGE WARDWELL: Okay, thank you. And the NRC at page 55, F-4, Crow Butte license application 2-121 and 125 show that the Arikaree group is present only in the far southeastern corner of the site. And would you agree with that statement also or have any reason not to believe it in regards to the license area?

DR. LAGARRY: I don't have any reason to

not believe that.

JUDGE WARDWELL: Thank you.

NRC testimony page 41 D-13, you state that the Arikaree and Ogallala aquifers are not present in or near the license area and only found several miles south along the Pine Ridge Escarpment for the Arikaree and south of the Pine Ridge Escarpment for the Ogallala.

I guess my question to you is is the Arikaree along the southeast corner or is it several miles to the south?

MR. BACK: Your Honor, I believe that was an oversight. I believe it is in the southeast corner of the site.

JUDGE WARDWELL: So, it does touch the southeast corner.

MR. BACK: Yes, Your Honor.

JUDGE WARDWELL: Thank you. I needed that clarification.

JUDGE HAJEK: Let me follow-up on that a moment, please.

It touches the southeast corner of the site but it is not within a mining area. Is that what you are saying?

MR. LANCASTER: Your Honor, our

understanding is that it is --

JUDGE HAJEK: Identify yourself, please.

MR. LANCASTER: Tom Lancaster, NRC. Our understanding is it is within the license boundary.

JUDGE HAJEK: I can't hear you. I'm sorry.

JUDGE WARDWELL: I found these don't bite. Really, I have hit my lip a couple of times and they didn't bite back. I hit it.

MR. LANCASTER: Our understanding is it is within the license boundary. We have got some Arikaree -- I'm sorry. You can't hear me?

Okay, can you hear me now? Okay.

So, our understanding is in the southern portion of the licensed area, the southeastern portion, specifically, we have got Arikaree present. It is outcropping and forms part of a hill, part of the escarpment that is present there, the Pine Ridge escarpment. This, from what I have seen and during inspections out there, annual inspections of the facility, we have got some perimeter monitoring wells that go through a couple tens of feet of the Arikaree but the actual injection and production wells in my unit 11 down there do not -- are not in the area of this outcrop of Arikaree.

JUDGE HAJEK: So, I think what I need to repeat it in a slightly different way. The injection and production wells for mine unit 11, which is the southernmost mine unit --

MR. LANCASTER: Correct.

JUDGE HAJEK: -- are north of the Arikaree outcroppings that you have noticed in your actual inspections of the site.

MR. LANCASTER: Correct.

JUDGE HAJEK: Is that correct?

MR. LANCASTER: Correct.

JUDGE HAJEK: Thank you.

MR. LANCASTER: Your Honor, just so it is clear, the perimeter monitoring wells that aren't production injection wells do go through 10 or 20 feet of the Arikaree down in the southeast portion of mine unit 11, just so that is very clear.

JUDGE HAJEK: Okay, but the monitoring wells are never -- these are 300 feet away from an injection well. Correct?

MR. LANCASTER: Correct, in accordance with our license conditions here. Correct.

JUDGE HAJEK: Okay, thank you.

JUDGE WARDWELL: And the Arikaree overlies the Brule and upper Chadron. Is that correct?

MR. LANCASTER: That's correct.

JUDGE WARDWELL: But still, its presence there, if in fact the faults and fractures are found to be significant enough to cause some movement vertically upward, could it not get in the Arikaree and then flow northeast towards the Pine Ridge Reservation?

MR. LANCASTER: Well, you have got the Brule aquifer. That is the overlying aquifer.

JUDGE WARDWELL: Under the assumption, just the assumption that that is fracture enough to provide some transmissivity, could not this ultimately be a pathway towards the Pine Ridge Reservation or still it could not be, even if that Brule -- even if the upper Chadron and the Brule did not provide the confining that is indicated?

MR. LANCASTER: Well, I would think that if you had a communication, you would first see it in the Brule and you would see it in their excursion monitoring well data.

JUDGE WARDWELL: Do you have monitoring wells in the Brule and the upper Chadron?

MR. LANCASTER: That is correct. We have wells in the -- or they -- Crow Butte has excursion monitoring wells in the Brule and those. And those

excursion monitoring wells are required by license conditions as --

JUDGE WARDWELL: And so those monitoring wells where you encountered the Arikaree do have wells in the Brule and the upper -- let's just call it the upper confining unit, period, between the basal Chadron and the Arikaree.

MR. LANCASTER: Could you repeat that again?

JUDGE WARDWELL: You are smart to ask because I was confused to in what I asked.

MR. LANCASTER: Okay.

JUDGE WARDWELL: So, is it your testimony that the monitoring well that encountered and penetrated through the Arikaree, which I thought I heard you say, that you have --

MR. LANCASTER: Correct.

JUDGE WARDWELL: Did you set a well and do you have a monitoring well in the upper confining unit at that location where the Arikaree overlies it?

MR. LANCASTER: Well, I didn't.

JUDGE WARDWELL: Again, in your review --

MR. LANCASTER: Right, right.

JUDGE WARDWELL: -- did you ascertain whether or not Crow Butte had one there?

MR. LANCASTER: Well, the monitoring wells I was referring to, the perimeter monitoring wells, they are screened into the basal Chadron. The overlying aquifer within the Brule has monitoring wells and, as per our license condition, one every five acres. But they actually are much less than that in their spacing.

But regardless, they have got, if we were to see an excursion from the basal Chadron through this confining unit that has been talked about here, we would see it in the Brule monitoring -- we would expect to see it in the Brule excursion monitoring wells and that is what I am trying to say here, before we see it in the overlying Arikaree.

DR. STRIZ: Your Honor, may I add something?

JUDGE WARDWELL: Not just yet. If you want to answer this question, that's fine but I want to go with my train of thought.

DR. STRIZ: I can answer this question. There are no monitoring wells in the upper confining layer. They are in the Brule.

JUDGE WARDWELL: And is there a difference -- I gather there is a difference between the perimeter monitoring wells and excursion monitoring

wells.

DR. STRIZ: No, they are all excursion monitoring wells. There is two types. There is the perimeter ring excursion monitoring wells, which are located in the basal Chadron to detect excursions from the production zone. Then there are excursion monitoring wells in the overlying aquifer, which we identify as the Brule and in the south, the Arikaree. And they are all considered excursion monitoring wells.

JUDGE WARDWELL: And you said there is one in the Arikaree in that corner or what did you say about the Arikaree?

DR. STRIZ: According to Tom's -- Mr. Lancaster's testimony, yes, through ten to a couple tens of feet in the south, it passes through. But I am not sure that it is in the saturated portion of the Arikaree.

JUDGE WARDWELL: So, it's not saturated but it is --

DR. STRIZ: I am not sure that the Arikaree is saturated there so it may not be sampling the Arikaree but it is sampling the saturated portion of the Brule in the southern location of the licensed area.

JUDGE WARDWELL: Where the Arikaree is located.

MR. LANCASTER: Yes, actually, these are perimeter monitoring wells that go through the Arikaree and they go down to the basal Chadron. They are screened into the basal Chadron and that is what goes through the Arikaree.

JUDGE WARDWELL: I understood you to say that there was also one in the Brule where the Arikaree overlies it. Do you know for sure?

DR. STRIZ: I apparently misspoke.

JUDGE WARDWELL: Okay, thank you.

DR. STRIZ: So, what he is stating --

JUDGE WARDWELL: So you will go with what the --

DR. STRIZ: Yes, that they go through the Arikaree perimeter walls.

MR. LANCASTER: I'm sorry.

JUDGE WARDWELL: No, I was just trying to get your name. It is all squished in there. I don't know names. Lancaster, there you go.

MR. LANCASTER: Sorry.

JUDGE WARDWELL: No problem. There you go. You are an entity.

MR. LANCASTER: We've got so many people

up here.

JUDGE WARDWELL: A real live person now, at least us.

MR. LANCASTER: Yes. Yes, so this is a -- what I was trying to say is that the Brule in the area of mine unit 11 has excursion monitoring wells, one at least every five acres. Now, they are less facing than that. But as far as the Arikaree down there that is outcropping on a hill right at the edge of the southeast licensed area, there is, from my understanding, the outer-most perimeter monitoring well ring, some of those wells, one or two, I can't remember off the top, but from what I recall, they go through 10 to 20 feet of Arikaree, probably -- possibly.

JUDGE WARDWELL: Thank you.

JUDGE HAJEK: I'm sorry. I would like to close this out. A monitoring well is sunk down into the Brule. And does it have withdrawal points along the depth that where you can sample?

Dr. Striz, I think also said there was not a well or not a monitoring well into the confinement area. And so I am confused by, since I am not familiar with these wells, can you describe how they are designed and how the extraction points for

monitoring purposes are handled for us?

MR. LANCASTER: These excursion wells, as Dr. Striz was detailing a little bit, we have got excursion monitoring wells in the Brule aquifer and the basal Chadron aquifer, not in the confining units. That is the overlying aquifer for vertical excursions and, within the Brule, the wells go down and they are screened within the water-bearing zone of the overlying aquifer within it. And so then you have got the basal Chadron, the perimeter monitoring wells that are 300 feet away, like you were saying, that are screened within the basal Chadron and those are the two excursion wells that you have in these mine units, two types. Per their application, they do have to be constructed a certain way or they have committed to constructing these wells in a certain way.

And so but the real point here is I was trying to provide information about the Arikaree and there are staff acknowledges the presence of some perimeter monitoring wells that go down to the tap, the basal Chadron water-bearing unit and we believe they go through a couple tens of feet of the Arikaree that sort of crosses the license boundary down there at mine unit 11.

JUDGE HAJEK: Okay, I apologize for having

difficulty in understanding.

MR. LANCASTER: That's okay.

JUDGE HAJEK: So, when you were monitoring for an excursion in one of these monitoring wells, you are sampling water that is specifically in the ore-bearing zone or near the ore-bearing zone. You are outside the ore-bearing zone, I understand that.

But at the depth of the ore-bearing aquifer, are you taking samples or is there a design in this monitoring well that enables you to take samples at more shallow depths?

MR. LANCASTER: No, each well will sample from a specific aquifer, a specific water-bearing zone.

JUDGE HAJEK: And then when you say it goes through the Arikaree or a few tens of feet or so into the Arikaree, what you really mean is from the surface drilling all the way down in this well hole, it happens to go through, physically all the way through the Arikaree and it is isolated from the Arikaree. Is that it?

MR. LANCASTER: That is correct. It is isolated -- it is cased.

JUDGE HAJEK: It's cased. Okay.

MR. LANCASTER: And these cases are tested

with mechanical integrity testing in accordance with our license.

JUDGE HAJEK: But you know it is physically actually going through the Arikaree for some other reason?

MR. LANCASTER: For some other reason -- I'm not sure I understand your question there.

JUDGE HAJEK: Well, you said it goes through the Arikaree.

MR. LANCASTER: Yes, I was just mentioning. I think it was brought up that do we have production and injection wells in that area and we just have -- all we see in these injections is not that. We have maybe one or two monitoring wells associated with perimeter monitoring well ring.

JUDGE HAJEK: That only go down into the Arikaree only. Is that what you are saying?

MR. LANCASTER: They go through the Arikaree.

JUDGE HAJEK: They go through.

MR. LANCASTER: And they monitor the basal Chadron. That is the perimeter monitoring well network, 300 feet away from the production injection wells and 400-foot spacing, you know something along those lines. Right?

JUDGE HAJEK: Okay. And when you said there is outcropping, the Arikaree outcropping, does that mean that if I would go down to the site I would see water in a stream coming from the Arikaree?

MR. LANCASTER: I mean that Arikaree can be seen at -- not seen but it goes to the ground surface. And I don't know if specifically you could say there is a rock outcrop or a sediment outcrop but it comes to the -- it is from -- it is at the ground surface in that area.

MR. BEINS: Your Honor, could I offer some clarifying information, perhaps?

JUDGE HAJEK: Sure. Is that okay with you?

JUDGE WARDWELL: It's yours.

JUDGE HAJEK: Yes.

MR. BEINS: Yes, what Mr. Lancaster has said is correct. The southeast corner of the permit area does have outcroppings of the Arikaree formation. Okay? The Arikaree formation makes up the cliffs and the buttes that you see as you are driving back toward Chadron tonight. Those particular buttes are a part of the Arikaree formation. In this particular area, the Brule aquifer is more than 200 feet below the base of the Arikaree formation here.

The Arikaree, at the mine site does not have water coming out of the sides of the cliffs or things like that in measurable amounts, necessarily. The wells that Mr. Lancaster talked about are the monitoring wells. They are cased through a small portion of the Arikaree formation but they are wells for the deeper Chadron aquifer, not for the Arikaree aquifer.

JUDGE HAJEK: So, they go through the formation.

MR. BEINS: The casing goes through the formation but we are not sampling it.

JUDGE HAJEK: It goes through the formation but it doesn't necessarily go through a body of water.

MR. BEINS: The Arikaree formation there is dry. There is no water --

JUDGE HAJEK: There is no water in it there, okay.

MR. BEINS: -- to be had.

JUDGE HAJEK: Thank you.

MR. BEINS: Yes, it is at the surface.

JUDGE WARDWELL: Let's move on to the White River structure. And starting off with Mr. Wireman, in your testimony, exhibit INT-070 page 1,

you state that in regards to the White River feature, the work needs to generate empirical data based on drilling or geophysical techniques.

Crow Butte, in their license renewal application on page 2-135, state that the White River feature is oriented northeast to southwest, generally along the White River drainage and based on recent closed-space drilling, the feature could be interpreted as a fold because a Chadron confining layer is continuous and not offset across it. Specifically, review of -- quote, review of more than 130 geophysical logs, three-dimensional geologic modeling indicates that the fault associated with a structural feature does not truncate or offset members of the White River group along a discrete fault surface. Rather, members of the White River group are broadly folded and are continuous across the structural feature.

The NRC, in its EA Exhibit 010, sections 3.4.2, page 27 and 3.5.2.3.3, pages 38 to 39 state that the staff evaluated the description of the White River structural feature and agree with CBR's conclusion that the White River structural feature does not include an offset of the geologic contact between the Pierre Shale and the basal Chadron

Chamberlain Pass formation, nor members of the Chadron and Brule formations -- nor members of the Chadron or the Brule formations. As a result, the feature does not affect hydraulic confinement of the basal Chadron sandstone aquifer.

Finally, NRC EA at Exhibit 101 at 27 and 38 through 39, and on pages 37 through 38 answers to D-9 and D-10 and page 44 answers to D-17, staff reached this conclusion of a fold based on the following seven items. So, I am going to repeat those to you and then just get your reaction to whether or not you agree or disagree with whether or not this White River structural feature is more likely a fold or a fault. And I will allow you or Dr. LaGarry or whoever wants to you on your team respond to this line of questioning.

MR. WIREMAN: Thank you.

JUDGE WARDWELL: This position of staff, they have seven items I want to read to you.

MR. WIREMAN: First of all, I stand corrected on the drill holes. That was a misstatement on my part.

JUDGE WARDWELL: On what?

MR. WIREMAN: I said I stand corrected on the statement I made about no drill holes. There are

drill holes.

JUDGE WARDWELL: Okay.

MR. WIREMAN: I was just wrong and I hadn't discovered that yet.

Secondly, and I will let Dr. LaGarry address this as well. I have uncertainty as to whether or not this is a fold or a fault and that is mainly based on sort of not a real complete description of what they found with the drilling. I didn't see a real complete description using the data from the drill holes to convince me that that was clear.

Now, there may be data and information from those drill holes that I am not aware of. So, I will say that.

And then the final thing is a fold can be permeable. I mean folds, just because it is a fold, doesn't necessarily mean that there is no water movement through it.

So, with that, I will let Dr. LaGarry address the fold.

DR. LAGARRY: Okay, two things. The first thing is that as I presented in my most recent testimony that there is a widespread area of what are called lineaments, representing faults and joints

visible from outer space and low-flying aircraft. And these are generally oriented in a northwest, southeast, and southwest-northeast overlapping pattern.

The White River follows on the stretch that heads north towards the Pine Ridge Reservation follows the southwest-northeast trend of this fracture pattern.

Additionally, if you look at the river drainages of this region from space, all of the rivers, almost all the rivers, there may be exceptions, almost all of the rivers and streams and creeks follow this lineament fault pattern.

So, if you look at the White River from space, it has its headwaters and the upper-most stretch of the White River follows the northwest-southeast lineament trend; and then southwest of Crawford, it does an almost right-angle turn and then joins the second southwest-northeast lineament trend.

Would a monoclinal fault like the NRC and Crow Butte maintains we would not see that. The White River would not preferentially follow a fold. However, it will prevent, preferentially follow and preferentially erode a preexisting crack in the rock.

JUDGE WARDWELL: What is the difference between a lineament, a fault, a fracture, and a joint?

DR. LAGARRY: Okay, a lineament is any unexplained straight-line feature. If you were to look at aerial photography or satellite data and just assume that everything on there was something in nature, you might mistakenly include fence lines and roads. But given modern satellite imaging tools like Google Earth or things like that, you can zoom right into ground level and check those out.

A fault is a crack in the rock of --

JUDGE WARDWELL: So, can I interrupt to ask questions on that?

DR. LAGARRY: Please.

JUDGE WARDWELL: So, a lineament is an apparent linear feature, a straight feature --

DR. LAGARRY: Correct.

JUDGE WARDWELL: -- observable on the earth's surface visually.

DR. LAGARRY: Correct.

JUDGE WARDWELL: Okay.

DR. LAGARRY: Correct. And then a fault is one of these straight-line features in which the rock has either moved vertically or horizontally. A joint is a crack in the rock in which no movement has

taken place, however, there is a crack there.

And what is typically done is that it is prohibitively time-consuming and expensive to crawl around in the landscape to find these things, although it was done in Western Nebraska. It is much easier to see them first from space and then go examine them once you have found them. And a graduate student at Chadron State College did a statistical study of joints and faults viewed from space shuttle radar.

JUDGE WARDWELL: And who was this individual?

DR. LAGARRY: Jennifer Balmat in a master's thesis from Chadron State College. It is cited in my last opinion, in which she field examined -- she saw these in the satellite imagery and then for her thesis, went out and field checked them.

And after eliminating roads and fence lines, she found that the remaining lineaments observable from space are, in fact, false.

JUDGE WARDWELL: And where was this? Was this in the license area?

DR. LAGARRY: This was east of the license area. However, other studies, notably Diffendal study from the 1990s encompassed the license area.

JUDGE WARDWELL: And how far away was it?

Was it Balmat did you say?

DR. LAGARRY: Balmat's thesis is from the Chadron vicinity. Her thesis was from the Chadron area, 20 miles east.

JUDGE WARDWELL: So 20 miles east here. All right.

DR. LAGARRY: However, Diffendal's 1994, I think, I would have to double-check, publication covered the entire area of northwest Nebraska. The area he studied had the license area in about the exact center of his study area.

And Balmat's thesis, the point of it was to reexamine Diffendal's data and confirm how much of that was fault and joints.

JUDGE WARDWELL: Are all lineaments -- and is a fracture the same thing as a joint?

DR. LAGARRY: Yes.

JUDGE WARDWELL: Okay. And are all lineaments indicative of fractures or faults?

DR. LAGARRY: Some are a feature called inverse topography, which Diffendal was able to clarify and point out in his publication. Discounting roads and fence lines, it seems that based on the data that we have available, yes, in fact, the vast majority of the lineaments are false.

JUDGE WARDWELL: And with that, would you agree that a claim that a lineament or a topographic feature in a satellite imagery represents a subsurface geological fault, fracture, or joint is speculative until ground truthing is performed with some hard field data?

DR. LAGARRY: I wouldn't use speculative. It is more solid than that. I mean once you have determined that within a given set of fractures, for example, the northwest-southeast trending, southwest-northeast trending overlapping set of fractures, that takes it less from speculative and moves it into a more certain than speculative.

You wouldn't necessarily want to assume and if it really, really mattered, you would definitely want to go check it.

JUDGE WARDWELL: Do you agree that some type of subsurface exploration would be almost needed to determine whether a fault or fracture is related to a lineament, especially in regards to its potential impact on any confinement?

DR. LAGARRY: I would look first for surface expression of the fault or something like lineament, where you can observe it at the surface. But if such a thing wasn't present, the oil industry

uses seismic techniques to do that.

JUDGE WARDWELL: And it is true that none of these lineament studies or even necessarily the field work of your graduate student 20 miles away from here would give you any indication of the hydraulic transmissivity of any given fault or fracture or whatever the third one is?

DR. LAGARRY: That would require access to the license area to do that.

JUDGE WARDWELL: Or any other area, for that matter.

DR. LAGARRY: Or any other area.

JUDGE WARDWELL: You would have to do some type of testing to define its transmissivity characteristics.

DR. LAGARRY: You would have to map them ---

JUDGE WARDWELL: The mere presence of a fault or a joint isn't by definition preferential pathway, necessarily.

DR. LAGARRY: It is a preferential pathway but how much -- if there was water present and how fast it moved, that would only confirmable by direct observation.

JUDGE WARDWELL: Yes, well wouldn't faults

also tend to have some materials, oftentimes, in that interface between the two zones where the movement occurred that tend to plug those types of things?

DR. LAGARRY: It depends on the grain size of the fault. In the Chadron formation, what we have been calling the upper confining unit, there are, in fact, slickensides along the faults. You can observe those at the land surface. They haven't healed. You can see the slickensides.

However, in the overlying Brule in Arikaree, there isn't enough clay to make slickensides.

JUDGE WARDWELL: In our particular endeavors here, isn't it the ultimate transmissivity of the fractures that is really of importance here and not just the mere presence of them?

DR. LAGARRY: It is. And these fractures are the basis of the secondary porosity and make the Brule an aquifer. So, if the Brule is acknowledged as an aquifer, so are the presence of the secondary porosity and the faults and joints.

JUDGE WARDWELL: Do you know if Diffendal did any ground truthing of his work or was it all from the photo -- ground topography?

DR. LAGARRY: He did the ground truthing

of the inverse topography because that was his area of expertise.

JUDGE WARDWELL: I'm sorry. Say that again.

DR. LAGARRY: He ground truthed inverse topography. Inverse topography is where you have a less-easily erodible unit forming a ridge surrounded by more easily erodible units. So, it is like a series of isolated Buttes that make a line. He field checked those but he did not field check the lineaments.

JUDGE WARDWELL: Okay.

DR. LAGARRY: Balmat field checked lineaments and Harmon Maher field checked lineaments.

JUDGE WARDWELL: Who was that last name?

DR. LAGARRY: Maher, M-A-H-E-R. I cite him as well in my opinion.

JUDGE WARDWELL: Do you know if your reference, I think you have referenced Figure 1 of Diffendal in 1994 in one of probably in your lineament study of 2015.

DR. LAGARRY: That is correct.

JUDGE WARDWELL: And do you know if that is in fact, your INT Exhibit 055?

DR. LAGARRY: I would have to look and see

about the number. It is one of the ones that I provided.

JUDGE WARDWELL: Could you do that beforehand, just to verify that that is what you referring to with that exhibit, so we know we have got that.

DR. LAGARRY: Super.

JUDGE WARDWELL: And the same thing with Balmat of 2001, page 53. Is that INT-056? So, 55 and 56, if those are Diffendal and the Balmat ones that you are referring to, that is what we would like to know after the break.

DR. LAGARRY: Okay.

JUDGE WARDWELL: Great, thanks.

Back to this discussion of a fold versus a fault. I would like to read off what NRC used to reach a conclusion and get your reaction to that, if I might, Dr. LaGarry, or you could pass it on to anyone else, if you want to.

And so back to the discussion, it was referencing the EA of the NRC, which, again, is the document of concern here for most of the contentions. Their conclusions in regards to whether the assessment of the environment has been adequate is what we need to decide.

And in that EA on page 27 and 38 through 39, these items were listed, as were their testimony on pages 37 to 38, answer D-9 and D-10, and on page 44, answer D-17. And there they say that their conclusions in regards to a fold versus a fault relies on one, first CBR's 3-D geological modeling, which we will talk about separately and we will get into a discussion of that. The second point was that the vertical gradient and potentiometric groundwater surfaces of the basal Chadron sandstone and the Brule aquifer over the area of the structural feature, gives them encouragement that it is a fold.

And third, an aquifer pumping test in the area of the White River structural feature that demonstrates the integrity of the overlying confining unit, and there they are citing their exhibit New York State 028 G-9 to G-11.

They then talk about distinct geochemical variations among the aquifers citing the Exhibit 028 again at G-9. And then the staff's groundwater modeling in their EA, indicative of a presence of a fault that penetrates the Pierre Shale through the Chadron or Brule formations is not probable. And if one exists, it does not convey water from the basal Chadron standstone aquifer to the Brule aquifer.

And six, lack of hydrologic evidence that the White River structural feature, whether interpreted as a fault or a fold, influences the groundwater flow in the basal Chadron aquifer.

And then lastly, that it is based on 130 geophysical logs lacking any discontinuity.

Now, that is a lot of information and if you haven't read their testimony or studied it much and you can't really comment on it, that is fine. I just wondered if you would like to comment on any of those particular topic areas.

DR. LAGARRY: All but the first one are outside my expertise. So, I will defer to my colleagues.

But I have mapped 81 to 24,000 quadrangles when I was with the Nebraska Geological Survey, including the ones that surround our Crawford and Crow Butte resources and we found faults and fractures and joints too numerous to map. So, ultimately, we decided in our mapping that we would map those that had five-foot displacement or greater.

The takeaway message from that is that these rocks here are soft and extremely brittle, extremely brittle. And so this idea that these rocks are somehow smooth and folded and plastic and ductile

enough to drape over a fold, when we have drilling data 12,500 boreholes in the Nebraska Geological Survey cited in Swinehart and others that showed numerous faults going through the base of the Pine Ridge, going from top to bottom and deep into the Pierre Shale.

So, the expectation of geologists working in this area that 1930s models of which they used clay to model the behavior of the rocks, that the rocks would bend plastically is considered outdated. That the expectation now is that, and this isn't just me, this is everyone that works in plains geology, that the rocks break, they are brittle, the fractures go into the surface into deeper rocks down below and manifest on the surface as lineaments.

So, if in fact this is a fault or is a fold, excuse me, if this White River structure is, in fact, a fold, then it would be the only fold which we would have observed in the region. That is not to say that it isn't a fold. I don't have access to study Crow Butte's proprietary subsurface data.

And with that, I will pass it on to my hydrogeologist colleagues for the remainder.

MR. WIREMAN: I will address a couple of your points. The difference in chemistry, for

instance, in the water from the Brule aquifer and the basal Chadron. Both of those, I agree that they are distinct hydrostratigraphic units and that the upper confining unit separates them and functions as an aquitard. An aquitard does not mean that no water moves up and down that. It just means less water moves than if it was a more permeable unit.

I mean differences in chemistry does not automatically mean there is no connection. It doesn't mean that at all. Mixtures are -- almost all groundwater -- the chemistry of almost all groundwater represents a mixture of more than one source.

So, what you see in the Brule aquifer, that chemistry, while distinct from the chemistry of the basal Chadron could still be affected by flow up from the Chadron that creates the chemistry of the Brule and they don't necessarily have to be the same.

Secondly, Dr. LaGarry's point about the faults is very well taken. The White River making that turn, rivers, we know this all over the west, follow major faults. There are many rivers in the west that are like that.

Faults, in my experience, there has been a paradigm in the geological world that is beginning to change that faults are barriers to groundwater

flow. You kind of grow up learning that and hearing that. But experience is telling us differently and it is related in one way -- there are a lot of factors but one is the age. If you plotted the age of a fault versus how open it is or isn't, you would find that most of the younger faults are more open and more transmissive than most of the older faults and that makes some sense. There has been more time for it to fill in. So, age of the fault is important.

And then finally, I will say this about folds. If this is a fold, and I don't know if it is or isn't, but folds don't mean no pathways. You know, I know areas in Wyoming where anticlines, which are folds, are highly transmissive and are areas of very focused recharge, down to depths to 11,000 and 12,000 feet from the surface into an aquifer.

So, the deduction approach to making some of these conclusions, I think needs to benefit from some newer concepts and newer paradigms that are developing over time, as we learn more about this.

So, I will say that, I guess.

DR. KREAMER: Dr. David Kreamer. I have something that is really short and it relates to the folds.

There are numerous photos from around the

world that show folds with intermediate layers and some are consolidated, some are semi-consolidated but you can actually see faulting in the fold. In other words, if there are brittle places and brittle layers in a fold, as you bend it with geologic forces, you are going to get a fold but you are also going to get a series of shorter faults within the fold. And so a fold is not exclusive of having faults in it. That is what I wanted to say.

JUDGE WARDWELL: Thank you.

DR. LAGARRY: Counsel handed me a little note here that says INT-055 is, in fact Diffendal and INT-056 is in fact Balmat.

JUDGE WARDWELL: Thank you, Dr. LaGarry.

One more question before we take a break because then we will finish up this section.

INT Exhibit 011 is a 2007 letter from NDEQ that that is the Nebraska Department of Environmental Quality, I assume is what the initials stand for, to Crow Butte providing technical comments on Crow Butte's aquifer exemption petition for the NTEA, the North Transit Expansion Area, aquifer exemption request. It raises questions regarding CBR's interpretation of the White River structural feature.

And I guess my question to whoever would

like to field it, and I will start off with Dr. LaGarry again, on April 7, 2011, did not DEQ approve the aquifer exemption petition for the North Transit Expansion Area, do you know?

MR. WIREMAN: They did.

JUDGE WARDWELL: Okay. So, I will stay with Mr. Wireman, then.

With respect to the potential for the White River structural feature to act as a conduit between the aquifers, did not the DEQ conclude, as did the NRC staff, that the basal Chadron formation at the NTEA was hydraulically isolated from the other aquifers, based on several lines of evidence, including, again, CBR's three-dimensional geologic modeling, drilling data from the NTEA site, and listed assistance from independent experts and the flowing artesian conditions observed in the North Transit Expansion Area and the results of the 2006 pumping test performed there.

Why are not those -- do you agree that that is what NEQ used to reach their conclusion that they agreed with CBR's interpretation of this feature?

DR. KREAMER: Dr. Dave Kreamer. Yes, that is what they used but they did ignore certain other information.

The aquifer tests that were run, there were five previous to a sixth test. The sixth test, pumping test, is the one they based their study on, it's in the Northern Trend --

JUDGE WARDWELL: Okay, so it is important that you said that sixth test here, yes, that is good for why it is a challenge to what the NDEQ has. Let's reserve all of that because I want to go through all of those tests one by one --

MR. WIREMAN: Absolutely, fine.

JUDGE WARDWELL: -- and have plenty of time to do it then with the other ones. So, it is important that you did mention that test but we don't have to go into the details of it.

MR. WIREMAN: May I address? Am I -- you mentioned the aquifer exemption request and the approval of that request. And within that document is what you are talking about in terms of -- okay.

Let me just say this and it will be very short. I am very familiar with the aquifer exemption process under the UIC program and how it works. The criteria for evaluating a request for an exemption really had not very much to do with hydrogeology. I mean those requests in the law, in the Safe Drinking Water Act, there are two or three criteria that are

listed that must be met in order to get an approved exemption. And those criteria are is it being used for drinking water; will it ever be used for drinking water down the road; and then the third criteria is hydrogeology. Is there a confining unit above and below? And those three criteria have to be met but the focus of all of those is on the use of the water.

So, in the evaluation of a request for an exemption there normally is not a lot of very hard core hydrogeology that goes into that. So, it is all the same.

JUDGE WARDWELL: Thank you. Staff, a couple issues. Let's start with the last one and we will work our way backwards and then we will take a break.

What about the NDEQ criteria focusing mostly on drinking water aspects and not so much about these hydrogeologic concerns in regards to whether it is a fold or a fault?

MR. BACK: Well, Your Honor, I went through in DQ's decision and it looked like they took it very seriously. They had public hearings on it. They declined it initially. They pulled together a group of experts to look to see whether it was a fault or a fold. It just seems to me like it was more than

just a cursory review of three criteria.

JUDGE WARDWELL: And in regards to the fold possibly being a pathway, does not some of their arguments make sense that the brittle material will still crack, even though you are folding it? There still could be quite a bit of fall through that.

MR. BACK: I'm sorry to interrupt. Your Honor, when we also look at this, we look at a feature that is two miles away in a basal Chadron. That is based on independent travel time calculations. That is a 500-year travel time to get there. So, you know, it is kind of outside the realm of what we would see as a foreseeable expectation for things to move up gradient, since we have an inward gradient to reach that fold to begin with. And so that was something that --

JUDGE WARDWELL: So, you don't dispute that the fold still could be a transmissive zone, similar to a fault?

MR. BACK: I don't -- the evidence doesn't suggest that but I can't say for sure that it is not. And the independent geologist said that a fold is plausible, which is kind of looser than yes, it is definitely a fold. So, there is uncertainty with it.

JUDGE WARDWELL: And the last one that I

-- no, second. Sorry I got you two excited, the second to the last one, the fact that different chemical signatures could exist, even though there is migration, why isn't that feasible? In fact, a change in the whole conditions that existed in a given porous media would be enough different to create different species associated with the same impact that is causing the problem?

MR. BACK: Your Honor, there is some truth to that. I mean an aquitard, it does allow a certain amount of flow. Now, whether it is enough to create a problem with the leakage through it, that is really the question. I don't think there is a dispute that --

JUDGE WARDWELL: My question is -- sorry, I didn't make myself clear. I am more concerned on your reaction to their position that just because there is a chemical difference in the species between two different zones, that that is any proof that there is not communication just because the chemical signatures are different.

MR. BACK: Your Honor, you would have a mixed water there. And it you wouldn't have clear distinctions between the two. It would show a clear mixing. And actually Spalding is one of the

Intervenors' exhibits talks about the different stratification and mixing between the aquifers, where it occurs. So, you would --

JUDGE WARDWELL: And so I lied again because, in fact, that was the last question because the other one was back to the brittleness associated with the fold and I think we have covered that.

CHAIR GIBSON: All right, we will stand in recess.

(Whereupon, the above-entitled matter went off the record at 4:32 p.m. and resumed at 4:46 p.m.)

CHAIR GIBSON: Okay, Judge Wardwell.

JUDGE WARDWELL: The Intervenors' petition Exhibit 043 page 4, this starts talking about the water resources -- oh, sorry -- that is a very polite way to tell me to straighten up and fly right. I'll do my best.

MR. SMITH: Judge Wardwell? This is Tyson Smith for Crow Butte here, behind the screen.

Before we move on from the discussion of the White River fold and feature, which it sounds like you are leaving, there was one line of evidence that wasn't discussed about tightly constrained age of the fault. And I was wondering if we would have an opportunity to remark on that briefly. I think it

might provide some helpful clarification.

JUDGE WARDWELL: I think it will come up again when we talk about the overall conclusions of that. And I did not see that in the areas that I was looking at specifically relating to the fault.

So, the answer is I am not interested in hearing about it from here but I think you will see that that will come up when we talk about overall conclusions of your position.

MR. SMITH: Thank you.

MR. WIREMAN: Your Honor, I have some information that was promised to bring back to you.

JUDGE WARDWELL: Yes, good.

MR. WIREMAN: Would you like that now?

JUDGE WARDWELL: Yes. Yes.

MR. WIREMAN: Okay. We were talking about the different directions of groundwater flow in the Brule aquifer.

JUDGE WARDWELL: Right.

MR. WIREMAN: And I have four different things here.

JUDGE WARDWELL: Okay, yes, that is right. That is correct.

MR. WIREMAN: In the license renewal application, page 2-140, direction of flow in the

Brule is indicated as north-northwest. In the license renewal application, the direction is indicated as east-northeast.

In the SER, page 22, it is indicated as northwest. And in Souders, 2004, it says water table configuration trends north-northeast.

So, I just wanted to point out those are four different directions.

JUDGE WARDWELL: And what was that last one?

MR. WIREMAN: Souders, S-O-U-D-E-RS.

DR. LAGARRY: Pronounced Souders.

MR. WIREMAN: Souders, I'm sorry, 2004.

JUDGE WARDWELL: And whose exhibit was that or was it? Where did you get that from?

MR. WIREMAN: Just from my reading and my notes, so I don't know if it is an exhibit or not.

JUDGE WARDWELL: Okay.

CHAIR GIBSON: Regardless of whether we accept it, I would like for you to get us a copy of that, if you could.

MR. WIREMAN: I will do my best.

CHAIR GIBSON: Souder?

MR. WIREMAN: Souders.

CHAIR GIBSON: Along with the -- what is

the name of -- Terry. Right. We are going to get Terry, could you also just get Souder as well and get that to us? Okay, thank you.

JUDGE WARDWELL: NRC, would you like to comment on those various directions, if y9ou have anything in regards to that?

DR. STRIZ: Yes, I would. Piezometric surface, piezometric head surfaces, as you correctly pointed out, noticing that the basal Chadron was based on so few points, are dependent on the number of points used to create the surfaces that are used to determine the groundwater flow of direction.

The Brule aquifer is highly used around the license area. There are many private wells around the license area that draw from the Brule and they can very much so impact the direction of the groundwater flow.

So, it is possible that based on how many points were used for each of these surfaces, you would get differences and you would get different interpretations of the direction of groundwater flow.

We, at the NRC, determined, based on what the licensee provided to us that the direction was to the northwest. And we had a lot of points in the last application, as we indicated, that actually indicated

that there were changes in some of the gradients because of having more points to define the surface.

JUDGE WARDWELL: Thank you. Moving on, the Intervenors' Exhibit 043 page 4, you state that the water resources map, that is the Wyoming Fuels Company 1982 shows the distribution of the potential ore area in the Crow Butte project. It is Figure 2.

The wells marked on a map may be useful in other contexts. However, what really caught my attention, and I believe this is you talking, Dr. LaGarry, was that the area marked as the potential ore body is generally northwest to southeast trending lineament, similar to the trend noted by Diffendal in 1994, which we now know is INT-055.

And my first question is that is the '82 water resources map that you referred to with this statement on page 4 of 043 the Figure 2 of page 5 of your INT Exhibit 043? I believe it is there. It is on the --

DR. LAGARRY: That is the figure I provided, yes.

JUDGE WARDWELL: Okay. And is there a title on that?

DR. LAGARRY: It's at the bottom.

JUDGE WARDWELL: Okay, yes. And who

entitled this figure, did the Wyoming Fuels or did you?

DR. LAGARRY: Title which? You mean in the very bottom right-hand corner of the map is the Wyoming Fuels data, where they talk about what it is. And then the caption that says Figure 2, that is me.

JUDGE WARDWELL: This is you where it says Figure 2.

DR. LAGARRY: Yes.

JUDGE WARDWELL: You have given it this name?

DR. LAGARRY: Yes.

JUDGE WARDWELL: Okay. What is the origin of the two red lines we see on this figure?

DR. LAGARRY: The origin of those two red lines are faults that inferred because of the kink in the linear trend portrayed on the map. It is a series of lines and the inner-most line looks like a sausage, except it is like if you took a hotdog and pushed the two ends together and it kinked in the middle. Right?

And so assuming that that is an accurate representation of what is going on in the subsurface, I would interpret that as fault offset, that there was in fact horizontal movement along two faults that offset that sausage-shaped trend.

JUDGE WARDWELL: It must be the time of day but you kind of lost of me on that explanation when you got to the sausage.

DR. LAGARRY: Okay.

JUDGE WARDWELL: So, you can stay with your sausage thing but I somehow glazed over when you said that and then I lost it.

DR. LAGARRY: My metaphors are all food metaphors.

JUDGE WARDWELL: I was trying to keep up.

DR. LAGARRY: Okay, it is a map --

JUDGE WARDWELL: Yes, I got that. It's a map.

DR. LAGARRY: -- that shows full potential. And you can see that it is generally lozenge-shaped. The inner most line is sort of sausage-shaped. And right where the lines are --

JUDGE WARDWELL: Are these the red lines?

DR. LAGARRY: Yes, the red lines. The red lines I put there. Everything else is the original figure.

JUDGE WARDWELL: Right.

DR. LAGARRY: So, the original Wyoming Fuels Company just mapped where they thought the ore was and it was a sausage-shaped trend.

JUDGE WARDWELL: Going northwest-southeast.

DR. LAGARRY: Going northwest and southeast.

JUDGE WARDWELL: Okay, I'm with you.

DR. LAGARRY: And it has a kink in the middle.

JUDGE WARDWELL: Got you. I see the kink now, yes.

DR. LAGARRY: Right. And so how would one explain that kink in the middle? Right? And so my business is geological mapping stratigraphy and structure. And the way I would interpret that kink in the middle is that there were two faults that it was originally a linear feature and then it was subsequently faulted, producing a kink in the middle.

JUDGE WARDWELL: Got you.

DR. LAGARRY: That's it.

JUDGE WARDWELL: Okay, thank you.

CBR Exhibit 045, which is a reply, I believe, page 2, answer 25 maintains that the faults were not drawn by Wyoming Fuels Company and you concur with that because you drew those --

DR. LAGARRY: I drew those.

JUDGE WARDWELL: -- your interpretation of

this. And also maintains that nearly 11,000 drill holes completed across a permit area aquifer tests and other evidence do not support the presence of a fault or faults in the permit area.

Besides this map, do you have any other evidence indicating faults within the permit area?

DR. LAGARRY: I don't have access to the permit area to make an independent investigation. Were I to be granted access, I would happily do so.

JUDGE WARDWELL: Is it your position that most of the fractures are aligned northeast-southwest in the direction of Pine Ridge or more in the northwest-southeast direction consistent with the lineaments described by Diffendal in INT Exhibit 055, page 145?

DR. LAGARRY: These lineaments are based on the fracturing properties of sedimentary rocks and what is called the stress strain ellipsoid that structural geologists use to predict faults and fractures occurring over geological domes like the black hills.

So, the two directions, northwest-southeast and southwest-northeast are like bookends. They occur together.

JUDGE WARDWELL: Thank you.

CBR 0455, pages 15 through 16 answer 29 in response to your lineament study 043 pages 3 through 4 state that LaGarry's reference to the poster presentation by Maher and Shuster, and that is INT Exhibit 060, and I believe -- is this the same Maher you referred to earlier today?

DR. LAGARRY: It is.

JUDGE WARDWELL: Great.

DR. LAGARRY: Yes, sir.

JUDGE WARDWELL: Super. Supporting the lineaments identified by Diffendal, CBR countered that, quote, the poster addresses faulting at four locations. However, all locations are outside the Crow Butte perimeter area. Crow Butte has not observed faulting or joints at the Crow Butte site and upward migration requires hydraulic conditions that are not present at the site. Crow Butte has demonstrated that faulting outside of permit area does not affect Crow Butte's ability to control mining fluid at the site.

And again, I assume that you do not have any information in regards to whether or not those four fault locations extend into the CBR site for the same reasons you have described before about having any abilities to evaluate the site.

DR. LAGARRY: My referencing Maher and his colleagues' paper was to provide information on how ubiquitous these features are in the region.

Neither Maher, nor myself, nor Diffendal, nor Balmat, none of us had access to the permit area. So, subsequently, we have to work in the vicinity and infer and generalize to the larger region. However, Maher's poster was one of the most detailed and thorough of those that exist. And in it, he also demonstrates the variability that these things can manifest in.

So, it was an attempt to demonstrate the ubiquity of these features.

JUDGE WARDWELL: Thank you.

I think that pretty much wraps up my questions on lineaments, faults, and fractures, thank goodness. And we can move on to finish up some things on a secondary porosity. And I think I will start with Exhibit 069 of the Intervenors', page 3 of Kreamer's testimony, where you state that the assumption that the sand or sandstone in the Chamberlain Pass has no secondary porosity is inconsistent with a reported directional anisotropy or isotropy.

DR. KREAMER: Sure. Just like homogeneity

and heterogeneity has to do with differences between two points, isotropy and anisotropy has to do with difference of a property at one point but in different directions. So, if we are talking about hydraulic conductivity, there are many places where the horizontal hydraulic conductivity will be different than the vertical and there are many geologic reasons this can happen. If they are the same in all directions, the media is said to be isotropic, that is at one point. But at that one point, if in different directions you have different hydraulic conductivities vertically, horizontally, et cetera, that is called anisotropy.

JUDGE WARDWELL: And what data do you have to support the report what you testify is a reported directional anisotropy. Where was this reported directional anisotropy that you are referring to?

DR. KREAMER: Well, there are a couple of lines of evidence to that. The first is that CBR, in the restoration, is going to a numerical model. And in that numerical model, they state that they will account for heterogeneities and differences in what they call the basal Chadron. And so the line of evidence that was first apparent is that as they are doing their numerical modeling, they are no longer, as

they were in the '80s, saying that the aquifer is homogeneous and isotropic, which is the basis for some of their equations, and now they going to a MODFLOW model, which actually specifies different hydraulic conductivities in different directions.

JUDGE WARDWELL: Okay. And I guess you are really saying that this directional anisotropy is caused or related with or some type of indication that there is these fractures that are secondary porosity within the geologic strata.

DR. KREAMER: Not necessarily for the -- well, it doesn't necessarily have to be associated with secondary porosities but it often is. If you have a fracturing pattern, it means that you have more ability of water to flow in some directions than it does other directions.

JUDGE WARDWELL: It is your experience that most sedimentary deposits exhibit anisotropy, regardless of any fractures, with the horizontal conductivity often times being ten times or more the vertical conductivity? Is that common with sedimentary features that we have here?

DR. KREAMER: It depends on the sandstone. There are clean sandstones. There are dirty sandstones. There are sandstones that are

cross-bedded. I come from a part of the world in Zion and Bryce and you drive up and you see sandstones that were beach and were very interbedded. So, you have --

JUDGE WARDWELL: Let's talk about the types of formations we have here that we are talking about at our site, where in fact there seem to be a fair amount of non-uniformity, if you will in the grain-size distribution of either the consolidated or unconsolidated strata.

DR. KREAMER: Great question, Your Honor. The anisotropy you would probably find in this area is because of the genesis of the sandstone. You had layers, it is streambed deposits and it is in a fluvial environment. And so as the sediments are laid down, the stream can meander, it can go different places. And so you would expect to not have this same layering vertically. When you have a situation like that, oftentimes, you will get anisotropy. You will get greater horizontal hydraulic conductivity than you will vertical.

So yes, the idea that in the remediation process they have to spot-treat areas that are more contaminated than other areas is an indication that it is not a homogeneous isotropic system.

JUDGE WARDWELL: And as you said, it is

your understanding that they didn't treat as a horizontal homogeneous isotropic strata. Is that correct?

DR. KREAMER: Crow Butte did both sides. In the '80s, when they were trying to show that there was no verticality and they were doing pumping tests. The analysis used equations, an analytical model, equations like the Tyce equation, the Jacob-Cooper modification, they used equations that assumed that the aquifer was homogeneous, isotropic, was the same thickness, did not tilt, and that is what they used for their analysis.

When it came to remediation, I guess they were not getting the efficiency they wanted for restoration and so they went to a numerical model. A numerical model sets up cells and so you can be much more complicated about the system and you can incorporate, as they said they have, when they reported in the model that they accounted for differences in thicknesses of the aquifer and differences in heterogeneities.

And so I guess Crow Butte Resources has done both. A lot of their initial calculations saying that there was no vertical hydraulic conductivity were based on assumptions of homogeneous isotropic layers

that were equally thick and were, more or less, infinite horizontal extent as far as the pumping test was concerned.

JUDGE WARDWELL: Thank you. On page 3 of your testimony, you state that quote, aquifer test analysis in the Chamberlain has reported permeability variations of approximately three times, which is inconsistent with the assumption of homogeneity in the production zone.

I guess my question to you is, is not this a relatively small variation in hydraulic conductivity, given the possible ranges of conductivity that exist? You know it is not unusual, is it, for a conductivity to range by a half an order of magnitude or more in a given geologic strata?

DR. KREAMER: More than that. Sometimes many --

JUDGE WARDWELL: So, wouldn't three times be a fairly small variation?

DR. KREAMER: It is if you are not considering secondary porosities. In other words, what you said is this is based on cores. And so they are looking at just the material itself that is unfractured and --

JUDGE WARDWELL: Well, in fact, my

question relates a little broader than that. That conductivity, by its nature, which varies by many orders of magnitude between various materials and varies by several orders of magnitude for the same material, and varies by a half an order of magnitude for the same material in a geologic strata, just by the nature of its existence. You know you have got a little bigger pore space here and a little bit smaller there. Isn't it easy for that to vary by three times just by its nature of that particular parameter that we are dealing with?

DR. KREAMER: That is correct, yes. This is a pretty clean sandstone and the variation in the rock, itself, matrix is not large compared to other sandstones.

JUDGE WARDWELL: Thank you.

Mr. Wireman, in your testimony at 070 page 1 through 2, you state that the aquifer test data were not appropriately analyzed and no data analysis methods were used that are appropriate for non-Darcy flow and fracture rock settings. Do you remember saying that?

MR. WIREMAN: Right.

JUDGE WARDWELL: It seems that your major concern relates to the potential migration of mining

impacts through secondary porosity, again, associated with this fractured rock. And I think we have all agreed that is the main issue that we are dealing here with in regards to the second porosity aspects. I think we said that before. Is that correct, Mr. Wireman?

MR. WIREMAN: That is correct.

JUDGE WARDWELL: Okay, good. Again, I think you have already answered you don't have any specific information because of the lack of abilities to determine whether or not there is fractured rock in the license area.

But I guess the heart of my question is why doesn't Darcy's flow apply to fractured rock in some cases and, in fact, most cases?

MR. WIREMAN: Well, I'm not sure about most cases. The conventional thinking on that is that the larger the volume of rock you are looking at, the more you can use Darcy flow. And smaller volumes of rock, it is less useful.

There are formulas that you can derive estimates of transmissivity in fractured rocks. It is related to the cube of the width of the aperture of the fractures and that is a standard method in most of the textbooks.

So, that is what I was getting at here is it would be useful, I think, to just run that. It is not terribly difficult if you have some, and it gets back to the discussion we had earlier about identifying fractures in the outcrop and measuring the aperture and all that. Collect that data, crank through this, get a transmissivity, compare it to what you get with the pump test.

JUDGE WARDWELL: And then the harder the problem then becomes not so much the ease with which a model can be run because it is fairly apparent there is lots of models out there and anyone can run them, it is the input parameters that you put into them. Isn't that correct?

MR. WIREMAN: Absolutely true.

JUDGE WARDWELL: And it then gets back to our previous discussion of what are you going to put in there for an aperture distance, the use of something at the surface we discussed in regards to the variations between what it might look like in the subsurface. I don't think we need to repeat that. But the mere fact that if in fact you are not looking at that type of flow but you have got a fairly large area compared to the size of the apertures would tend to create a situation that does somewhat represent

flow through porous media, which is what Darcy was derived for, wouldn't it?

MR. WIREMAN: The answer to that is yes, on a larger scale. However, that does not accommodate flow through a single highly-preferential flow path, whether that flow path be a fault, whether it be an intensely jointed fractured part of the rock, whether it be an opening in a fold. That, you can't use Darcy flow on that sort of two-dimensional type of flow, which is what we are talking about oftentimes with highly preferential flow through lineament.

JUDGE WARDWELL: Is this now a size issue or a laminar flow issue? Size of the representative element that you are trying to model, compared to the size of the aperture or is it that you are concerned about non-laminar flow occurring in these larger apertures?

MR. WIREMAN: It gets a little complicated but Darcy flow can actually occur within a preferential flow path. So, within a two-dimensional fault, open fault, you can have Darcy flow within that fault. But one foot or five feet either side of that fault, you have little or no flow but it is Darcy flow. So, it is a scale thing to a large degree and the more rock you want to analyze, the more you can

use a Darcy equation.

However, if your concern is the potential for movement of a contaminant through a highly preferential flow path, having an estimate of Darcy flow of some large massive rock is really not very useful.

So, the way I always look at this, it is really important to understand if there are preferential flow paths, what are they? Are they lineaments? Are they fractures? Are they significantly more permeable zones in the rock? That is the very first thing that is really, really important.

Then, once you understand those and where they are, then you start to focus on the hydrology of those relatively small areas. And if it is truly a two-dimensional fault or fracture, then you really need to go back to some non-Darcy flow sometimes.

So, it gets quite complicated but I am always --

JUDGE WARDWELL: Okay, clarify again, exclusive of taking measurements at the surface, which we have talked about, exclusive of that, do you have any other suggestions of how you would characterize those apertures that are 200 feet into the geologic

strata?

MR. WIREMAN: Okay, have at it.

DR. KREAMER: Dr. Dave Kreamer. Yes, there are several ways you can look at cores, if you core the rock and look for fractures. And there is typical fracture analysis that we did not see in reviewing this.

Another way, I was a peer reviewer --

JUDGE WARDWELL: So, back to these cores. How are you going to determine the aperture after you get the cores out of the ground? I mean they are going to be disturbed.

DR. KREAMER: Right. Well, then there is another way. Another way is downhole TV logs. At Yucca Mountain --

JUDGE WARDWELL: Downhole what now?

DR. KREAMER: Television logging, where you send a camera down the borehole. These cameras are very small. They can look sideways or down the hole and you can actually measure the size of the aperture. The angle of the aperture, the orientation. You can look at two holes and see whether that aperture or that fracture continues on further. I was a peer reviewer for Yucca Mountain and I looked down more holes and at more fractures than was healthy for

me to do. But that is a common technique is a TV logging or television logging of holes is another way. Another way is geophysical logging in these holes and some of that was done.

JUDGE WARDWELL: We will get into this more in the next couple of days but you say this TV logging is common but your reference that you use for the use of this did not use any common techniques that I am aware of in regards to trying to define the conditions at Yucca mountain. At least when you look at the dollars spent, none of it was very common. They used, in my experience, really complex techniques. Why I don't necessarily think that TV is very complex, wouldn't you tend to agree that your common garden variety geotechnical FERB would not readily be using this on most projects?

MR. WIREMAN: Let me just answer that. I think it is increasingly common to do this and it doesn't require a big budget process. These TVs are out there now. They are really easily sent down a hole and watch. You can watch water flow in a fracture with these. So, no, I don't think just the logging of a hole is prohibitively expensive.

JUDGE WARDWELL: But given the time frame when they were logging holes, was it common?

MR. WIREMAN: That is a very valid point. You know it is certainly cheaper today than it was 20 years ago, no question.

JUDGE WARDWELL: And certainly probably more readily available than it was 20 years ago.

MR. WIREMAN: And the cameras were bigger and they didn't go down smaller holes as they do today. A lot of them didn't look sideways as they do today but it is used very commonly in fractured rock systems to see for like non-aqueous phase flow a lot of times it will go opposite the groundwater direction and you can actually see the non-aqueous phase come out of the fracture.

JUDGE WARDWELL: And we, to your knowledge, we don't have any of those issues dealing with --

DR. KREAMER: No, no non-aqueous phase flow regimes.

JUDGE WARDWELL: And we will talk more on what this focused towards, and that is an EA and what is needed for that later on.

The horizontal aquifer communication with the license area with the Pine Ridge Reservation, I have a couple of questions dealing with staff's testimony on 001, page 41, answer D-13. Based on the

absence of the Ogallala and Arikaree in the license area, there is no hydraulic connection between the basal Chadron sandstone aquifer and the Arikaree and Ogallala aquifers.

Staff, in 01, page 32 to 33, D-4, in regards to the extent of the basal Chadron, staff states that there is at least a 25-mile barrier to flow within the Chadron formation that separates the basal Chadron sandstone aquifer in the license area for any aquifers that supply drinking water at the Pine Ridge Reservation.

And staff, you did state that the Arikaree does exist on the southeast corner. We have been through that. Some of these we may have already covered and I get reading to find out we have covered it. So, just bear with me.

Given that the area between the license area and Pine Ridge is not within a license area, do you have any information, Dr. LaGarry, or anyone else on your staff, in regards to showing that there is hydraulic communication between the basal Chadron and the Pine Ridge Reservation? And let me start off by saying does the basal Chadron underlie the Pine Ridge Reservation to the northeast?

DR. LAGARRY: The basal Chadron does

underlie the Pine Ridge Reservation to the northeast.

JUDGE WARDWELL: And where was that on that map? We looked at the zero -- the isopach map of the thickness of the basal Chadron and didn't that zero line fall well short of the Pine Ridge Reservation or was I misinterpreting that?

DR. LAGARRY: No. No, the interpretation is correct. I mean the Chamberlain Pass formation is not isolated to the syncline that Crow Butte mines. There are multiple synclines and other features that radiate from the Black Hills that contain Chamberlain Pass formation.

JUDGE WARDWELL: Are those connected hydraulically directly across from one to the other? So, you are saying it is underneath the Pine Ridge Reservation, another radiated line of the basal Chadron does exist under the Pine Ridge.

DR. LAGARRY: Yes, it does. Swinehart and others in 1985 show cross-sections of the Pine Ridge escarpment through -- so, the Pine Ridge escarpment starts at the Wyoming line, as it enters Nebraska, it goes from Wyoming, it crosses the Wyoming-Nebraska state line, comes through this area, and then angles to the northeast, following the lineament trend that Diffendal talks about.

So, the Pine Ridge escarpment, as it is manifested today, is very likely a product of faulting and that stress strain ellipsoid and pattern from the Black Hills.

So, although it is eroded off, if I was a molecule of water and I was at the permit area and I wanted to migrate northeast to the reservation, I would butt up against the eastern limb of the syncline, where the Chamberlain Pass formation is eroded away. And then I would cross that structure and I would get on the other side and then I could find Chamberlain pass and I could continue my journey.

So, it is correct. That isopach map is correct that it pinches out, assuming -- assuming that the red clay -- okay, so the red clay that is the lower unit of the confining layer, that is part of the Chamberlain pass formation. That red clay, if that is part of that figure that pinches to zero, then, in fact, there is no direction connection via the Chamberlain Pass formation.

However, if my opinions are correct and that these faults allow transmissivity of fluids connecting these little isolated pod to Chamberlain Pass formation, then water could migrate through Chamberlain Pass, through a fault, through Chamberlain

Pass, through a fault, through Chamberlain Pass, through a fault, through Chamberlain Pass to the reservation.

However, that being said, the most likely conduit for contamination to the Pine Ridge Reservation is not through the Chamberlain Pass formation. It is from where the Chamberlain Pass formation meets the White River alluvium. The White River alluvium diagonally transects the Pine Ridge Reservation from southwest to northeast.

JUDGE WARDWELL: Thank you.

DR. LAGARRY: You're welcome.

JUDGE WARDWELL: Staff, when you were preparing your EA, how did your conclusions differ from those that were presented by Dr. LaGarry in regards to the horizontal communication between the basal Chadron and the Pine Ridge Reservation?

And I will start off with do you agree that there is basal Chadron Chamberlain Pass material beneath the Pine Ridge Reservation?

DR. STRIZ: No, we do not agree. We find no pathway from the --

JUDGE WARDWELL: Could you speak up a little bit or just pull that right toward you.

DR. STRIZ: Okay. We do not agree that

the basal Chadron is present under the Pine Ridge Reservation.

JUDGE WARDWELL: What is your evidence for that?

DR. STRIZ: There are actually two studies that were done by the USGS. The first one is NRC-025, which was the Water Quality of Selected Springs and Public-Supply Wells at the Pine Ridge Indian Reservation and there is a table in there that describes the Chadron and does not describe the basal Chadron member as being present.

In addition, there was a groundwater modeling study done on the Pine Ridge Reservation in 2014, just recently. Once again, when they described the Chadron, they did not describe the basal Chadron member.

JUDGE WARDWELL: Is that an exhibit here?

DR. STRIZ: Yes, for both. It is NRC-025 and NRC-026, the tables.

JUDGE WARDWELL: Thank you.

DR. STRIZ: They also did not include a basal Chadron in the groundwater model. The only aquifers they considered at the site were the Arikaree and the Ogallala.

JUDGE WARDWELL: Dr. LaGarry, did you have

a chance to look at that at any time and what is your reaction to that statement?

DR. LAGARRY: I have personally mapped the geology of the Pine Ridge Reservation this past July in Pierre, South Dakota, at a presentation of the National Science Foundation South Dakota and Experimental Program for the Stimulation of Competitive Research. My student, Sean Garnett, presented a poster in which he describes the White Clay Fault, in which the basal, what used to be called the basal Chadron now we call the Chamberlain Pass formation is exposed and is transmitting radioactive geothermal waters through the land's surface.

So, the use of the latest, most recent research has plagued this proceeding from its beginning and I would say that those publications are, in fact, that NRC sites are in fact out of date. In fact, we are preparing work on that.

In my testimony, I provided the citation for at least three abstracts detailing the presence of the Chamberlain Pass formation on the Pine Ridge Reservation.

JUDGE WARDWELL: I will give you one last chance for the back and forth.

DR. STRIZ: In addition, the Arikaree is

not saturated at the license area. We just had Crow Butte testify to that. So, there is no pathway in the southern portion of the license area for water to get in the Arikaree and to be transported 30 miles all the way up to the Pine Ridge Reservation.

In addition, anything that enters Brule, the groundwater flow direction of the Brule is very distinctly toward the White River alluvium. So, any particle entering the Brule would have to go cross-flow all the way across to the Reservation. There is no pathway.

And as he agreed, the basal Chadron pinches out and then you have all the siltstones and mudstones for 27 miles that a particle of water would have to pass through.

JUDGE WARDWELL: But Dr. LaGarry, didn't you say that the particle of water you are concerned about is the one that goes to the White River alluvium? Is that --

DR. LAGARRY: That's right. That is the one that really worries me is the one that comes out of the Chamberlain Pass formation, 12 to 15 miles downriver from here and from there, it gets into the White River alluvium and then its first stop is Pine Ridge, the community of Pine Ridge.

JUDGE WARDWELL: At that point, it will enter the --

DR. LAGARRY: Pine Ridge Reservation.

JUDGE WARDWELL: And what aquifer source at the Pine Ridge Reservation?

DR. LAGARRY: That would be the White River alluvium, in which the Pine Ridge Municipal Well Field is developed.

JUDGE WARDWELL: Okay. So, in fact, you are not counting on the basal Chadron as the transmitter of any impacts that underlies the Pine Ridge Reservation. It is the alluvial.

DR. LAGARRY: No solely. The contaminated water could not take that route without connecting faults and fractures, without connecting secondary porosity. However, secondary porosity does not need to be invoked to transmit contaminants from the Chamberlain Pass formation to the White River alluvium to the Reservation.

JUDGE WARDWELL: It does not --

DR. LAGARRY: It does not.

JUDGE WARDWELL: -- because they are connected where it outcrops in the river.

DR. LAGARRY: That is correct.

JUDGE WARDWELL: You don't believe it is

there.

DR. STRIZ: No, the basal Chadron is at depth that does not outcrop in the White River alluvium. It outcrops 12 miles northwest. It is very deep under it. There is no evidence of a fault that is flowing that would connect from the basal Chadron to the White River and all the five lines of evidence that we provided about the confinement of the basal Chadron. We see no pathway.

JUDGE WARDWELL: Thank you.

Let's move on to vertical aquifer.

CHAIR GIBSON: Let me just ask one question. Did you say there was a 2014 study --

DR. STRIZ: Yes.

CHAIR GIBSON: -- on the Reservation. Is that correct?

DR. STRIZ: Yes.

CHAIR GIBSON: And Dr. LaGarry, I am curious. You were critical of these other studies because they were out of date. Was the data out of date that was used in this 2014 study? I am just wondering if you guys are talking past each other or if there is some way we can understand this. Because that does not sound out of date to me.

DR. LAGARRY: It depends on the source

material that the 2014 researchers were using. I wasn't directly involved with that study and they may have relied on existing research from the 1930s, '40s, and '50s.

The Chamberlain Pass formation wasn't recognized as a thing until 1998. So, if their reference material predated 1998, there would have been no mention of it. They would have been subsumed within the Chadron formation, parts of it. The remainder, the red clays would have been subsumed within the Pierre Shale.

And so I recognize that people are, more or less, at the mercy of the reference material provided. It is incumbent to dig as deep as possible and consult as widely as possible.

So, it is entirely conceivable to me that the 2014 study being cited was compiled by individuals who weren't familiar with the Chamberlain pass formation and the fact that a change in an interpretation had been made. So, they might be able to look right at it and see it.

CHAIR GIBSON: All right. Do you know the source of the data for the 2014 study off the top of your head? If you don't, we'll go on. I don't want to drag this out.

DR. STRIZ: Well, I have the entire modeling report here and I can look into that. I don't typically question USGS.

CHAIR GIBSON: Well, you know, I think we would appreciate learning about that later but I don't want to hold this up.

DR. STRIZ: Okay, thank you.

CHAIR GIBSON: Okay, thank you. Maybe you could talk to us in the morning about that?

DR. STRIZ: Yes, I would be glad to.

CHAIR GIBSON: Thank you.

JUDGE WARDWELL: Last couple topic areas before we adjourn here.

The vertical aquifer communication between the basal Chadron Chamberlain Pass formation and the upper Chadron lower Brule and upper Brule aquifer, Crow Butte Exhibit 013, page 39 states that for the North Trend Expansion Area, quote, all available data indicated upward hydraulic radiant between the basal Chadron Chamberlain Pass sandstone and the upper middle Chadron with an average hydraulic head difference of approximately 90 feet between the two units.

Crow Butte's testimony on page 49, answer 92 says the vertical hydraulic radiant, and I am

quoting, is strongly downward within the permit area. Would you care to clarify which it is upward or downward, Crow Butte?

MR. SPURLIN: Yes, this is Matt Spurlin. The upward hydraulic gradients are observed at North Trend.

JUDGE WARDWELL: Say that again.

MR. SPURLIN: The vertically upward hydraulic gradients are present due to artesian conditions at North Trend, not at the current license area.

JUDGE WARDWELL: So the current license area is, in fact, downward?

MR. SPURLIN: That is correct.

JUDGE WARDWELL: And it is upward in the North Trend Expansion Area.

MR. SPURLIN: That is correct.

JUDGE WARDWELL: Okay, thank you. Your testimony, Crow Butte -- well, no, it is the license renewal application Tables 2.7-5 on page 2-194 and 2.7-6, page 2-195, what is the head difference shown on these arcs and what does that result in gradients and where is this for?

Let's start off with the 2005 one. That says it is Brule water levels. Correct?

MR. BEINS: This is water level data from 1982. Earlier, you had asked about what wells had been sampled to create the one particular potentiometric surface map. This, I imagine, was the data that was used to generate that map and it shows the flow to the northwest, towards the White River from the current license area.

JUDGE WARDWELL: And what does CSA mean? Is that stated on there somewhere?

MR. BEINS: Well, I believe CSA is commercial site area or commercial study area.

JUDGE WARDWELL: And what is that, compared to the license area?

MR. BEINS: It is the same as the license area.

JUDGE WARDWELL: Okay.

And if we compare -- and then what is Table 2.75 -- 6, I mean? That is the basal Chadron, the water levels for relatively the same time period?

MR. BEINS: The same time period, similar --

JUDGE WARDWELL: What are the difference in those heads show and where is this located? Is this in the license area or is in this in the North Trend?

MR. BEINS: These wells are located regionally. It is going to cover the area of the current site, as well as the North Trend area.

JUDGE WARDWELL: And is the difference in these elevations indicative of the head difference between the Brule and the basal Chadron?

MR. BEINS: I would assume they are, yes, sir.

JUDGE WARDWELL: Well, don't assume. What is it? Is it or isn't it? I mean these are water level elevations. One is in the basal Chadron and the other is in the Brule that lies above it.

MR. BEINS: Certainly.

JUDGE WARDWELL: And would not the difference in that elevation indicate the head difference between those two water-bearing bodies?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: And that would be indicative of the gradient, would it not?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: With the highest indicating which direction it is going to flow, the highest would be the pushing one, if you would, compared to the receiving one.

MR. BEINS: Yes.

JUDGE WARDWELL: And what does this show?

MR. BEINS: That is only going to occur where we have well pairs, as my colleague here has pointed out, where the wells in the Chadron formation are in very close proximity to the Brules.

JUDGE WARDWELL: To a certain degree. So, you don't think we can -- these aren't well pairs or anything? You don't think they can just look at the elevation differences? What is the elevation? What is the average elevation of 2.76, 3.75 something, looking around at it?

MR. BEINS: Which well would you like?

JUDGE WARDWELL: Just --

MR. BEINS: Just pick one?

JUDGE WARDWELL: Yes, it doesn't matter. Just what is --

MR. BEINS: Looking at RC-4 --

JUDGE WARDWELL: I see a 3.75 in the last number varies, basically.

MR. BEINS: Yes.

JUDGE WARDWELL: Let's go back up to the other one and see what that says. Isn't these 3.9s and 3.8s instead of 3.75s?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: Isn't that larger?

MR. BEINS: That is larger.

JUDGE WARDWELL: Doesn't that indicate downward flow?

MR. BEINS: That is going to indicate downward flow.

JUDGE WARDWELL: Thank you. So, that supports your downward flow from the Brule down to the basal Chadron, would it not?

MR. BEINS: Yes, sir.

JUDGE WARDWELL: That is all I was trying to get.

MR. LEWIS: If I may just add to that, this is a pre-mining condition or prior to significant development. As development progresses, you have a lowering of the depression of the potentiometric surface in the basal Chadron, which exacerbates and increases that downward gradient that you see from the pre-mining and early development stages.

JUDGE WARDWELL: I don't believe that was an answer to any question I asked, though, but thank you for sharing.

And that, in fact, was going to be my next question so really thank you for sharing.

(Laughter.)

JUDGE WARDWELL: It says is this

difference shown on these tables caused by mining of the original. You are incredible! I apologize for being snippy with you.

We are almost there, gang. We are almost there for the day.

Crow Butte's testimony page 16, answer 40. If significant hydraulic communication was present, the hydraulic heads of the two aquifers would expect to be much closer in elevation.

You know what the question is going to be. Well, how much closer would they have to be before you would be satisfied that in fact there is significant communication?

Well and this shows what, many tens of feet?

MR. LEWIS: Yes.

JUDGE WARDWELL: A lot.

MR. LEWIS: Yes, and currently more on the order of a hundred.

Basically, the question is relative. In a laminar flow system that has a perfectly laminar flow, if you had a system that was in full hydraulic communication, the water levels would be equivalent and there would be no difference in head between the upper part of that aquifer and the lower part of the

aquifer. As you introduce vertical flow gradients or you have significant barriers to flow, such as aquitards, the upper confining unit in this case you introduce greater degree of separation of those water levels as the isolation is more and more prevalent. And I would just say in my experience, when you are looking at head differences of as much as tens to hundreds of feet over a thickness that we are looking at, that that is a very solid basis for confinement.

JUDGE WARDWELL: Thank you.

I will turn to the Intervenors and ask if anyone would like to comment on these hydraulic heads or do you have any arguments with them, or the gradients indicated here?

MR. WIREMAN: Mike Wireman. I will just make one short comment. Currently, at the North Trend Area, the gradient is upward. The direction of flow is from the current license area towards the North Trend Area, in that direction. So, you have a potential, in a post-closure scenario, for contaminated water to move northwestward along the flow path and then it enters an area where there is an upper gradient.

JUDGE WARDWELL: Thank you.

The last topic area I want to touch on

tonight is the abandoned boreholes, where CBR Exhibit 045, page 17, answer 32 discusses the 10,000 plus explorations made at the site, as shown on CBR Exhibit 056, which is a map of drill holes at the permit area, which I think, again, is that that same priority? It doesn't matter. I don't need to call up any. I just wondered if you remember. It doesn't matter.

CBR, have all of these holes been adequately sealed in accordance with standard practice?

MR. BEINS: All holes have been sealed and abandoned according to standard practice.

JUDGE WARDWELL: Now, was this done when they first drilled them or were there some open for a while until the technology realized the significance of open boreholes and what that allowed for communication?

MR. BEINS: We are required by the Nebraska Department of Environmental Quality to abandon all of our drill holes in a timely manner. The longest period of time that I am aware of that we have left a drill hole open without any abandonment fluid in it probably does not exceed more than four to five days.

JUDGE WARDWELL: And can you testify that

that same process was carried out in 1983?

MR. BEINS: I can, sir.

JUDGE WARDWELL: And what kind of fluids are these usually used to abandon the holes, the whole process, just describe it.

MR. BEINS: To abandon a drill hole, currently, under our mineral exploration permit or our Class 3 permit, if we are operating inside the license area, the drill rig will mix a bentonite-based abandonment fluid that has been approved by the DEQ. In this particular instance, we use a CETCO product known as Plug Gel and it is a high solids bentonite-based drill hole abandonment powder. We mix that in a jet hopper into the drill pit. And as we are mixing that, we are circulating that material through the entire borehole. We mix that material, continuing to add additional bags of that particular Plug Gel to the pit until the pit viscosity of the fluid that is in the pit, when that viscosity reaches a point that we are able to measure of 61 seconds, using a Marsh funnel and cup, once it reaches that 61 seconds or a viscosity that is --

JUDGE WARDWELL: Too much detail.

MR. BEINS: Okay.

JUDGE WARDWELL: You plug it with

bentonite clay.

MR. BEINS: We plug it with bentonite. And at that point, we put a cement cap at the surface six feet down with a piece of rebar and a hole identifying marker.

JUDGE WARDWELL: Do you know if that was done in the 1980s also, that same basic process?

MR. BEINS: It was done in the 1980s, yes.

JUDGE WARDWELL: Is there any place this has been documented in the license renewal application? No is an answer.

MR. BEINS: I don't believe that it is, no.

JUDGE WARDWELL: In your testimony on page 35, answer 69, and I quote, CBR has plugged all exploration holes to prevent comingling of the Brule and Chadron aquifers and to isolate mineralized zones. Successful plugging was tested by conducting four hydrologic tests prior to mining. Are you referring to the pump tests when you talk about those four tests?

MR. BEINS: That is correct.

JUDGE WARDWELL: We will get to that tomorrow. Finished for the day.

One comment, I think. I think this would

be a good time, also to receive questions that we haven't asked on the topics we have covered today, if you are agreeing. And if they could submit those tomorrow morning.

CHAIR GIBSON: So, your homework tonight: your homework, at least the lawyer's homework tonight is to review your notes on what you have heard today and to draft up any questions on the testimony that we have heard today from these witnesses on Contentions A, C, D and F, and 14 so far. And then please give those to us in the morning. And if you could get them to us by maybe 30 minutes before we go on at 9:00 tomorrow morning, maybe at 8:30, we can review them and try to get those questions together so that we won't waste a lot of time. Can you all do that for us? Very well.

If there is nothing, we will stand in recess until 9:00 tomorrow morning but you all get us your homework at 8:30. Thank you.

(Whereupon, the above-entitled matter went off the record at 5:45 p.m.)