STATE OF NEW MEXICO

ENERGY, MINERAL AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

ORIGINAL

APPLICATION OF THE NEW MEXICO OIL AND GAS ASSOCIATION FOR AMENDMENT OF CERTAIN PROVISIONS OF TITLE 19, CHAPTER 15 OF THE NEW MEXICO ADMINISTRATIVE CODE CONCERNING PITS, CLOSED-LOOP SYSTEMS, BELOW GRADE TANKS AND SUMPS AND OTHER ALTERNATIVE METHODS RELATED TO THE FORE GOING MATTERS, STATE-WIDE.

CASE NO. 14784 AND 14785

VOLUME 4

May 17, 2012
9:00 a.m.
Wendell Chino Building
1220 South St. Francis Drive
Porter Hall, Room 102
Santa Fe, New Mexico

THE COMMISSION:

JAMI BAILEY, Chairperson

GREG BLOOM, Commissioner

DR. ROBERT BALCH, Commissioner

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EXHIBITS

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NMOGA EXHIBITS

OGAP EXHIBITS

(Note: In session at 9:00)

CHAIRPERSON BAILEY: Good morning. This is a continuation of the Oil Conservation Commission hearing on Consolidated Cases 14784 and 14785. Today is Thursday, May 17th, and we are in Porter Hall in Santa Fe, New Mexico. All three commissioners are here so there is a quorum of the Commission.

As I recall, we had finished with one witness and we are about to call the last witness for NMOGA.

MR. HISER: That's correct, Madam Chair.

CHAIRPERSON BAILEY: If you would please call the witness and if you would please stand to be sworn or be sworn by our court reporter.

MR. HISER: We call Bruce Buchanan.

BRUCE BUCHANAN

after having been first duly sworn under oath, was questioned and testified as follows:

DIRECT EXAMINATION

BY MR. HISER

Q. Could you please state your name for the record, please?

A. Bruce Buchanan.

Q. Where do you reside?

A. I reside in Farmington, New Mexico.

Q. And could you tell us what your academic background is?

A. My background is a bachelor's from the University of Utah in botany in 1966 and a master's from the University of Utah in plant ecology in 1969 and then a Ph.D. in 1971 from Montana State University in forest ecology.

I then left the graduate school and went to work and I became a professor at New Mexico State University in 1971.

Q. What were you a professor of?

A. I was a professor of forest soils at New Mexico State.

Q. Can you tell us some of your professional experience?

A. I was at New Mexico State from 1971 until 1991. I was a professor. And I left in '91. During that time that I was at the university I worked and published in areas of reforestation and reclamation and soil erosion, and I had several projects that I was working on in mine reclamation in New Mexico.

In '91 I moved to Farmington and opened up a full-time consulting business and my publications

then were mostly centered on either salt movement or mine reclamation or disturbed land reclamation, and I have been a consultant from 1991 until the present day in Farmington. That's about what I have done, I guess.

Q. Have you served as an expert or an assisting expert for any agencies?

A. Yes, several agencies. And I testified also several times for those agencies.

Q. And did any of that work involve oil and gas or the oil and gas industries?

A. Yes, it did.

Q. Who was the agency work done for?

A. I testified for Vermejo Park, Pennzoil Oil, Shell Oil, for -- a few years ago I testified here at a hearing and --

Q. Did you serve as an expert for the Wyoming Department of Environmental Quality?

A. I did. Just a couple years ago I was an expert for Wyoming.

Q. If you turn to the NMOGA exhibit book behind Tab 16, does that appear to be a resume or curriculum vitae of what you have done?

A. It is.

Q. Did you prepare that?

A. I did.

Q. Does that fairly and accurately represent your educational experience and academic background?

A. It does.

MR. HISER: We would move to admit Exhibit 16.

CHAIRPERSON BAILEY: Any objections?

MR. JANTZ: None.

MS. GERHOLT: No objection.

MR. FORT: No.

MR. NEEPER: No.

MS. FOSTER: No objection.

CHAIRPERSON BAILEY: So admitted.

(Note: Exhibit 16 admitted.)

MR. HISER: We would also tender Dr. Buchanan as an expert in soil sciences including soil assessment and salt migration, reclamation and revegetation.

CHAIRPERSON BAILEY: Any objection?

MR. JANTZ: None.

MS. FOSTER: No objection.

MS. GERHOLT: No objection.

MR. NEEPER: No objection.

CHAIRPERSON BAILEY: So recognized.

Q. Thank you. Have you prepared a

presentation for today?

A. I have.

Q. And that currently is found -- I think that's behind Tab 17 in the NMOGA exhibit book; is that correct?

A. That's correct.

Q. Would you like to -- shall we turn to the first slide of that? And the purpose of this presentation is really two-fold. One is to talk about issues in terms of salt migration and then to sort of subsequently turn to issues of reclamation and revegetation; is that correct?

A. That's correct.

MR. HISER: I guess in the interest of full disclosure, what I submitted was, in fact, one earlier version than what we thought it was. So the only actual change is to the first slide which adds the terms reclamation and revegetation to reflect what he is covering. There were two inadvertently omitted slide titles which we will point out when we get to them, and one word change that is significant which we will point out when we get to that so that you fully understand. I don't want to mislead anybody.

CHAIRPERSON BAILEY: Thank you.

Q. What was your objective as you looked at issues in terms of reclamation, revegetation and controlled salt migration?

A. The main objective is to demonstrate that salts do not migrate to the surface of soils or sites that have been reclaimed and -- properly reclaimed, and that salts will migrate but they don't migrate to the surface and they don't accumulate at the surface.

Q. And what's your basis for making the statement that while salts may migrate they will not migrate and accumulate at the surface?

A. Well, I have a statement that based on research and practical experience from the field of soil chemistry, soil physics and reclamation will be used to support that position that this upward salt migration to the surface of closed drilling pits does not occur when the site is properly reclaimed.

Q. And the next couple of slides will actually lay out the basis?

A. Yes. If I can, I would like to go through and start out somewhat basic so that we all can be on the same page and so you can understand why I have this hypothesis or thesis that salts do not migrate, and by building some platform information

or base information I think I can demonstrate that, if I can proceed.

Let's start with something very basic about water in soils. Water exists either in a saturated condition or an unsaturated condition. If we started out with an ideal soil, about half of that soil would be air space and the other half of that soil would be mineral space. That space that we call the pore space can be filled with water. In a very productive agricultural soil, about half of the air space is water and about half of that air space is air.

So let's go back very basic. Here is the soil. About half of it is minerals, sand, silt and clay particles. About half is air space and about half of that is filled with water.

When it's completely filled with water, that water will move, and it's said to move under saturated flow conditions. As that water moves, it moves primarily with gravity, and gravity pulls that water down. I will show some pictures here in a moment to demonstrate that.

Once it's no longer saturated, then the water is said to be in an unsaturated condition, and any movement of water under those conditions is

under unsaturated flow conditions, and it's very slow. As that water is removed from the soil by plants or evaporation, that water becomes less and less and is held very tightly by the soil particles and the movement becomes almost stopped. It doesn't stop but for all intents and purposes we think of it as almost being stopped.

One thing I would like to point out, if you will draw your attention to the slide. On the one on the right, the unsaturated flow, it shows a void between these particles, and that void is the air space and it has a fairly high humidity. It's nearly 100 percent humidity, and that is a vapor phase of water. It's not too important, but it exists.

One thing I want you to be aware of is that vapor phase does not carry salts. Vapor is water vapor and it has really nothing in it other than water. The saturated water can carry salts. The unsaturated water can carry salts. It's liquid. And whatever constituents are in the soil, whether it's something like fertilizer, which is very common, it dissolves. Whatever is dissolvable will dissolve in the water, and as the water moves, it will move.

Q. Let's turn to a depiction of how this water is moving. Let's start on the left of this slide. We have a soil profile.

The situation here is that it's raining and it's raining while we're talking. As that rain hits the surface, it is saturating that surface and all those pores are being filled with water. That water will move by gravity and it will start to move down. That's what I have tried to depict with the four soil profiles, that that water moves down into the profile. But notice how the saturated flow is becoming less and less until finally there's no more saturated flow.

What I'm about to tell you is important for you to understand, so I want to make this point clear. The saturated flow is moving down by gravity, and as it moves, behind that saturated flow, between the saturated flow and the surface is unsaturated flow. So that water has moved out and there's -- it's no longer saturated above the saturated flow.

I know it sounds like a bunch of mumbo jumbo, but if you will forget what I said and just look at the pictures, I think the pictures probably make sense.

But what's in front of the saturated -- and in front is below. It's unsaturated as well. So as the saturated flow goes down, it's wetting the soil and it's running out of water until finally I get down far enough in the profile, I'm out of water, and all of the water in the soil is now under unsaturated conditions. It's kind of important that we have an understanding of that.

Let's go to another picture. I start at the left side. The blue is representing water. It's saturated. Notice how I have tried to depict that the water isn't saturated below the saturated zone but it's getting moist. As that water moves down it's moist behind unsaturated, and it's dry in front of the front. The front is going to diminish. The soil is going to get wetter, and finally I get to the bottom of the profile and the soil is moist.

What's behind? What's on top? Well, some water got used and the sun acted on that soil and some of the water evaporated and some of the water may have been used by plants, so it is dry at the top and moist at the bottom. I know this is really simple but it's important that we understand how this works because gravity is playing such an important role in the movement of water.

Now what I want to say is that as that water is moving, anything in that water moves with that water. I know that's simple and basic but that's how it works and it's not any more complicated than that.

Let's introduce a plant to this whole situation and kind of in your mind integrate all of what you have been told here the last couple minutes. For some reason this soil has dried at the surface, either from evaporation. There's water deeper in the profile. That water is going to be taken out and it's going to be taken out by the plant.

Now, I know -- I think we probably learned that in kindergarten actually. We have known that all of our lives, and we know that water is taken up by plants and water goes through the plant. If there's salts in that water, those salts will move with that water and will move into the plant and plants are able to do that. Some are. Some are not so good at it. They don't like salt and so they have to deal with that salt and they don't deal with it well so they don't live.

Most of the native plants have learned to -- I don't know if they have learned -- they have

evolved with the mechanisms that allow them to take that water in, even though it's somewhat salty. If the salt concentrations in that water become very high, it is said to have an osmotic concentration. It has difficulty -- remember when we were in high school and we had a membrane and we had some water here and salt over there and the stuff would move through a membrane. Well, the salt wants to move to the clean water but it has to go through this membrane and it's difficult for this plant sometimes to take that salt because it's being held by the salt concentration.

Some plants are able to do that. Let's not worry so much about the plants. Let's be concerned that there can be salt concentrations in that water in that soil.

Now, if we were going to have a quiz today, one of your first quiz questions would be what's the status of the water that's being taken up by that plant? Is that saturated or unsaturated? And your answer would be unsaturated. Most of the water that's taken up by plants is taken up under the conditions of unsaturated flow.

Saturated flow -- this is a really important point to grasp -- saturated flow exists

for very brief periods in soils, particularly in arid and semiarid regions. That saturated water exists right after a rain, during a rain, but within sometimes even hours and certainly within a day that saturated water has dissipated down by gravity and all that water in there now is in an unsaturated condition -- that soil is in an unsaturated condition.

Let me take a breath and you think about what I just said and let that sink in for a moment.

The water is being moved up by the plant. What's going to happen to that soil at that level? It's going to dry out, and that's what I tried to depict in this slide, is that the plant takes up the water and that soil starts to dry.

Certainly if Quiz Question No. 2 was what are the conditions, your answer would be, again, unsaturated flow. But now there's even less water. This is kind of a technical thing, and we know this. When does the plant stop taking water? And when you were in Botany 1 when you were in college, you would have been told that plants quit taking water at about 15 atmospheres, and, of course, you were probably majoring in something else and had no idea what an atmosphere was, but it's the amount of

pressure and that's quite a bit of pressure. That water is held, if you will, under that tension and the plant can't get that water across its membrane because it can't overcome that tension.

Well, that's what we believed for a long time and that's what we were taught in Botany 1. We took an honors class and I found out that's not exactly true. I have done studies where I have been able to demonstrate that ponderosa pine can take water down to 30 atmospheres. There are numbers of plants that we know about that can take water down to 40 atmospheres. That's so far beyond 15.

So if I were to depict what is happening here, this water is being removed from the soil by the plant down to very, very dry conditions, and that's how water gets, for the most part, that's how water gets out of the soil is the plants extract it out. Do you believe that? I do, and I will tell you why I believe it.

We do some farming -- and Montana would be a good example. I'm sorry, I said we. I mean other people. I don't farm in Montana. There are people who farm in Montana. At those farms there wasn't enough water to grow a crop if they farmed every year so they invented a thing called the fallow

system. So half of the field was cropped and half of the field was not cropped. There are no crops in the fallow part of the field. It rains, the water goes in. For the most part, what I want you to think about is that there are no plants in that fallow field. What happens to the water? It gets stored.

Now, if there's a lot of water, it will move down at great depths and it can move at great depths. Ten feet, sometimes further. But for the most part it stays in the wetting profile. So that water is not being taken out is the point I'm trying to get across.

Over here where the crops are growing they are taking the water out. So what do I do next year? I crop the fallow part fallow the part that was cropped and I store water. I can get a field of wheat or barley or whatever I am growing because I can store water because I have no way of getting that water out.

So let's go back to New Mexico. Let's go back to our situation. We are not fallowing. What we are doing is we're growing plants. Those plants extract the water out. They dry the soil down. They will dry that soil down to about four feet.

Some plants will take the water from deeper parts of the profile. Grasses, for example, predominantly grow in the upper 24 inches of the soil so they are taking the water out. If water got -- let's just say for our theoretical situation grasses are confined to the upper 24 inches, and for the most part that's a true statement.

What happens if water is at 36 inches? Do the grasses get it? No, they don't have roots there. Who gets it? Those plants that have roots that go down to get it. Shrubs and to some extent forbs.

So this will come out later, the importance of having grasses, shrubs and forbs so the water is being extracted from all parts of the profile. I don't know what quiz question we are on, but the question is how deep will plants remove water? And your answer is about four feet. If you put something about four feet, you will get an okeydokey for that question.

Let's go to another situation. This is a native soil. This is a picture of an honest to goodness soil. And I'm going to say this not so much to impress you but I want you to realize what I have done for most of my life. I have seen about

6,000 of these soil profiles. I have mapped soils for most of my career. I have sampled soils for most of my career. I calculated here a few years ago I had described and sampled something in the vicinity of 6,000 soil profiles. I calculated here a while back how many soil samples I have taken, and it exceeds something over 8,000 soil samples.

Why I am telling you this is I think I have a pretty good idea what a soil looks like. What I'm going to show you and what you are looking at here is what I would say typifies a semiarid soil. So let's typify this and let's learn a little bit about the soil.

This is a native soil. This is an undisturbed soil. This is a soil that is probably several thousand years old. The landscape position has been in that position for a long time. It has a surface horizon.

Notice to the right, and I know it's a little difficult to see, but maybe you have a description of that in front of you. But what the audience should see is the electrical conductivity of that surface horizon is .6. So we all know, electrical conductivity is a measure of the soluble salts in a profile. We take a sample, we get it

wet, we either put an electrode in it or extract the water out of it and put it to an electrode, an instrument, and it measures the amount of salt in that soil. Not just salt but the soluble salt. That's an important juncture here.

So the value at the surface is .6. In the next horizon now we have moved down the profile. We have gotten through the first three or four inches and we are down about 12, 15 or 16 inches. We have a horizon that has accumulated clay. That doesn't really matter to you much. That's a big deal to me and I get really excited about things like that. So if you want to know what excites me, I like to see clay in soil. I say that kind of jokingly but I love talking about soil profiles.

The electrical conductivity at this horizon is .58, so for all intents and purposes it's the same as it was at the surface. So the soluble salts level is measured by this number and it's about the same in the upper two horizons.

The next horizon is where calcium carbonate has accumulated. How in the world about the calcium carbonate get there? Let's go back to Quiz Questions 1, 2 and 3. The water moved down. Calcium carbonate is relatively insoluble compared

to the soluble salt, but it is soluble and it does move and because it's relatively insoluble it will precipitate out sooner than more soluble salt.

Did you get that? Doesn't matter if you did or didn't. Just pay attention that the calcium carbonate will precipitate out below the horizon where the clay has accumulated. Look what happened to the electrical conductivity. It went up a bit. I think the number is 1.39. Now watch what happens.

We move down the profile. We are not at 48 inches yet. We are still moving water down. In fact, there are going to be roots down below the tape, but look what happened to the electrical conductivity. What are we measuring? The soluble salts. So the carbonates have precipitated out and we get this carbonate layer. Now the soluble salts have moved down below 24 inches and they will move down to 30 and 36 inches.

I don't know what quiz question we are on now, but do salts move down? This is a true/false question. I don't like them and I never asked them when I taught at a university. I avoided them like crazy, but if we were going to have a true/false questions: Do salts move down in a semiarid native soil? The answer is true. The soluble salts have

moved down about 24 inches in this particular profile. Profile after profile, I promise you in looking at the profiles and sampling the profiles this very much typifies the situation that occurs in native undisturbed soils.

What's controlling all of this? Water. For a brief moment it's saturated. The soil is saturated and those salts move with the saturated flow. As the saturated flow no longer exists, which is most of the time, then any movement is going to be with the unsaturated flow and there is some movement. Which way does the unsaturated flow move? In most soils and most situations it moves down because of gravity.

What makes water move up? Plants will take water up. That's for sure. If it's dry, if the soil is dry and it's wetter below, water wants to move from a moist place to a dry place and water will capillary up.

Now, the thesis is that the salts don't move up to any great extent. Yes, they move up a little bit, but only for very short distances.

Now, the next thing I'm going to say is really important to grasp. Does it rain on these soils? Absolutely. Sometimes it's long times

between rains, but when it rains, remember what happens. It was saturated and the water moves down and the salts that capillaried up a little bit, bam, they get -- well, I don't know about bam, but -- well, I can't think of a good word what they do. They are transported by that water and they are moved down.

So the rains bring the salts down in dry periods. There's very little water, very little movement, and there's just slight capillary movement up and there will be some salts that will move up. Water will also move as a vapor. Now, I think I wanted to emphasize to you, is there any salts in the vapor? No, no salts in the vapor. So as the vapor moves, the salts don't move.

What I have tried to describe here is basically what happens. So let's turn to some research and I have had the good fortune of being able to do research over my career as a soil scientist and I'm going to pick on just a couple projects I have worked on. But I want you to have a grasp that research has been done in almost every western state on what I'm going to talk about. North Dakota, South Dakota. Some of the early work was done there. Colorado, Idaho, lots of work in

Montana, a fair amount in New Mexico and a lot of the work was by Bruce Buchanan. Arizona. Did I say Colorado?

All of us who do that, we belong to a society. It's the society called the American Society of Mining and Reclamation and we meet and talk about things. It didn't come up, but I happen to be the president. It's a national society, the American Society and Mining and Reclamation. In a few weeks I will go to Mississippi. I am president elect and I will become the president. And we talk about these things and we share information and we learn from one another and we do research.

So some of what I know is from my own research. Some of what I know is from research that I have read from other people, and to a great extent what I know is what I have learned talking to people, and we share ideas. It doesn't necessarily get published, probably never will, but we have learned from one another. And what I'm going to show you is very much typifies what happens in the west.

This particular project was done in New Mexico. This particular project was done 12 years after the site had been reclaimed, so these samples

were taken 12 years after the site had been reclaimed. This is entirely in spoil, and I will talk about that in a second. There was no cover soil. This would be like having pit cuttings at the surface, but this isn't pit cuttings. These are materials that are removed from a mine and in place they are called bedrock, overburden. They are picked up, dumped, and when they go out of the pit they are called spoil.

They are basically shales and sandstones. They are not too dissimilar from the materials that are brought up in pit cuttings in that they are salty. They have a lot of clay stones, silt stones, sandstones, that kind of material.

This is now -- think about this as being at the surface and there's no soil on top. Here is what happened: Twelve years after the material had been moved out and planted, and I will tell you that the vegetation didn't grow very well here. There were shrubs that did exceptionally well because they are very salt-tolerant.

We sampled down through the profile to 13 feet and here is what we found. That the salts moved out of the upper ten inches and they accumulated at about 20 to 30 inches so they moved

out of the upper part of the profile and they only moved down about 30 inches and there was a big bulge. The salts -- when I say salt, I am here talking about soluble salts. The salts moved out of the upper part and moved down to the lower part.

Is that what you would have predicted? That's exactly what you would have predicted if you had studied native soils and undisturbed soils and you had taken samples from there. This is what you would have -- you might not have predicted those depths but you would have predicted that the upper part of the profile would have relatively low salts and the lower part. Were the salts the same as when we started? Absolutely. I have taken thousands samples of spoils and the salts are equally distributed day one through the profile. I have studied spoils after a number of years, two, three, five, ten up to 20 years and the salts move down.

Let's go to another study and see what happened here. This is another one that I did. In this case, again, it was in New Mexico. Samples represent four years after the site was reclaimed, and this time there are 24 inches of soil over the spoil.

Here is what we found: None of the salts

migrated to the surface. The salts migrated into the topsoil about four inches. We took samples in four-inch increments down through the 24 inches of the profile. There were no salts in the upper -- no accumulated salts, no salts higher than what was there four years previous. But at the four-inch zone right above the spoil there was an accumulation of salt.

What happened below? This was really interesting. Not only did the salts move -- they moved out of the soil. Some moved up. A lot of it moved down and there was a salt bulge below about 12 inches below the spoil. So the water came down.

Why were there salts in the topsoil? Why did it move up four inches? Because there was some capillary action, there was some conditions with unsaturated flow, not saturated flow, unsaturated flow, and our theory is that the salts moved by diffusion. So if I have a column of water and I have some salt here and I don't do anything, I don't shake anything, I'm watching it, those salts will want to go from a high salt concentration to a low salt concentration and that salt will move through the water through diffusion.

Conduction is when the water is moving

from one place to another and the salt is convecting with that water moving. We don't think that's what's happening. We think the salt moved by diffusion and that's how we account for the salt in the topsoil.

So what's the concern here? It's a huge concern. This is a huge concern. And I know this sounds crazy to you but 40 years ago, you know what? I was studying this stuff 40 years ago and here is what -- this is what we were being told. I don't think I ever believed this. Those salts are going to migrate to the surface and all the vegetation is going to die. This is wrong. This is not the way to reclaim the soils. Putting 12 inches of soil over the spoil material is nothing but a disaster because the salts migrate to the surface.

There was a study done and it tried to demonstrate -- it was done in North Dakota -- that the salts migrated to the surface. Well, they did. But what somebody forgot to tell us is there was a water table at 24 inches. The water was perched, so there was saturated flow, saturated water in this material and yeah, the salts migrated to the surface. That happens all the time around rivers, for example. I see it all the time.

I had to work this in. I spend a lot of time around rivers because I love to fly fish but around rivers, the salt, if the water is near the surface will migrate to the surface. Totally different situation.

So here was this fear that reclamation in the west -- this is 40, 50 -- started out 50 years ago, but 40 years ago that was a real fear. So studies were being done all over the west to see if salts, in fact, migrated to the surface, and that's why there's been so much research done on this particular subject, and there's a lot of research that's been done on that subject and it's been done with different depths of soil and I have done it with different depths of soil. It's been done with different concentrations, different natures of spoil.

Let's go to another study. This particular study was done in Texas, and this is more of what we want to talk about. This is a study that was done by McFarland. What I'm going to show you is data 20 months after the reclamation. I'm going to show you where in this case he put 36 inches of soil over the pit contents and this time instead of spoil, these are pit contents. I'm actually going

to characterize those.

What I'm going to show you is that the salts migrated into the soil from the pit contents but they didn't migrate to the surface. So let's look at some data. I know this is a little overwhelming so if you will stay with me. Let's start over on the left-hand side. I'm going to show you two sites, one is called the Mertz site and one called the Weatherby site. We're going to start with the Mertz site.

Let's create what happened. What happened is McFarland put out some pit contents on the ground, probably dug a hole. Put the pit contents down and put 36 inches of soil on the pit contents. Let's turn to the pit contents first. If you look to the left you are in the column for electrical conductivity. Remember electrical conductivity is the soluble salts and the value is 169 millimoles percent centimeter. McFarland also measured the amount of sodium in the pit contents, and he found it to be 1913 millimoles per liter of sodium, and then he also measured the chloride. So you got a feel for what the pit contents are, so let's see what happened.

He took measurements one month after he

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constructed the plots, and let's go down the column for electrical conductivity. In the upper six inches of the profile of this topsoil that had been put on, the EC was .6. Below that was .5, below that was .5 and then we will look at two six-inch zones right above, .4 and 1.8. You might want to think -- and that's okay if you want to think this -- but maybe there had been in a month some salt that moved into the six-inch zone. I'm kind of not sure about that. And it doesn't matter.

The sodium is .9, 1.1, 1.3, 1.4 and 7.5. Now I'm a little more sure here and McFarland was, too. He said some sodium had migrated into the upper six inches in the first month. What we would have expected if he put the soil out, you would have expected the sodium concentration at that six-inch above the pit contents to be the same as all the other numbers above.

Then let's go over to the chloride. Same thing. Wouldn't you expect the chloride concentration to be the same in the soil top to bottom? Yes, that's exactly what you would expect. So in about a month some chloride had transported itself from the pit contents up into it.

Let's jump over to the other figure and

this represents 20 months.

Q. Before we do that, Dr. Buchanan, one thing that I think is important here is when we look at this depths from zero to 6 and 6 to 12 and 12 to 24, those are sort of like the bucket depths. In other words, he sampled in that range. We really don't know if the salt extended one inch, two inches or six inches in the study because he took the sample from the interval; is that correct?

A. That's absolutely correct. That's one of the problems -- excuse me, let me get a drink of water. Did you catch what Mr. Hiser said? See, I sampled all six inches. I didn't sample in little one-inch increments so how far did it migrate? I don't know, but I have a sample from zero to six inches and one from the next six inches. And that's kind of one of the problems. Only on a couple of occasions have I been able to sample in very, very small increments. For the most part we are sampling in six, ten, 12-inch -- and I say ten-inch because we do 25-centimeter increments, so sometimes we sample in metric and sometimes we sample in English units, but for the most part we sample big blocks of soil.

Okay. Let's move over to the graph, the

table on the right and let's see what happened after 20 months. For the most part, the upper 36 to 30, no change. Thirty to 24, no change. I'm sorry, I'm on electrical conductivity so we're all together here. From 24 to 12, .5 to .4, no change. Twelve to 6, .4 to .5, no change. Then from six to zero, 8.1.

I think we would all agree that the electrical conductivity increased above the pit contents. I think we can all agree on that. McFarland certainly said that and I certainly agree with him. Look at the sodium. For all intents and purposes there's no change until we get to the six-inch zone and then look at the chloride. I don't know if you want to get excited about 1.6. Things like that don't excite me. McFarland didn't try to explain. His conclusion was that the salts hadn't migrated into the upper 12-inch zone but they certainly had -- chloride had moved from the pit contents up into the six.

Now, I didn't show this, and I'm sorry I didn't, but McFarland extended this study and he extended it out 44 months. So he extended it 24 months beyond the data that we are looking at and then he collected the data again and virtually two

years later there was no change at the Mertz site. I'm going to tell you the same thing for the Weatherby site.

So one might try to draw the conclusion: Oh, so the salts are moving up so they will continue to move. No. The mechanisms -- go back to the very basic things that we learned, oh, my golly, 45 minutes ago. Forty-five minutes ago we talked about the mechanisms of how this all works. There's no mechanism to get the salt any higher than where it is and that's what McFarland found out. Two years later the salt concentration was basically the same and that the salts didn't migrate any higher than where they had migrated to this point.

I have done studies that were 12 years after, and the salts migrated up but then that's it. They go so far and then they quit. Let's go to the McFarland study and maybe we can get through this quicker.

I'm sorry, I am really confusing you now. This is the Weatherby site, still the McFarland study. So in this case are the surface soils different? Yes. These are a different set of soils that he used for topsoil.

Let's kind of cut things short here and go

to the zero to six-inch layer. One month after, yeah, looks like EC went up, sodium went up, chloride went up. What happened 20 months later? Looks like it went up a little more than six inches. It certainly went up six inches but look at the six to 12. So McFarland concluded that in this situation the salts migrated up a little higher and he is correct. And he also continued this study and two years later his conclusion was that's as far as they ever migrated, this 12 inches. Notice how little migrated into the six to 12-inch zone compared to the first six inches.

Q. So, Dr. Buchanan, what is the mechanism in your mind that Mr. McFarland talked about in his study that causes the salt to move up and why does it stop at that level?

A. The salts are moving in an unsaturated flow condition. The soils are moist enough -- the water has moved down. They have stayed moist enough and there's enough water at that contact zone where the soil meets the pit contents. The water moves down. Water will move through a soil media without any interruption unless it hits something that is like a barrier, so this pit contents is like a barrier. The water moves down. What happens when

it hits these really fine materials? It essentially slows down or for all intents and purposes stops.

So think of this plunge of water coming down, coming down, coming down, behaving just like we thought it would behave and then it hits and gets stopped. And gravity is having trouble pulling that water through that so you get a buildup of water right at that contact zone. That's why we get some salt movement in the first month.

What happens to the water up above? Gravity moved it down. There was some evaporation. That is very dry soil. There's not enough water to capillary that salt any higher. There's something -- the Weatherby site -- he probably put the same amount of water on there but there's something about those soils that water was able to capillary a little higher in that particular soil, and that's why it went up to 12 inches.

Why didn't it go to the surface? Because the soil is too dry. It can't carry those salts any higher. There's no mechanism. There's no diffusion and that's one of our premises is that's how the salt moves is through the diffusion through these connections of the water, but there's so little water in the profile that there's no diffusion

appearing so it stops the movement of salt.

We see it time and time and time again. We see it in natural soils. We see it in recreated soils. We see it in soils that either have pit contents with cover soil, we see it in soils that have been reclaimed and mines where there's spoil material and it will migrate up and then the soil is too dry and you can't get the salts to migrate any higher.

Q. And Doctor --

A. Let me interrupt. Well, go ahead, please.

Q. My witness is out of control. Go ahead and finish your thought and then I have a question.

A. You know what? You are going to realize how old I am. I just lost my thought. Why don't you ask your question and maybe that will get my thought going.

Q. So as I understand what you have just said is that there is this area of moisture above -- a slightly moister area above the pit contents in this particular case and that diffusion caused the salt to move up six to 12 inches, depending on the sites. Then you said periodically the moisture is refreshed with water that comes down.

A. That was my thought.

Q. The water that was moving, is the movement of the water, that convective flow, is that going to do anything to the salts that have moved up a little bit?

A. Yeah. It will -- if you caught what he said, and that was my thought where I was going with this, was now as I put water on top of this profile, either by irrigation or by rainfall, and for the most part we are going to talk about rainfall. It doesn't matter, it's just water. Water comes down, and remember how it was saturated 45 minutes ago? That water will move the salt down momentarily. Then as it dries it moves up a little bit and then it will move down. In time it will come to an equilibrium. It will only move down so far and it will only move up so far.

At various times in my life, I have gone out and sampled those soils and I caught it at a time when it was going up or down, but it was only moving a few inches. And what we are able to measure is that there is salt above the pit contents or there is salt above the spoil material. Did I explain that okay?

Q. Yes.

A. Okay. Let's go to another situation.

This was done in 2007. This was done for ConocoPhillips and I did this with a couple people. Once in a while I get to do something fun and this was kind of a fun project. This was done in New Mexico. This was 40 years. We sampled this site 40 years after it had been reclaimed. In this case there was no pit liner. This is a drilling site. There's drilling materials. There was no pit liner. This is 40 years ago. And they put 20 inches of cover soil over the pit contents.

Now, I call this the wedding site and I call it that because that was the year that -- I'm sorry. That's the year my wife and I got married. And we are still married.

Okay. Well, I apologize for that. Let's get back to business here. This is a reclaimed site. It was reclaimed in 1967 and this is what it looks like. It has grasses, has a few shrubs. Notice in the background where it was never disturbed. Of course, you don't know what that is, and you don't have to believe me. That's sagebrush. So this is a sagebrush type of community. This is definitely semiarid, about ten, 12 inches of precipitation, closer to ten.

So we have a track hoe and we dug a hole

and dug a hole about 15 feet. What I hope you can see are what would be called pit contents, and they would be at about 20 inches below the surface and they are, oh -- I forget now. We will look here in a minute. I think they are like 15, 16 inches thick.

Q. Just for the record, since the record can't see the picture, that's the gray area that you see as a stripe across the picture?

A. Right. So here are pit contents. No pit liner and there is soil from the local site put on as topsoil and it was 20 inches thick. So we dug another hole a couple hundred feet from this site in a native soil that represented undisturbed conditions.

I'm going to show you data from the two sites. So one is native undisturbed and one is this pit here with the pit contents. Now, what I want you to do, from all that you have learned this morning, I want you to think about what do you think you are going to see? You think about what you are going to see and then we will see how well you did. This is Quiz Question No. 7.

Q. The next slide is one of the ones that has changed, because what happened is the one you got

was set horizontally whereas it should be set vertically. I corrected that here.

A. If you have that in your book, just turn your book sideways. Let's concentrate on the blue line, okay? The blue line has no pit contents, right? Because it's a native site. Remember the soil that I showed you earlier? Remember what we talked about? So what happened? I took samples in 12-inch increments down to, oh, about 164 inches.

That profile a is depiction of the electrical conductivity. The soluble salts. What were you guessing before you saw the slide? You thought the salts would move down? You were right. They have moved out of the upper part of the profile, upwards of 36 inches. In fact, we don't see any accumulation until we are almost down below four feet, about 60 inches, five feet. We start to see a little bit of pickup of soluble salt. It picks up and picks up and it kind of maxes out at about 92 inches and diminishes back and it comes back to a level not too different than the surface at -- oh, somewhere around 144 inches per Es, so that's about 12 feet. Is that what you predicted? Sure you did, because you are good students and you are going to get an A today.

Now, what happened with the pit contents? The pit contents are 20 inches below the surface and they are approximately 16 inches thick. Would you have predicted salt would migrate from the pit contents up? Yes, you should have said that. And notice that the pit contents had an electrical conductivity of about nine. And just above, four inches above the pit contents, it's about seven then another four inches up it's about more or less five, and then finally it gets over to about two, and finally it gets back over at oh, about six inches or eight inches below the surface it's back to where the original native soil is.

A couple things to learn from here. Salts migrate up. Do they migrate to the surface? No. Forty years later did they migrate to the surface? No. Will they ever migrate to the surface? My thesis is no, they will never migrate to the surface. The mechanisms that control the movement of water in the soil will maintain those salts out of the surface. That thesis is mine and this only reinforces that.

Look at the levels of the electrical conductivity. At the third sample, which is represented at about a ten-inch depth, it's two, and

then it's about five at more or less, I guess, the 14-inch, 16-inch zone.

This is kind of an important point here, and we will get into this in the reclamation part of this discussion. But when we started out in agricultural, we were very concerned about electrical conductivities of four and greater. For the most part, what agriculturists said is we can't grow crops above four. We know better than that. We can pick some crops and by good salt management we can grow crops at a little higher than four but we like to not have to deal with that. So four has been kind of the standard for agricultural.

In fact, two, if you have a soil and you are going to buy a farm and it has a electrical conductivity of two, you ave low salt content and you can grow almost any crop on that soil. Not any crop but nearly any crop.

But look at the one where it's at seven. We don't want to farm with that. But here is what we have learned about reclamation and native plants. I had a student do her thesis on this very subject. We did some greenhouse studies and we did some field studies, and what she found was that some of the plants, alkali sacaton, and I know that doesn't mean

anything to you but it's just a grass that's really important in reclamation -- can handle electrical conductivities of in excess of ten, upwards of 12.

Four wing saltbush can handle electrical conductivities 15, 16. What am I saying? I'm saying that some of the plants that are growing at this site could actually root into those pit contents and extract water because they are capable of handling soils that have electrical conductivities in excess of nine, and that's what those pit contents are.

So here is the magic question. Were there any roots in those pit contents? Yes, there was. Not only were there roots in the pit contents but there were roots below the pit contents and there were roots in this particular profile down about 40, 48 inches, just almost as we would have predicted.

This soil, this particular site, behaved very well. It did a lot of the things that I thought it should have done based on previous research. The salts migrated up. They didn't go to the surface.

I'm sorry, we haven't talked about this yet. Did the salts migrate down? I don't know much about salts migrating below the pit contents because

I haven't studied that much and I don't want to get into it too deep but I will just say what happened at this particular site. The salts migrated down, and right below the pit contents the salt content isn't too dissimilar than the pit content. Then it starts to diminish and it moves down. It diminishes and diminishes until we get down about seven feet below the pit contents and then the salt content starts to match the salt content of the native soil.

So I think one would conclude, and I would conclude here, that the salts have migrated down and they have migrated in this particular case, this particular situation and conditions, about seven feet below the pit contents. And I will remind you -- of course, you remember this. This particular site does not have a pit liner, so these materials or the water in this profile was able to move through the pit contents and move below the pit contents.

Would you have predicted that? Yes, you would have predicted that. You would have predicted water would move about four feet. Has it moved beyond four feet? Yes, in this particular case.

How did the salts get down there? Water took them down there. They don't have little feet

to walk down there. They had to migrate with the water and then they stopped migrating at about seven feet -- about ten feet below the surface. Why did they stop migrating down? Because water wasn't getting down any deeper than that.

And I have had the good fortune at times to be able to dig deep holes. For the most part all the holes I have dug in my life -- if I dug them personally they weren't deep but with a backhoe I could get town to about 60 inches but on occasion I have explored 10, 15 feet and I was interested in looking at the root patterns of plants at those depths and there are plants -- there are some that will go down that deep.

But here is what I learned. Roots don't go where water doesn't go. Now, is that rocket science or what? Roots go where the water goes. If the water doesn't go there, they don't go there. Simple. So if somehow water gets down ten feet, there are some plants that will produce roots that will go that deep. Will grasses do that? Largely, they don't. Grasses for some reason, and I think it's genetic, for the most part confine themselves to the upper 24 inches of the profile. I have seen that with natural soils, reclaimed soils. Grasses

must have some really strong genetic propensity to stay in the upper 24 inches of the profile even when there's water below that, because shrubs will go deeper. I don't know why I said that. I just thought that was interesting.

So what did we learn from this? We learned that salts migrate up. They don't migrate to the surface. We know why. They migrated down and they migrated with the water.

Q. Dr. Buchanan, if we look at the pit content, in this case this pit never had a liner?

A. Correct.

Q. So presumably the pit was still damp or wet when it was closed, so there may have been moisture although to some extent that's speculation and we don't know?

A. We don't know. But we know the pit contents are pretty much intact because they were very stratified and they weren't mixed with soil. They were pretty much pure pit contents.

Q. So if a liner was there during the time that the liner was holding the water in, would there be a way for water to move below that liner?

A. If that liner were a liner that could keep water from moving through the liner, then the water

would not have moved beyond -- my premise would be -- my assumption would be that if the water can't get through the liner then the water couldn't move below that particular point and we would have seen nothing happening in the way of salt accumulation below the pit contents.

Q. Then in terms of with the proposal that's presently pending before the Commission with the removal of the upper liner that formerly would have been over the pit, would you expect there to be roots from the shrub classes that might extend into the lower depth of the 48-inch cover and possibly into the pit contents itself?

A. If these pit contents -- all I know about it is the electrical conductivity. Based on the electrical conductivity, there's nothing based on the electrical conductivity that will limit the growth of shrubs into those pit contents. They wouldn't be limited by that electrical conductivity.

In fact, if what I said is true, that grasses grow about 24 inches and the pit contents are 20 inches from the surface, wouldn't you be suspicious that the grasses would be into the pit contents? As I remember, there were some roots in there, and it's kind of hard to tell shrub roots

from grass roots and forb roots, but the electrical conductivity of those pit contents are not limiting to alkali sacaton. Alkali sacaton could have survived easily at electrical conductivities of ten, and nine would not have limited that plant. So you would expect some plant roots to grow into the pit contents.

Q. So where there are some native species or other species that could put their roots in there, would they tend to draw moisture out of the pit contents?

A. Yes. If the roots go in to a profile, pit contents or whatever and they are able to survive and they are able to handle the salt concentration, then they would extract water from where they are growing. That didn't sound very smart, did it? You understood what I said so I don't think I need to repeat that.

Q. Did you draw any conclusions then from your experience with this ConocoPhillips study that are summarized on the next slide?

A. I think he wants me to move on. The conclusions here are this study was done in New Mexico. It was 40 years after reclamation. There was no pit liner. There was 20 inches of soil.

There were no surface salts. The salts migrated about 12 inches from the pit contents up and they migrated about seven feet down from the pit contents.

In summary, what we talked about up to this point regarding salt migration, what I hope I conveyed to you is salts migrate upward into the cover soils from a salt layer, whether it's spoil or pit contents, but salts do not migrate to the soil surface, and salt will migrate downward in a spoil material or in pit contents if they are unconfined. If there's nothing to control that movement, then they will also move downward and they will move with the water.

The current rule, No. 17, requires that there be 48 inches of cover soil, 36 inches of soil and a foot of topsoil, so 48 inches over the pit contents is sufficient for the successful reclamation of the site and for the salt management of that site.

Q. And the proposed industry revisions aren't calling for any reduction in the cover?

A. No.

CHAIRPERSON BAILEY: Is this a good place for a ten-minute break?

MR. HISER: Yes.

(Note: The hearing stood in recess at 10:15 to 10:30.)

CHAIRPERSON BAILEY: We will go back on the record. Mr. Hiser?

Q (By Mr. Hiser) Now, Dr. Buchanan, I believe you were getting ready to switch gears and talk about reclamation. Did you have any general observations about reclamation before we move on in the slides?

A. There's a couple things I would like to say. The first thing is those of you taking the quiz in the last section, your test papers are in the back and it looks like everybody did well.

I would like to draw an analogy to reclamation. Before I do that, I would like to just, in a sense, kind of introduce reclamation. That we started about in the 1950s and much of what we know about reclamation has really been learned after that. It came out of the fields of agriculture, came out of the fields of soils, came out of the fields of geomorphology, came out of the fields of physics, chemistry, range science, forestry, and these people putting their minds together and contributing here and there.

Agricultural had a very strong influence.

We started to learn, and by the '60s we were doing some pretty significant reclamation back east. It actually started for them a little sooner. We didn't really start reclamation in the west until, oh, late '60s. And I came on to the scene in the late '60s. By 1971 I was at the university and doing some studies in reclamation.

Let me draw an analogy to this. Reclamation is a lot like making oatmeal cookies, and I love oatmeal cookies. It takes flour and water and eggs and vanilla. It takes oatmeal, by the way, sugar, and some brown sugar. So if I had all of those components and I knew all those were important and somebody told me that was part of making an oatmeal cookie but I didn't have a recipe and I kind of happenstance put this stuff together, I may or may not getting something that tastes like an oatmeal cookie. If I didn't put the oatmeal in, I promise you don't get oatmeal cookies.

We know the components that go into reclamation. We learned that a lot to a great extent from agricultural by trial and error and we did this and we did that. But we never in those early years really knew what the recipe was, and we

were making oatmeal cookies that tasted not so good and a lot of our reclamation failed. We got a reputation for not being very good scientists because we weren't being very successful in getting reclamation established.

As the years went on, the recipes got better and we learned, but we still made mistakes. And Mother Nature played tricks on us. We thought it was going to rain and it didn't. We thought it wasn't going to rain during that period very much and it flooded. So these things were happening and these cold -- I remember we planted something one time and it was very successful, very successful reclamation. Then we had a ten below zero spell come. That was unprecedented. What was that all about? Every four wing saltbush we planted died. Just died.

Oh, my. I guess we will start over. So what I'm going to talk about, to some extent, if you want to think about the oatmeal cookie, we are going to talk about reclamation and the recipes.

One of the very basic laws to reclamation is Liebig's Law of the Minimum. Justus Von Liebig in about 1840 came up with the idea. Now, he's a very interesting person and I would love to tell you

a lot of trivia, but I will tell you he was one of the first people to invent fertilizer. You know what he did? It was insoluble and couldn't be used in the soil and he couldn't give it away. He had the idea that the carbon in a plant came from the atmosphere, from carbon dioxide. He was absolutely right.

He also had the idea that that factor in the least supply is that factor that will control the growth of the plant. If you remember that principle in reclamation. If you leave something out, you don't get an oatmeal cookie. If you don't put enough of it in, and that thing that is in the least supply, that will be the thing that will have the greatest influence on the success of that reclamation. Liebig's Law of the Minimum.

The recipe is basically for today going to be three major components: Topography, topsoil and vegetation, and I want to address the three subjects. The first one we will address is topography. We found that we need a stable topography, something that is geomorphically stable. If it's geomorphically stable, the vegetation only helps maintain that stability. If it is not geomorphically stable, if the landscape is not

stable on its own, all the vegetation in the world -- and I know somebody is writing this down and I wouldn't want to be quoted so I will say it a different way. You can put a lot of vegetation on an unstable site and it will still be unstable and it will erode. Vegetation isn't the answer to everything. The stability of the site is so critical. The vegetation helps.

We had a situation where we had a geomorphically stable site. It rained two inches in less than 15 minutes. No vegetation. It had been seeded but the vegetation hadn't grown yet. Virtually no erosion. The erosion was very minimal. Why? Because the site was geomorphically stable. Once the vegetation was established, that site is very stable, very successful and that particular site, the very one I am talking about has won national awards as the best reclamation in the whole United States and it's right here in New Mexico.

Q. So Dr. Buchanan, we were talking about the geomorphology. That means basically the structure of the soils and stuff that will be present --

A. The structure of the landscape, that the landscape is such that it minimizes erosion and -- I know what you want me to do. You want me to define

geomorphology. Geomorphology is the shape of the landscape, and the shape of the landscape is critical to the maintenance of that landscape. If it's unstable it changes its shape. If it's stable, it doesn't change its shape.

Q. And then you said that if I had an unstable geomorphology to begin with, even if I put vegetation on it, it would still be unsuccessful; is that right?

A. It's still unstable and in almost all instances it will be unsuccessful. The erosion will capture the site. I am showing this picture. This is our enemy. Erosion is our enemy. This is the thing we are trying to control. If the erosion is controlled, then we can have successful reclamation.

There's other parts of this reclamation in terms of success, but one of the things is the topography has to be successful.

Q. Now, before you move on to the questions about erosion, a lot of times in older reclamation practice we talked about restoring things to its natural or original contour. If the original, natural contour is not geomorphically stable, is that a good idea?

A. That's right, it's not. It's not a good

idea, and we did that in the early years. We AOC'd everything. Approximate original contour, AOC. By law we were to AOC. And know what we did? We FSC'd it. That's not in here so just write down the letters, FSC, final surface configuration. We went from AOC to a final surface configuration that was stable.

Q. Generally with the final FSC as you just said, we were trying to approximate the original contour to the extent we can, but we take out those features of it that may have made it geomorphically unstable?

A. We are trying to get away from the instability, and at the same time we had these brainy ideas that the things we could do out there, like big long drains, for example. What an awful idea that was, but we did it and we built bunches of them. We thought well, this is a way to control erosion. And it doesn't work. We have learned now it doesn't work and we are taking them out and changing the shape of the landscape.

Oil pads aren't so bad. For the most part, they are flat, but there's usually a cut slope and a fill slope and those can be cut in such a way that they can be geomorphically stable and the fill

slope can be filled in such a way that they can be geomorphically stable. For the most part, things that are flat don't erode too much. Don't get too excited about that because there's a lot of flat places that erode. But if we are careful with how water comes on to the sites and off of the sites we can do a great deal to control the erosion.

Q. The important things here as we look at the rule and the changes that the industry has provided for is to allow a little bit more flexibility to achieve the geomorphology that's stable?

A. Correct. We want to have the flexibility to do the thing that is right. Let's turn to another subject, topsoil, and spend a little time talking about soil. One of the beginning arguments was this building a standard for topsoil. What constitutes topsoil? It has to have these characteristics and these characteristics. Well, where did those ideas come from? Out of agricultural. What happened is we were trying to grow native plants using agricultural standards and we said well, we can't have anything with an EC over four and we can't have an SAR greater than 12. We can't have this and we can't have that.

So we were restricting ourselves so much and, in fact, sometimes to the point where we weren't allowing things to be in the topsoil that were necessary to native plants. I will give you an example.

So what did agricultural say? Low sodicity, low salinity, low gravel content. Can't have gravel in the soil. Well, yeah, it breaks up plows and it's hard to plow soil that has rocks in it, but that's not the case in native soils.

Now, this is another quiz and I want to teach you something here. See the word sodicity? S-O-D. That's the first three letters of the word sodium. So when you see the word sodicity, you are talking about concentrations of sodium or you're talking about the sodium in the soil.

See the word salinity? The first letters are S-A-L. That's the first three letters of salt, S-A-L-T. Salinity is the electrical conductivity, the soluble salts. The sodicity of the soil is the amount of sodium in the soil. I mean this to be funny: You are on your own for gravel.

So in reclaimed areas we can have high sodicity and be very successful. We can have high salinity and be really successful and we really like

high gravel contents. Gravel is our friend in topsoils for reclaimed sites. Why is gravel our friend? Because it's very resistant to erosion. We can do great things in controlling erosion by having some rock fragments in the topsoil. I know that's counter to a lot of our thinking but it actually -- and that particular site I was telling you about that has won the national award in part won that award because we had the imagination, if you will, to put gravel in some of the topsoils and those sites were not only geomorphically stable, but now they were very resistant to surface erosion.

Something we know is as topsoil depth increases, for the most part the amount of cover, the amount of plant cover at a site increases. So if you have very shallow topsoil, you will get less vegetation. If we have very deep soils, and in my world deep is things that are over 24 inches. When we get to four feet, we have a very deep soil. So between zero and 24 inches we get a lot of distinction between the amount of cover. Once we get to about 24 inches of root zone material, we can get to the point where we are maximizing cover.

The other thing, the sister to that is diversity. If we increase the depth of topsoil we

increase the diversity. Now, sometimes we don't want really deep soils in some instances. We want shallow soils because that promotes shrubs. The middle depth soils about four to six inches of soil, you will get almost exclusively shrubs and hardly any grasses. Six to nine inches, you get, not exclusively, but a lot of forbs. After we get 12 to 24 inches of soil we get mostly grasses. Do we get shrubs on deep soils? Absolutely. But we get more grass on deeper soils.

So don't get confused here as to what I'm recommending. What I am saying is we can control diversity to some extent by the depth of soil, but if we are trying to do something else with depth of soil like protect something, then we will accept that we will get grasses and then we can do some other things to encourage the growth of shrubs and forbs on those deep soils. And I will show you that in a moment.

One of our enemies in reclamation is compaction. If there's any one thing, if Liebig was right on any one thing -- and he, of course, didn't say this -- but it's compaction. If there's one thing we need to take care of, the thing that we need to eliminate, plants do not like compaction.

There's a whole bunch of reasons, but just accept that -- basically you know that. If soils are highly compacted you have very difficult times establishing vegetation.

So what do we do? We break up the compaction. One way is with chiseling. We will chisel or sometimes we will put up deep shank -- we pull it with a cat -- I'm sorry, I lost my train of thought.

You do something to the soil to break up that compaction. Another thing that's really important is seed bed preparation. If there's any one thing that you will go across the nation and talk to 100 reclamationists, one of the first things they will tell you is seed bed prep. You have to get the seed bed prepared correctly for the seed that you are putting in. I want to emphasize that, that we carefully do that and do it in such a way that we give that seed every opportunity to germinate and grow. There's a whole bunch of ways to prepare the bed, and we have done them over the years and many of them work. It has to be tailored -- this is very important -- it has to be tailored to the site.

Some soils need to be prepared this way.

Heavier soils need to be prepared that way. So this is not a one-thing-fixes-everything. This is you tailor that seed bed prep to the soils that you are working with. Fertilizer --

Q. Before you go on, this is the one case where there was a missing word in the presentation and that is the "no" in front of the fertilizer.

A. Do you notice that the slide is out of focus? It's on purpose. It's not real clear, and I don't mean this as a joke either. It's not really clear about fertilizer. What we know is that as we fertilize, and we did that in the early years, we got Knapweed, we got White Top and we got Halogeton, and those are all nasty weeds. Here is the message that you take home. If you fertilize, even if your home garden, you are going to encourage weeds. Period, end of paragraph.

We try to avoid using fertilizer as much as possible. We would like to get to the point where we use no fertilizer because these plants, if we are native, and they should be native, they don't know what to do with the nitrogen. They have never evolved with that much nitrogen. They have never evolved with that much nutrients. They are used to having very difficult circumstances, so we babied

them too much when we started out. We thought oh, these poor characters. They need this stuff and we put the stuff in there. We didn't get what we wanted but we got weeds. So we learned a lot about fertilizer and we are careful in using it. I'm not saying not to. I'm saying you have to be extremely careful and for the most part we avoid fertilizers. The last thing is vegetation.

Q. Before we move off of that, the take-home message here is these are very site-specific evaluations and do they lend themselves well to a rule to address these steps of the reclamation process?

A. I know this is being smart, but they lend themselves to flexible rules really well. They don't lend themselves to strict rules at all. If we have one strict rule that we can only stay within those confines, we will very much limit ourselves as to our ability to be successful at reclamation. We want to have -- we, as a reclamationist, we would like to have flexibility to match the right seed mix to the right place, the right seed bed prep to the right place, the right geomorphology to the right place.

I'm going to move on to vegetation. Seed

rate. This is the amount of seeds that we put on the ground. For the longest time -- and this is a big long lecture and takes about a half hour and I'm not going to get into it so you will have to skip through it -- we put it out by pounds. We put a pound of this and a pound of that. And what a mess we had. You put out pure live seed, PLS per square foot. We would like to put somewhere between five and 50, and this comes into the flexibility.

Do all sites have to be seeded with 25 seeds PLS? No. Some sites need five or ten seeds per square foot and some need as many as 50. Some times of the year we put more seed and some times of the year we put less. At these elevations we put more seed; and at lower elevations we put less seed. So it falls within the range of five to 50, and the point I'm trying to get across is we don't put it out in a poundage way, we put it out as the number of seeds per square foot.

We need to adapt that to the site. One of the things that's also important in this is the seed mix. There's a paper that was written, and the author said what you seed is what you get, and he was right. What you seed is what you get. If you seed alkali sacaton and that's all you seed, that's

all you get. If you seed grasses and forbs and shrubs, you have the opportunity to get grasses, forbs and shrubs.

So is one mix good to all things? Of course not. We want grasses, forbs and shrubs.

Now, watch what happens here. So some mixes are for steep slopes, some are for north, some are for south, some are for east, some for west, some for flat places, so we adapt the mix to the type of location. The type of location. The elevation will make a huge difference as to what mix is used. We are still using grasses, forbs and shrubs, but we change up that mix. We change up the species. We don't grow alkali sacaton at high elevations or western weed at low elevations. It can't handle the low precipitation. Or we get into a wet area. We don't want certain species in there because they don't do well. It's a just a waste of time and a waste of money. They compete for things that they have no ability to compete with.

So the seed mix is very critical here, and it has to be tailored to the place that we are seeding.

Seed timing. This is when we actually do the seeding called seeding timing. This is really

some interesting stuff. I like talking about this. The difference between annual and seasonal precipitation. We always say, oh, well, it's a 12-inch precip zone or that's a 10-inch precip zone and we all talk about annual precipitation. That is meaningless in reclamation. The seasonal precipitation, what time of the year does that precipitation come? Spring, fall, winter, summer? If it comes in the summer, when do you seed? When the precipitation comes.

What if the spring is extremely dry? I worked in areas where we would go 60, almost 90 days without precipitation. Did we plant trees during that time? Absolutely not. We waited until the rains had established themselves and then we planted and timed our seeding to the seasonal precipitation.

Now, it goes one step beyond that. It's not only seasonal but the number of rain events. We know, and if you have spent any time in New Mexico, you know that when it rains sometimes it rains cats and dogs. We can get a two-inch rainstorm, a three-inch rainstorm, so that's the amount. So in this particular season, we get two inches of rain. Do you want two inches one day or would you like to have that spread out over ten days? Of course you

want it spread out.

So one of the things that I have looked at very carefully and have made a big deal out of is not only what season to plant in but what time in that season so I maximize did I get the greatest number of rain events during that period of time? What am I talking about? I am talking about getting frequent irrigations. It gets a little rain and a couple of days later it rains again.

If I get 13 rain events in the month of July and I get one rain event in the month of August, I want to be planting during those frequent rain events. I know I am making a big deal out of this but it's a big deal to me.

Let me talk about diversity. This is a very interesting subject because it involves so many different things. Diversity, for the most part, we think of grasses and forbs and shrubs. That's diversity. One of the things that we did in the early years, and we made a big deal out of, was that we had this grass, this particular grass species. We will pick on the one on the right, alkali sacaton.

That species name is Sporobolus airoides. That's what's growing there in the reference site in

this particular instance that I'm giving you.

But I don't get alkali Sporobolus airoides to establish very well but I can get Sand Dropseed, Sporobolus cryptandrus, to establish very well.

Now, I would like to tell you I interviewed a cow one time and I asked the cow what the difference was. I think I interviewed the cow but he just never said anything. Here is what I am speculating the cow would say. The difference of those two plants is the openness of the pannicle and the length of the ligule on that grass and a cow cannot tell the difference. For the most part, most human beings cannot tell the difference on the length of the ligule. But if you are stuck on species diverse diversity and you had alkali sacaton and you now have sand dropseed, you would say I didn't meet the diversity standard because I don't have alkalide sacaton.

So about ten years ago, another professor and I came up with this goofy idea of life form diversity. What we said was if it was a grass before, a life form -- an example of a life form is grass. Another example of a life form is a forb and another life form is a shrub, and another life form is a tree. If I had grasses before and they were

native grasses, and we can categorize those life forms however we want, but if I had alkali sacaton before and I had sand dropseed later, I have the same life form and I promise the cow can't tell the difference. Then I have established the life form.

So I am proposing that when we measure diversity in reclamation, we measure based on life form and don't get so caught up with the species.

Okay. You know what? We are almost done here. I'm going to summarize what I have said about reclamation. There's some critical elements for success. There are some parts that go into the oatmeal cookie. We know that and we know there's some things that go into reclamation. We know that some things are important, very important for success and we try to get those in the right proportions. One of them is a stable topography. Another is sufficient topsoil and three feet of root zone material with one foot of topsoil is sufficient. Forty-eight inches is sufficient and we are able to establish vegetation on soils that deep.

Compaction management is very important. It needs to be dealt with. Seed mix. And I know I pounded on that and I know you believe me that seed mix is very important and that we approach diversity

from a life form standpoint and we need to plant in a favorable growing season to maximize the ability to get those plants established. That's kind of the recipe. It's kind of a goofy recipe because it doesn't have one teaspoon and two tablespoons and three cups, but we know the parts, and when we talk to professionals who are reclamationists who know some about this, they know whether it's two cups, three cups, two tablespoons or a teaspoon and we address those issues and we are pretty smart.

We are actually pretty smart people. I don't mean reclamationists. I think all people are smart and we just have talents in different subjects and reclamationists are smart in their field and we have been pretty successful in getting reclamation established if we do the right things. That's really all I have.

Q. One question. You talk about compaction management. Does that differ between whether we are looking at the final reclamation when we are trying to reestablish the vegetation? What if I wanted to use a part of that for pit parking or moving equipment? Is there a difference in my compaction standard between the interim period and the final period?

A. Yes. In the interim period we are visiting the site. We want it compacted. We are not trying to -- fact is, we are not trying to grow vegetation on it. We are driving on it and visiting that site and we're taking data from the well or adjusting instruments at the well. When we get to the final reclamation, yes, we have to get rid of the compaction. If we don't get rid of the compaction it's a death wish. We are not able to -- for the most part, we are not able to establish reclamation on sites that are highly compacted. There's hardly any exception to that.

Q. At this point, Dr. Buchanan, I would like to change from sort of this general view of reclamation, revegetation, salt control and look at some of the changes to the rule. So if we look at Attachment A behind Exhibit 1 in NMOGA's exhibit book and we go to Definitions on Page 2, under L there's a definition of life-form ratio and that's defined as the relative percentage of plants in each of the following classifications: Shrubs, forbs and grasses. What are you seeking to do with the definition of life-form ratio?

A. Try to get away from species, a ratio of species to one another to define diversity; that by

using a life-form ratio, this is the ratio of the grasses that were there -- the grasses to the grasses and the forbs to the forbs and the shrubs to the shrubs and the trees to the trees so we get, within reason, about the same ratio as what we had before.

Q. And so your belief is that by looking at this life-form ratio we should have a more sustainable community in this part of the vegetation and reclamation?

A. What I have found, and it's just a practical thing. I have never published on this but it's just kind of a practical thing. We are required in various disciplines to meet a diversity, and we have had to meet it by species. Here we have this wonderful reclamation, award winning reclamation, all kinds of things growing out there and we can't meet the diversity standard so the site fails. I'm not talking about the oil and gas industry, I am talking about the mining industry. And we failed and failed in diversity.

I have gotten on my soap box so many times that the poor box is worn out, that we have successful reclamation and we have diversity if we would only look at it from a different viewpoint and

stop worrying about one species being replaced by another species, that we replace grasses with grasses and forbs with forbs. It's gotten some attention, and I am asking that that be considered for this Pit Rule. That we look at diversity from a life-form standpoint instead of a species standpoint.

Q. If you flip back to the closure and reclamation standard issues and move to Page 38 of the exhibit, you see here the general provisions on site contouring. Under Section 1A, there's this long paragraph. If I look at the second to the bottom line of the paragraph I see some wording that talks about "that approximates the original contour." And this is sort of the -- is that the older standard of trying to return the original contour that we discussed?

A. I'm sorry, we're having trouble finding it.

Q. Page 38, Section F 1 A, second to last line of F 1 A.

A. "The operator shall substantially restore the impacted surface area to the condition that existed prior to oil and gas operations by placement of soil cover as provided in Section" --

Q. No. Mine reads that they will recontour the location of associated areas to a contour that approximates the original contour and blends with the surrounding topography.

A. Okay.

Q. Is that sort of the older, trying to return everything to its original contour that we discussed a couple minutes ago?

A. Yes.

Q. So your recommendation to the Commission is we look at this -- and I notice that industry didn't propose a change here -- is that what's important here is the approximate as opposed to getting back to the exact original contour, right?

A. Yes. Here approximate would work.

Q. Then if we turn back one page to Page 39, which is the Reclamation and Revegetation, you will see there's a new section here. Does the language here in Section 3 B really better approximate what you believe is current reclamation practice for successful revegetation?

A. Yes, it does.

Q. Then in Section C where we're talking about reclamation, is this where you have introduced the concept of our industry's proposed the concept

of the life-form ratio?

A. That's correct.

Q. And in your opinion, as a person who has worked for a long time in reclamation in New Mexico, is this a good standard for successful reclamation of oil and gas pits?

A. Yes, it is. It is.

Q. Now, I notice that in the fourth line from the bottom, which would be the fifth line from the top, there's a discussion of a uniform vegetative cover, and by uniform vegetative cover, do you mean --

A. I'm sorry, where are you?

Q. The fourth line from the bottom of Section C.

A. Okay.

Q. I'm sorry to have to point the words out this way, but there it's talking about "or uniform vegetative cover has been established." By uniform in this context, are we talking about it's all the same plant?

A. No.

Q. Or are we talking about that it's uniformly disbursed across the surface?

A. Correct. That's the intent is that

there's vegetation over the entire site.

Q. So perhaps if we said uniformly disbursed or well disbursed across the landscape that would be better than the term uniform here because it could be looked at as a uniform planting across the cover? Would that be true?

A. Yeah, that's possible to interpret that incorrectly.

Q. Did you prepare -- if I turn then to the exhibit book and we look at Tab 18, is this a report that you prepared?

A. Yes, I did.

Q. Does it substantially summarize the testimony that you provided to the Commission today?

A. Yes, it.

Q. Behind that, behind Tab 19 of the NMOGA book there is a salt migration study for ConocoPhillips 2007. Did you prepare this?

A. Yes.

Q. And this is additional information on the study that you presented to the Commission today?

A. Yes, it is.

MR. HISER: Madam Chairman, I move we admit NMOGA's Exhibits 17, 18 and 19.

MR. JANTZ: No objection.

MS. GERHOLT: No objection.

MR. NEEPER: No objection.

CHAIRPERSON BAILEY: They are admitted.

(Note: Exhibits 17, 18 and 19 admitted.)

MR. HISER: I tender the witness for cross-examination.

CHAIRPERSON BAILEY: Ms. Foster, any questions?

MS. FOSTER: I do not.

CHAIRPERSON BAILEY: Mr. Jantz?

CROSS-EXAMINATION

BY MR. JANTZ

Q. Thank you, Madam Chair. Good morning, Doctor. Just to preface sort of the more technical questions --

A. I'm sorry, I'm nearly deaf and I have hearing aids on. I can hear most of what you say but don't be afraid to speak loudly.

Q. Okay. I won't. I appreciate you giving me a heads-up. Just to preface the technical questions, you testified before the Commission in 2007 on the Pit Rule; is that right?

A. Yes, I did.

Q. And the testimony then was essentially substantively the same as it is now; is that right?

A. To a great extent, yes.

Q. And the report, I guess, that's now Exhibit 18, you had submitted a report to the Commission in 2007. Are those reports substantially the same?

A. Pretty much the same.

Q. All right. Thanks. Now, if we can go to Slide 17-11. When you evaluated this study or when you did this study, did you look for hydrocarbons as well?

A. No.

Q. Or was it just chlorides? Were you evaluating just chlorides?

A. No, I was evaluating soluble salts.

Q. Soluble salts. Okay. But no hydrocarbons?

A. No hydrocarbons.

Q. Okay. This may be beyond the scope of your expertise and say if it is. Do you know if hydrocarbons behave the same way in terms of transport as salts do?

A. I don't know.

Q. Thank you. Now, when you were talking about saturated versus unsaturated soils, you mentioned that around rivers, groundwater or the

ground is often saturated?

A. I was generalizing, but around a river it's not uncommon for there to be an elevated water table. And when there is an elevated water table, elevated meaning close to the surface, that those soils in that area will often be saturated. Not all the time, but they can be saturated.

Q. Okay. And how far away from like the river's edge?

A. Oh, my goodness. You know what? Boy, I -- there are just so, so many factors that affect where the water table is, and I am not the person to ask that question.

Q. So it could be a site-by-site kind of analysis?

A. Absolutely.

Q. Great. Can we go to Slide 17-14? Now, I'm going to give you the opportunity to teach remedial chemistry here, because I don't know -- I'm not familiar with the millimoles per centimeter or millimoles per liter.

A. Okay. I saw that when we were going through it. I made a mistake. Electrical conductivity is measured in millimoles per centimeter which is the same a decisiemens per

meter.

Q. So they are equivalent?

A. They are equivalent. If you have millimole per centimeter you have one decisiemen per meter, okay? Sodium is measured in milliequivalents per liter so the numbers are okay but the units should have been milliequivalents per liter and the chloride should have been milliequivalents per liter. With changes you can make those into parts per million, for example, but those units should have been milliequivalents, not millimoles.

Q. So the source of my confusion is I'm not -- in the regulations we are dealing with milligrams per kilogram, milligrams per liter. How do these measurements that you have, millimoles per centimeter, millimoles per liter, relate to the measurements, say, in the Tables 1 and 2 in NMOGA's proposed regulations?

A. You know, if you get a really good chemist -- and I'm not a really good chemist -- you change milliequivalents per liter over to parts per million. You can do that. And if I had a textbook and one of my employees to help me, I could probably get through that. But you know what? Today I can't get you over there. But it can be done.

Q. Okay. So we are sort of on our own in terms of trying to figure out how these correspond to the concentration tables?

A. Yes. The point here is that what McFarland was trying to show is the migration of salt. And I have no idea how those would translate.

Q. Okay.

A. I mean, I shouldn't say I have no idea. I have a very good idea. I just don't know how to do it.

Q. That makes one of us who has a good idea. You said when you were talking about the Weatherby drilling pit study that at some depth the salts reach equilibrium. They don't go up and don't go down.

A. They will do that eventually.

Q. At what depth is equilibrium reached?

A. It's very dependent on the soil type, very dependent on the climatic conditions, so you can't say one depth. I can't give you one answer. It will vary for the conditions of climate, soil type, soil texture, et cetera, and the type of salt, of course. The more soluble salts will be deeper and the less soluble will come to equilibrium higher in the profile. It's very difficult to speculate where

they will come to equilibrium.

Q. So you get more rain or moisture and the equilibrium will be lower?

A. Correct.

Q. You get less moisture, equilibrium will be higher?

A. That's a correct statement.

Q. In terms of the soil type how does that affect it it?

A. To the greater extent, soils have different texture, sandstones and clay. We refer to a heavy texture soil as one with quite a bit of clay. Water moves in those soils much differently than they move in what we would call a light soil, which is a sandy soil. Sandy soils, water moves quite differently.

The principles are the same, but they move differently and the storage capacity of a soil is greatly different whether it's sandy, loamy or clay.

Q. Okay. Can we go to 7-19 please. On this one you started talking about what sort of plants -- the beginning of your discussion which you continued later on -- about what sort of plants can survive in the high salt content soils.

A. Correct.

Q. And all those plants were native grasses, shrubs and trees -- well, native grasses and shrubs. I guess you didn't cover trees; is that right?

A. I don't remember what I said, but you can include trees.

Q. Okay, you can include trees. But it doesn't include crops, grain crops, food crops?

A. I know you asked the question, but you are going to have to ask it again.

Q. Are your typical food crops, grain crops, amenable to growing in salty soil?

A. For the most part, no.

Q. So if reclamation were done in agricultural areas, it may have to be done differently than what you explained here?

A. That would be true.

Q. Now, you have said that compaction is bad for the crops or the cover crops, right?

A. I think I said vegetation but cover crop is fine.

Q. And NMOGA's new proposed rules on Page 39, top of the page, deletes the word "compacted." Four feet of non-waste containing earthen materials. Does your analysis account for subsidence in this cover soil?

A. Yes. The answer is yes. Maybe we should just leave it there and say yes.

Q. Okay. In trench burials under NMOGA's proposed rules, liner flaps get folded over the waste. Would that liner affect how root growth -- would that affect vegetation root growth at all for some of the shrubs?

A. If the roots could reach the depths and hit the liner, they would be affected by the liner.

Q. And how would they affect the liner or how would they be affected by the liner, I should say?

A. I mean this in a serious way. Roots don't have eyes, but roots would see that as a barrier and they would see that as something that they couldn't penetrate. What they will do, if the roots can grow what they will do is they will grow like they grow on a layer that they can't penetrate and they come down and then they will spread. I don't have any experience of roots coming down and hitting a liner. I have never seen that in my experience, but I have seen roots come down and hit barriers, buried pavement, and the roots come down and then they want to go sideways, and that's what they will do. That's what they do.

Q. Okay. Now, just sort of a layperson's

perspective. You see tree roots, some weeds especially, can come up -- you can get it so they will crack concrete. Is it conceivable that shrub roots could breach a liner?

A. I guess it's conceivable. You know, I'm going to repeat something. I have never dug around such things and I don't know much about that. I'm only speculating, so are you saying is something possible? Yeah, I think something like that is possible. I don't know.

Q. Okay. And just my last question is for clarification purposes. The next slide, 17-20. On my copy that was submitted with NMOGA's prehearing statement, the ConocoPhillips study has a 25 years post-reclamation period. Which one of those is it?

A. Well, it was reclaimed in 1967 and Ruth and I will be married 45 years in June, so 2007, 40 years. If my math is very good and -- it's not very good -- but I was married on July 1st and I know that. So 40 years will be the correct number.

Q. So 40 years is correct. All right. I think that's all I have. Thank you, Dr. Buchanan. I appreciate your testimony.

CHAIRPERSON BAILEY: Before we go to the next cross-examination, it's getting 11:30ish. Why

don't we take a break for public comment and we can resume cross-examination following that public comment period. We have five people who have signed up for public comment. I would like to repeat what the process is. Public commenters will be given five minutes for their discussion. They can be either sworn or unsworn testimony. Sworn testimony will subject a person to cross-examination. We have Theresa over here with a timer who will enforce the five-minute time limit.

The first person on the list is Mike Sauck. Will you come closer so the court reporter has no problem hearing you. Would you like to make sworn or unsworn comment?

THE WITNESS: Sworn.

MIKE SAUCK

after having been first duly sworn under oath, was questioned and testified as follows:

CHAIRPERSON BAILEY: State your name and place of residence.

MR. SAUCK: My name is Mike Sauck. I live in Aztec, New Mexico. I am the vice president of West Largo Corp. which is a small independent gas and oil company. We drill natural gas wells in the San Juan Basin. West Largo has operated wells in

the San Juan County since 1990. We have since that time drilled and completed 23 gas wells, which is certainly not a very large number compared to many other independent operators in the basin.

Nevertheless, we have enjoyed great success for a small company with only three direct employees. West Largo had the distinction of ranking 58th in natural gas production in the state of New Mexico in 2011.

Since 2004 when we began our infill drilling program, we have drilled ten new Fruitland Coal wells with a total cost of 3.7 million dollars. With a limited number of working interest partners, including notable majors such as ConocoPhillips and BP America we finance our drilling programs out of our own cash flow, not out of borrowed money. Thus, we have every incentive to drill and complete our wells as economically as possible.

In response to the request for information regarding drilling cost comparisons before the Pit Rule regulations and after the Pit Rule regulations were enacted I have provided two AFEs for wells drilled by West Largo Corporation in the San Juan Basin. Both wells were drilled and completed in the Fruitland Coal formation at comparable depths.

West Largo had drilled and completed 22 Fruitland Coal wells in the basin between 1990 and 2008 but we chose to halt our drilling program after implementation of the Pit Rule until we could gain information as to how the new rules would affect drilling costs. We chose to drill our 23rd well in 2010, and even with the best advice that we could glean from other operators and drilling contractors, our drilling costs were woefully underestimated. Please note that the comparisons of the actual costs shown for the two wells. And I have -- I don't know if you want to look at this later or --

CHAIRPERSON BAILEY: You are submitting that information as part of your testimony, sworn testimony. Yes, you are allowed to submit documents.

MR. SAUCK: We were grossly misled by the drilling contractor and drilling cuttings hauler/disposal company as to the estimated costs involved. Note that we budgeted $8,000 for disposal and it ended up costing $77,000. We believe we were intentionally misled to prevent us from deciding to cancel the well due to unreasonable cost.

The drilling contractor cost increased by 27 percent and the time to drill was doubled due to

the inability to resume drilling until the supersucker truck had removed the cuttings from the previous day's drilling.

We hope this actual data will be helpful in establishing the negative economic impact of the implementation of the Pit Rule. West Largo, being such a small independent company, has relied on the excellent assistance of the oil and gas service companies located in the Farmington/Aztec/Bloomfield area. Unfortunately, we have witnessed many fellow business partners and oil service companies go out of business or leave the basin and the state due to the implementation of the Pit Rule. I would like to thank the New Mexico Conservation Commission for the opportunity to present this material for their consideration.

CHAIRPERSON BAILEY: Are there any questions of the witness?

COMMISSIONER BLOOM: Mr. Sauck, thank you for your testimony. Could you tell us how the proposed changes would have led to lower drilling costs in this instance?

MR. SAUCK: The proposed changes?

COMMISSIONER BLOOM: So if you were drilling under a set of circumstances similar to

those under which we would see if these new rules were put into place, how would that have changed your experiences in drilling the 23rd well?

MR. SAUCK: I think that the main thing would be that we would not have to haul our cuttings and dispose of them in another location and those were the main increases in the cost.

COMMISSIONER BLOOM: Thank you.

CHAIRPERSON BAILEY: Any other questions?

COMMISSIONER BALCH: I also have a request for clarification. You are talking about hauling waste from the closed-loop system?

MR. SAUCK: Yes.

COMMISSIONER BALCH: That's the delay?

MR. SAUCK: Yes.

CHAIRPERSON BAILEY: Thank you.

MS. FOSTER: Madam Chairwoman, could we bring the letter to the court reporter?

CHAIRPERSON BAILEY: Give it to Florene.

MR. NEEPER: Question, Madam Chairman. Although our witness for economic things is not here, would we be able to get a copy of this witness' exhibits?

CHAIRPERSON BAILEY: Yes.

CHAIRPERSON BAILEY: Bill Humphries?

Would you like to make a sworn or unsworn statement?

MR. HUMPHRIES: Sworn.

CHAIRPERSON BAILEY: Dr. Buchanan, I hate to have to move you twice, would you mind please leaving the witness stand for people making sworn testimony?

BILL HUMPHRIES

after having been first duly sworn under oath, was questioned and testified as follows:

CHAIRPERSON BAILEY: Please state your full name and your name of residence.

MR. HUMPHRIES: Bill Humphries. I live south of Tucumcari, New Mexico. I realize this process has been evolutionary and there are constant changes in the proposed rules, so if I miss something, I apologize. But I would like to say that I prefer the existing rule in most cases. I do not want to see the rule prohibit responsible oil and gas development, though, for New Mexico and for lots of obvious reasons for the economy and America's health.

I do want to see OCD be able to protect all other resources and values associated with the rule and those of us who live with it. A couple

things that bother me is I would really prefer actual empirical data to modeling data. I fear that modeling data has lots of latitude that we would not have information that could be necessary to make a decision. If we have known depth to groundwater and existing water quality in the process of the rule development, I think that would be beneficial to all. I would like to see known detail of existing soil and surface to water information if that becomes part of the process that's necessary to issue the final rule.

I'm concerned that the distance or separation from existing residences, dirt tanks, wells and watercourses at 25 feet, if that's still the current number and I believe I saw no changes in that, that's the approximate width of this room, and I think that's probably, if nothing else, logical that that's a little too close, and I certainly prefer that to not be the case on my property.

I prefer not to see any contents left on-site if that's at all possible. And if that is the case and the rule does allow it, then I think detail analysis of the pre-existing conditions and what's in there -- in other words, actual data of the chemical analysis, if you will, and all other

types of analysis of what's in the buried site should be available, should be known. It could be on the website or at least in the public records that OCD holds. And the continuing responsibility for that be held by those who develop the well and left them there, not the public, not the landowner and certainly not the taxpayer.

I also think that we need to know the cumulative results of the changes. I see some complexities that I can see advantages to and disadvantages, yet I'm not able to make that cumulative call as a public citizen. So I would like to see additional involvement of the surface owners if at all possible. I think the proposed change let to taking surface owners one step further out of the picture.

Again, at the end, regardless, it seems to me it might be beyond the scope of this hearing but for OCD to have adequate capacity and funding to oversee the remaining results of whatever the changes may be. That concludes my testimony.

CHAIRPERSON BAILEY: Thank you. Any questions of the witness? Seeing none, thank you for your comment.

The next person who signed up is Phil

Bidagen. Would you like sworn or unsworn testimony?

MR. BIDEGAIN: Sworn, please.

PHIL BIDEGAIN

after having been first duly sworn under oath, was questioned and testified as follows:

CHAIRPERSON BAILEY: Would you please state your name and place of residence.

MR. BIDEGAIN: Yes, ma'am. My name is Phil Bidegain and I live at Montoya, New Mexico, which is west of Tucumcari. I have a Conchas phone number, Tucumcari address and I live in Montoya so you won't be able to find me.

Madam Chairman and the members of the Commission, I appreciate this opportunity to speak. I have been following but it's been kind of hard to stay up with the changing proposed rule, so if I miss something, I apologize for that. I did spend -- I was on the task force before the previous hearings and spent quite a bit of time on it, and I thought we had come through a pretty good compromise. Not everybody got everything they wanted but we compromised with our proposal to the Commission. There was agreement of the task force, and I feel like now we're trying to go back maybe even to the starting point of the previous, which

doesn't seem fair if when you compromise you reach an agreement and then certain parties don't stick with that agreement.

I think we should realize -- I have a ranch that's in three counties, Quay, Guadalupe and San Miguel, and when San Miguel put a moratorium on drilling they turned some of the leases back and so I was testifying on the other side. Well, maybe not the other side, but I testified that the state rules should be good enough and the County should accept them. And now that we are revisiting the Pit Rule I feel like it didn't make me look too well because apparently the rules weren't good enough.

But if the State doesn't have a good set of rules and stick by them, then you are going to end up -- the oil companies will end up dealing with 33 sets of different numbers and more moratoriums, which is not fair to certain counties. It would be overly fair to others.

Some of my issues are the so-called burritos, the in-trench burial. I have two of them that I have to live with only because I was not educated at that time and the rules allowed for in-trench burial but they are going to be there forever. I probably won't be there forever to make

sure nobody drills a post hole or puts an electric line through there or any of that.

So I would be opposed to the in-trench burial. As far as the numbers, the siting numbers, the proximity to -- it especially excites me the 100 feet from a livestock watering well is just -- it's just not very far, because you have -- that's 100 feet from the edge of the pit but the pad may extend, depending on the configuration and stuff, could extend closer. And that's -- I just think it would be easier to prevent anything happening by having a larger distance. One hundred feet is only 33 yards. That's only 33 steps when you think of it that way it's pretty close.

So I basically oppose most of the changes in the proposed rules, so I oppose the rules.

CHAIRPERSON BAILEY: Thank you. Are there any questions of this witness?

MR. JANTZ: Yes. Madam Chair, I have a question. Mr. Bidegain, how many wells do you have on your property?

MR. BIDEGAIN: No producing wells. I have one temporarily abandoned well and the rest are abandoned.

MR. JANTZ: How many abandoned ones?

MR. BIDEGAIN: Over the years, probably ten.

MR. JANTZ: How many pits have been buried on your property, if you know?

MR. BIDEGAIN: Ten. A lot of the older wells they would just bulldoze them over, which was my dad's generation, but then I have two in-trench. I will give them the in-trench burial better than bulldozing over.

MR. JANTZ: Have you noticed how the reclamation is doing over the in-trench burials?

MR. BIDEGAIN: We just have a little bit of grass and weeds. They were never reclaimed.

CHAIRPERSON BAILEY: Any other questions?

MS. FOSTER: I have a question. Mr. Bidegain, you said that you were on the task force before the last Pit Rule hearing.

MR. BIDEGAIN: Yes, ma'am.

MS. FOSTER: You stated in your testimony that there was an agreement with all parties.

MR. BIDEGAIN: Yes, ma'am.

MS. FOSTER: Is that actually the case or was it that the testimony presented was that there was an alleged consensus between the parties over there? In other words, not everybody agreed to

every single provision; is that correct?

MR. BIDEGAIN: Yes, I would say that.

MS. FOSTER: At the last hearing I believe you testified as well; is that correct?

MR. BIDEGAIN: I did.

MS. FOSTER: You said you testified in Mora County or San Miguel?

MR. BIDEGAIN: San Miguel.

MS. FOSTER: That was in support of the oil and gas industry?

MR. BIDEGAIN: Yes.

MS. FOSTER: That was so we could operate a potential natural gas well on your property; is that correct?

MR. BIDEGAIN: Not on mine, a neighbor's, but it will eventually get to us.

MS. FOSTER: So you would like to encourage drilling in San Miguel County?

MR. BIDEGAIN: Yes. I'm not against drilling. It can be done where both parties gain from it.

MS. FOSTER: And you said you are in Tucumcari, which means that you are on the northeastern side of the state?

MR. BIDEGAIN: Yes.

MS. FOSTER: And which operator was on your property?

MR. BIDEGAIN: We had multiple operators. I mean -- well, I have had some dealings with Sayha and Tucumcari Exploration.

MS. FOSTER: Not recently, sounds like?

MR. BIDEGAIN: No, not recently. It's strictly a wild cat, so you don't get the major companies usually.

MS. FOSTER: No further questions. Thank you.

CHAIRPERSON BAILEY: Thank you for your testimony. Representative vehicle letter? Would you like to make sworn or unsworn testimony?

MR. STRICKLER: Sworn.

JAMES STRICKLER

after having been first duly sworn under oath, was questioned and testified as follows:

MR. STRICKLER: Thank you, members of the Commission for allowing me to speak.

My names is James Strickler, State Representative of District 2, San Juan County. I live in Farmington, New Mexico. I make my living in the oil and gas business. This is my 35th year. I'm a petroleum landman by trade and I'm a small

independent producer and I have a lot of good operators that operate my wells in San Juan County.

Four years ago when we had 17 days of hearing to decide whether or not we should implement Rule 17, which is the current rule, I, along with three other legislators, Representative Dan Foley, Representative Candy Spence Ezzell and Representative Paul Bandy and myself testified or had a short presentation at that time opposing this new rule.

It's a matter of we didn't know at the time that since New Mexico has a Uniform Procedures Act, it wasn't in effect for vetting out this new rule, Rule 17. And I think what we have found is that it hurts our air quality. I think it really hurts the environment. We have a lot of trucks hauling sand and gravel to the land farm.

We are blessed in the San Juan Basin that we use freshwater as our drilling mud system, which is a safe method of drilling, and the first discovery well in San Juan County was in 1921 so we have had oil and gas activity for 90 years and the basin started developing full force in the 1950s. There's over 30,000 wells drilled in the San Juan Basin. To my knowledge, not one well from a

drilling pit, from a reserve pit, has caused any groundwater contamination.

Now, we know we have had problems with production pits. They were a problem and that issue was addressed and those earthen pits were removed and remediated. We used steel tanks to take care of that. But for a drilling operation, a reserve pit, and now we have a liner, it's the safest way to drill a well.

Thank goodness we are dealing with sand, gravel, clay, coal. We are using clay products for that mud system and it's a very environmentally friendly way to drill a well. As a small working interest owner, the cost of Rule 17 has been exorbitant. I participated in the Rosa Unit 60 miles from the land farm and the well costs went up $200,000.

I appreciate West Largo talking about increased cost. In the San Juan Basin since the peak drilling year was 2008, we had record oil and gas prices so that certainly benefited us. We had 38 rigs running. Since the Pit Rule was implemented July of 2008 prices have gone down dramatically and that's hurt our economics, but also the increased costs have knocked down the rig count to less than

five today. One rig employs 200 folks. Since September of 2008 we have lost 5,000 jobs in San Juan County. San Juan County is 130,000 people. I think the state lost 50,000 jobs. We lost 10 percent of the jobs state-wide.

So I am in favor of fixing this and revising Rule 17. It's hard to fix a rule so complicated as this. You have a one-page form in Rule 50 and now you have a 27-page form. I think it's cost a lot of business. And I have read some reports. I don't have the exact numbers in front of me, but since the new rule was put in, Rule 17, the State has lost approximately six billion dollars in rig activity, drilling activity, economic activity. Of that, we lost a billion dollars in tax revenues. I serve on the Taxation and Revenue Committee in the State House, and our budget in the boom 2008 was 6.1 billion dollars. We had to cut every year except for this year down to 5.4 billion dollars.

That's a tremendous hardship on our schools, on our colleges, on Medicare, on our highways and prisons. I mean, right now we had a little increase in revenues. We are up to 5.6 billion dollars so we are starting to see a little recovery in the economy, but this Pit Rule, it's a

job killer. We can't compete with our neighboring states: Texas, Oklahoma, North Dakota, Pennsylvania. A lot of our hands are working in those states. They have reasonable rules and regs. Unfortunately, Rule 17 is out of the norm.

We are all in favor of protecting the environment. We all drink the same water and breathe the same area in San Juan County certainly, and I'm just amazed that of the 30,000 wells that were drilled in the last 90 years we have not had one instance of groundwater contamination from a drilling pit. We have had problems, obviously, with production pits.

So I just plead with the Commission to fix this, to get our economy going again, to protect the environment and stop all this needless truck traffic, which hurts our air quality hauling sand and gravel, which is used in other states as road base. In colorado you take those drill cuttings and you build up the surface location, and to treat this as something that's damaging to the environment is beyond me. Thank you, members of the Commission. I appreciate it.

CHAIRPERSON BAILEY: Thank you. Do we have any questions of this commenter? Dr. Neeper?

MR. NEEPER: One question. You mentioned the hardship on jobs. Do you have any comparison for how the requirements to treat the waste or take care of the waste creates jobs for workers who have to do that compared with what you feel is the loss of jobs from other restrictions?

THE WITNESS: Well, I can only speak for my county in San Juan Basin. Those are the folks that I'm most closely living with. We have lost 5,000 jobs since September of 2008. I don't have an exact breakdown on how many of those were oil and gas jobs. I would estimate roughly half. The construction industry got hammered in my area, so, you know, it's a multiplier effect. Because if you lose those oil and gas jobs that pay about $70,000 a year, they like to build houses, so it's kind of a ripple effect in our economy.

I think our truck drivers -- and yes, I guess you do hire more truck drivers to haul this benign material that we use for road base in other states. So there may be some job creation in hauling off these things, but I would rather have jobs that are a positive impact and not harm the environment. Diesel emissions are a problem in our area. The Environment Department is extremely

concerned about air quality. Again, I refer back to the Uniform Procedures Act. When you pass a rule like Rule 17, you are supposed to vet it with the Environment Department, also the impact on the Highway Department. We didn't do that. I think four years later we realized that this rule has had a bad impact on the environment. So as far as job creation, I'm sure there are jobs created in the truck industry.

MR. NEEPER: And you have given us an implication that a lot of your job loss was due to the Pit Rule and that that reduced drilling. When we look at curves either for this state or for all states, the impression I get is that rig count correlates very closely with the price of oil and not with anything else, not even with the price of gas, which doesn't make sense to me that the correlation is with the price of oil and not anything else.

MR. STRICKLER: You know, that's certainly is part of it. Right now we are suffering low natural gas prices at $2 an MCF, and you will be very reluctant to drill at this juncture. You are exactly right.

Let me just bring you back in time to 1994

when I first moved here with Meridian Oil which later became Burlington which is now ConocoPhillips. We had a dollar a price regime back in those days. We continued to drill because our costs were low. And the theory was we could drill these wells at a reasonable cost without the Pit Rule, without extra cost, because we were hoping that natural gas prices would recover.

I asked the vice president of the company, "Why are we doing this at a dollar an MCF?" And we are going to continue to drill because the costs were so low. They looked ahead and they hoped that the prices would recover in two or three years.

So our rig count that is actually -- I mean, from 38 to five, and you look at comparable gas operations. Their rig count might have dropped 50 percent but not 90 percent. So I would say it's had a negative impact on drilling. We need to drill to replace our reserves. Every well we drill, we generate tax revenues for the state. Thirty or 38 percent of our revenues come from oil and gas. Without oil and gas we would have to raise everybody's taxes dramatically. Oil and gas is one of our core industries and we need to be reasonable and compete with Texas, Oklahoma, Pennsylvania and

North Dakota.

MR. JANTZ: Actually, Madam Chair, one question occurred to me if I may.

CHAIRPERSON BAILEY: Yes.

MR. JANTZ: Representative Strickler, you mentioned an increase cost of $200,000 on a well. Do you have a breakdown of that cost?

MR. STRICKLER: It's a Fruitland coal well in the Rosa Unit which is east of Navajo Lake so it's a good 60 miles from the land farm on the Bloomfield highway. And it's a directional well, so about 3500 feet. And the first well -- there's two wells per unit, 320 acre unit. The first well was $900,000 and the second well which was drilled a year later, two years later, was 1.1 million dollars.

So there was, you know -- I asked the engineer, "Why did the cost go up so much? Was it because of the Pit Rule?" He didn't give me an exact breakdown but it's roughly an extra $200,000. Again, thank goodness we are using freshwater. We should have buried those cuttings on-site like we have done from 1921 to 2008.

MR. JANTZ: Thank you.

COMMISSIONER BLOOM: Representative

Strickler, I thank you for coming in today. You mentioned your concerns about the diesel emissions. Are you familiar with the NMOGA and IPA proposal for multi-well fluid management pits?

MR. STRICKLER: Somewhat. I work -- again, I'm a landman by trade but I work with the engineers quite often. I know there's a project in the Rosa Unit that that is a multi-well pads to drill horizontal Mancos wells, a gas formation, 53 wells. I am familiar with that, yes, sir.

COMMISSIONER BLOOM: Could you talk a little bit about how these multi-well pits could assist or hinder operations. I would like to know your thoughts.

MR. STRICKLER: I think the positive thing about multi-wells is you get to use that precious water to complete the eight wells per pad. But the bottom line is these benign materials should be land farmed on-site or buried on-site. What you are talking about certainly helps on water conservation to complete a well, so it's kind of two different strategies there. If they still have to haul those drill cuttings to the land farm it's going to really increase the cost.

COMMISSIONER BLOOM: What about hauling

water in and out of the site?

MR. STRICKLER: Well, talk about job creation, we have a healthy trucking industry in San Juan County to haul water. You will still need the truckers. I'm not trying to put the truckers out of business. But to haul sand and gravel is unnecessary.

COMMISSIONER BLOOM: Thank you. No further questions.

CHAIRPERSON BAILEY: No further questions? Thank you. And we have one more. Ellen Veseth?

MS. VESETH: I'm here. I just thought I was signing in to be here.

CHAIRPERSON BAILEY: So you decline making a comment?

MS. VESETH: Yes, my apologies.

CHAIRPERSON BAILEY: There are no other names. It is now noon, so Mr. Hiser, we will resume cross-examination of Dr. Buchanan when we return from lunch, which should be 1:00 o'clock?

(Note: The hearing stood in recess at 12:00 to 1:00.)

CHAIRPERSON BAILEY: We are back on the record. Mr. Hiser, we are in the process of cross-examining your witness, Mr. Buchanan. I

believe Mr. Jantz, you had finished your cross-examination?

MR. JANTZ: Correct, Madam Chair.

CHAIRPERSON BAILEY: And it was time for Ms. Gerholt.

MS. GERHOLT: No questions.

CHAIRPERSON BAILEY: Mr. Dangler?

MR. DANGLER: Thank you, Madam Chair. I have a few questions.

CROSS-EXAMINATION

BY MR. DANGLER

Q. For the first study you did in Texas, the McFarland, he did the study but you used those results. Do you know how the sites were selected for that study?

A. No, I don't.

Q. So you don't know how the site contents might compare to other sites?

A. Oh, you mean the pit contents?

Q. Yes.

A. No. I think I would just speculate what was available, but I don't know what reasoning came to why they picked those pit contents.

Q. Thank you. And the same question about the ConocoPhillips study that you did. Was there a

selection criteria for that particular site?

A. Yes. Yes, there was.

Q. What was that criteria?

A. We were looking for a site that did not have a pit liner so we specifically wanted something that was old and something that didn't have a pit liner, and that site was available. It was close by and it just was a method of criteria.

Q. My final question is in preparing for these hearings today, have you participated in or are you aware of any systemic kind of study of the various pits in New Mexico?

A. Do you want to help me with that?

Q. Just the sort of question that you got a site that you picked for one study and you have a couple sites in Texas and I'm just wondering if there's any comparison to all the different sites that we have got in New Mexico.

A. No.

Q. No further questions. Thank you very much.

CHAIRPERSON BAILEY: Dr. Neeper? Do you have any questions?

MR. NEEPER: Yes, I have questions, Madam Chair.

CROSS-EXAMINATION

BY MR. NEEPER

Q. Good afternoon, Dr. Buchanan.

A. Good afternoon, Dr. Neeper.

Q. You made an initial statement that caused me some surprise and that relates to the testimony previously so I will bring it back, and that has to do with this rule refined in the literature, that is technical judgment refined in the literature that says plants don't survive above about 15 atmospheres of suction, however that suction is achieved, so we are both familiar with that commonality. You said that's not quite true.

A. Correct.

Q. One of the specific exceptions you gave was you said a ponderosa pine tree that survived at 30 atmospheres.

A. Correct.

Q. Was that just a one-time spot check or was that a sustained suction?

A. It sustained itself for more than 60 days. It was in a greenhouse and we were tracking a variety of ponderosa -- I'm sorry, I didn't say that right. We were tracking a number of ponderosa pine that were in pots, and we were doing -- we were

taking data from the leaves to establish what the soil/water potential was in the plant. And we went well beyond 15 and we kept taking it and taking it. Finally we got down to 40 and the soils were very dry and there was a number of plants that were surviving. I don't remember any of them dying actually, and then the study was over. The student was finished and he went on to bigger and better things so I watered the trees.

I have done studies in the field similarly, and we have found that soil/water potential of native growing trees in dry soils to exceed 15.

Q. Would it be your general conclusion that they can survive in 15 bars or more than 15 bars for some period of time but that wouldn't be an indefinite situation?

A. Wow. The first part of the question, yes, I think they would sustain themselves for long periods of time. Would they do it indefinitely? I don't want to go there. I just don't know, you know, indefinitely. I'm thinking for years. Is that what you're thinking?

Q. I'm thinking for a period of a year, and then I'll give you a reasoning behind that so you

can respond.

A. Okay.

Q. In ponderosa we often observe the banding in the needles and the progressive movement of the dark zone when they are being starved either of moisture or when they are being oversalted.

A. Dr. Neeper, I'm sorry, I just cannot think of an instance that I am familiar enough with that I know of a native situation, a natural situation where ponderosa pine had to exist at 15 bars for much beyond a few months, three or four months. Now, that I will testify to and tell you that they will live through a three-month drought period. Beyond that, I don't really want to go there.

Q. Thank you. Can you put a study, such as the Mertz and Weatherby studies that you showed, in any way into the common units that are used in the proposed rule?

A. That question was, I think, asked earlier. I can't. I can't today. The answer is no.

Q. You mentioned that -- and described, I think, very well how a wetting front moves downward and at least in our dry cells gets narrower as it moves downward. Your description showed it eventually running out. But is it not true that

such a wetting front can reach an aquifer?

A. When you say it's not true, why don't you ask me is it true instead of -- why don't you leave the "not" out.

Q. I will be glad to rephrase the question. Can such a wetting front reach an aquifer?

A. Sure.

Q. Is that what we call recharge of the aquifer?

A. Sometimes it's referred to as recharge. Now, are you saying in a saturated condition, that that front is saturated to the recharge zone?

Q. Until it reaches the aquifer, yes.

A. Well, I probably want to back up a little then. There are instances where the saturated zone would reach an aquifer, okay? If the aquifer is very deep, no. The saturated zone of that soil in normal conditions wouldn't extend very deep in the profile, so it wouldn't reach the aquifer in a saturated state. Is that clear?

Q. That is clear to me.

A. I don't think it's clear to anyone else.

Q. All right. I will ask it a slightly different way that may help clarify because you and I are on the same page here. The recharge that

reaches the aquifer then, most of the time anyway, would get there by an unsaturated flow?

A. What you just said is correct.

Q. Thank you. You mentioned that if the water is not moving, or not moving much, that the transport of salts is by diffusion largely. Do I understand that correctly?

A. Probably not. The diffusion of salt -- most of the time when salts move by diffusion -- are we okay? Does everybody know what diffusion is? I mean, if you don't, just so no. Because this is going to make no sense if you don't understand diffusion and I'm assuming you are okay with that.

When a soil is saturated, salt will move by diffusion or that's principally how it moves. As the saturated zone moves, the salt will move by convection. So it's moving by diffusion and convection. When the water content in the soil becomes very, very low, it's no longer saturated. We all know that. It's now unsaturated, and that salt, very little of that salt will move by diffusion, if any at all. Any of that salt moving is moving in the unsaturated flow as long as the concentration in that flow will support that concentration of salt. And it will only support

only so much salt. You can only put so much salt in water and then you can't put anymore salt in there, so it will stay at that concentration. It's unsaturated. As that -- see, the very word unsaturated flow, that implies that the water flows, and it flows in an unsaturated state. We all know what saturated is.

So it flows to the greater part by convection. And very little of that is going to be by diffusion. Did that help?

Q. I will take another stab. You and I are clear what we are talking about. When it's in an unsaturated form --

A. I'm sorry, Dr. Neeper. If I get outside noises I don't hear you very well. You are speaking loud enough. I just get confused sometimes.

Q. That's fine. I'm with you. Just raise your finger and I will stop. When the soil is unsaturated and the water is moving, the unsaturated water is moving very slowly, then the movement of the dissolved salt, if any, is by diffusion in that unsaturated thin layer of water.

A. By convection.

Q. If it were not moving so it would not be convecting, then there would also still be a

diffusion if there were a concentration base; is that not correct?

A. I know what you are asking. I do. This is a rather important point.

Q. Yes.

A. This is what I heard. We have a situation where the soil is unsaturated and there's a very low water concentration in the soil. So think of these films of water being very thin on these particles. There are some dissolved, if you will, salts. There's dissolved things in the water. If that water is not moving, then really nothing is happening. The salts aren't water. The water is not moving; the salt is not moving. The question I think I was asked is if the water is not moving and we have that situation, is it possible for the salts to move by diffusion. Is that correct, Dr. Neeper?

Q. That's correct.

A. Do I understand that? Here is my answer. I know you are dying for this. This is my answer. At that point that water is moving so incredibly slowly, there's so little water in the soil that it doesn't really want to move. It does, but it doesn't want to really because it's being held by these particles called soil particles. It's very

resistant to move so for a while the water is not moving. So here are these salts and they want to move on a gradient. They want to move from a high salt concentration to a low salt concentration. But here is the problem: There's a lot of discontinuities between the water films in this zone. So in this portion that's continuous, yeah, the salt is going to move by diffusion. Dr. Neeper's comment is correct on that point.

But it only moves into the distance or the continuity of that water. If that water is discontinuous to the next particle, then it only moves that very small distance and that's the end of the diffusion. Now, that makes a lot of sense to me and I hope it makes sense to you.

So now, until that water connects up with another column of water or another bit of water, then there won't be any diffusion. And because we said there wasn't any water moving in unsaturated flow, then there's no convection either. And until that water starts to move, then we get convection and when it connects up with another film of water, then there could be diffusion again. And that's my answer.

Q. I will stay with that and just discuss it

because we have two different circumstances we are thinking about.

A. Okay.

Q. In your 2007 ConocoPhillips study in Northwestern New Mexico, do you know if that pit was drilled with freshwater or what was the type of water that was used in drilling up there?

A. Dr. Neeper, I don't know the answer to that question.

Q. All right. Can you give us some feeling for what was the concentration that you found in the remaining pit and then in the surrounding territory compared to what we are talking about --

A. Dr. Neeper, you have to ask me one question at a time.

Q. Very good.

A. Because I'm not very smart and I can only do one thing at a time. So you asked do I have some feel for the concentration of the salts in that pit contents?

Q. Yes, in the remainder of the pit.

A. Is it okay if I rephrase your question?

Q. You may rephrase my question.

A. Here is the question I thought I was asked. Do I have some feeling for the concentration

of the salts in the pit contents. Yes, I do. I will go ahead and answer that. The electrical conductivity of the soluble salts in the pit contents was about nine millimoles per centimeter or nine decisiemens per centimeter, so it's about nine. If it you were remembering earlier, we have some feel for what that means in terms of plants. So yes, I do, and the answer is about nine decisiemens per meter.

Q. You had expressed, I believe, that some of the plants that could reach that depth could withstand even a higher electrical conductivity.

A. Yes. Yes, I said that and I will stand by that.

Q. And so the content of that pit then, by itself, was not terribly threatening to your type of vegetation?

A. The electrical conductivity of that pit was not threatening to the circumstances that you and I are thinking. I'm assuming you are thinking like I'm thinking and that there was nothing there with the electrical conductivity that would limit the growth of native plants there. So now let's go to the practical side. Were there any roots in there? Yes, there was. So apparently I was right.

Apparently my theory is right and there were roots there and apparently whatever was in there that would keep roots from growing wasn't there because there were roots growing and they grew through the pit content and continued down below the pit contents.

Q. Go ahead and have a drink.

A. You wonder how I ever got through a lecture when I was at the university, don't you?

Q. At least one of us was younger at that time.

A. One of us was. I know there's a funny remark I can make back but I'm not smart enough to come up with it. Go ahead.

Q. If the content of that pit had been anything like what is allowed under the regulations, could there have been roots growing in it?

A. I believe so. I believe so. Because, you see, those contents were all pit contents. The regulation says you take the pit contents, today's pit contents, and you mix them with soil, and I'm of the belief, and I not only believe this but I've also observed this, that when you take material that may be limiting to a plant and you mix it with material that's not limiting to a plant and you mix

it to such a dilution, if you will, that the plants can find places to grow in those materials that are less limiting, then, in fact, they grow in that. When you say, "Dr. Buchanan, have you ever seen that?" Yes, I have. I have seen situations where the pH of part of the matrix was a pH of two. There are only very few plants in the world that can grow at pH of two or less. Ponderosa pine is not one of them. I know you don't want the lecture, Dr. Neeper, but I think it clarifies something.

Ponderosa pine grows in a pH of four so how? Because there are places where the pH is six. Although the matrix is two, if you take a grab a sample and run it you get pH of two. But in little tiny places, you will find soils that aren't two, they are higher. And the roots have a way of finding those. You go boy, roots are smart. No, roots are very random. They come down and go every which ways. Then one of them goes over here and goes, "Oh, that's okay," and it continues to grow. All the other guys died. We come along some time later and say, "What a smart plant. It sent a root to that place." No, it sent roots everywhere but one of them was successful.

So when you take pit contents and mix them

with suitable material or material that plants' roots can grow in, I am of the belief that the roots will find places to grow in that material because that material isn't limiting to the plant, whereas the original material may or may not have been. I don't know if it is or isn't. If it was, then all I said before is right, and if it's not limiting then all of what I said before is right also. I know that was a long answer, Dr. Neeper, but it just had to be said.

Q. It was new and surprising to me so I will ask one more question to be sure I'm clear and I understand it. We have two burial standards. One is 2500 milligrams per liter and one is 5,000 milligrams per liter of chloride in the rule. Do I understand correctly that you are saying the plant root can grow in that because it's due to find places due to the dilution not at that level but at some other level?

A. Yes.

Q. If those are the standards and you have to take a finite sample to measure, then does not that sample represent the heterogeneity of the soil, the whole thing, of the whole mix?

A. Dr. Neeper, I have such a problem with

double negatives that I don't know where to go.

Q. I can rephrase.

A. I'm going to ask you to take the "not" out again. I want to say yes, but I'm not sure I am saying yes to no or yes to yes to make a no.

Q. I stand, shall we say, corrected.

A. I'm not here to embarrass you.

Q. I'm not embarrassed.

A. I just don't handle double negatives very well.

Q. The sample that is taken from the soil or the buried material is necessarily finite and therefore represents the mixture.

A. Correct.

Q. But yet the standard applies to that broad mixture.

A. Okay. All right. Is that a question?

Q. So I come now to the final question. You maintain then that within that mixture there are places that have lower concentrations, significantly lower so the plant can grow.

A. I maintain that that's possible, yes.

Q. Thank you. If we can presume that the allowed concentrations in burial are significantly larger than the concentration you experienced in the

Conoco study within the pit -- this is a hypothesis at the moment because you don't want to compare concentrations. If the concentrations as buried, according to the rule, were much higher, would not also the --

A. There you go again.

Q. If the concentrations in the buried material were higher, would the gradients leading away from that burial unit also be proportionately higher?

A. In theory, yes, that would be true. There would be a different gradient and for the most part proportionately higher.

Q. Could we have your slide showing the EC values leaving to the surface in the Conoco study? I don't have an immediate reference to that.

MR. HISER: Do you want the graphical representation?

MR. NEEPER: The one that you moved from horizontal to vertical.

MR. HISER: That is on Slide 17-19.

A. That one?

Q. Yes. Above the pit we see what you and I call a gradient, namely a change of concentration of distance.

A. Correct.

Q. If, let us say, the concentration in that pit then were ten times higher, would the concentration in that gradient at all those points likely be ten times larger?

A. No.

Q. Then would the gradient simply be steeper adjacent to the pit?

A. Correct. Yeah. If it were higher, the gradient from the pit contents to the first increment of soil, that gradient would be very steep. Now, here is what I heard you say so I'm going to repeat what you said and then I'm going to answer that. Here is what I heard you say. Would the values above the pit contents in the soil be ten times higher than the values that I'm looking at right now?

Q. Correct.

A. Is that what you said?

Q. That's what I'm asking.

A. And my answer to that is no. The values in the soil would not necessarily be higher just because the pit contents are higher. I really want to explain that because you look like you want an explanation, but I won't explain it if you don't

want it. But I'm just going to say no, the content in the soil isn't entirely driven by the content in the pit.

Q. Below the pit for a distance of, I believe, several feet there we see a nearly uniform concentration. There are jiggles up and down but it follows a value of roughly six for some distance.

A. All right. Yeah.

MR. HISER: For clarification, Dr. Neeper, you are talking about the blue line?

MR. NEEPER: I am talking about the red line.

A. So for a few feet below the pit contents it kind of goes to a value of five and then it kind of goes over as high as seven and back to five and so on. Okay. Is that the area you're talking about?

Q. That's the area I'm talking about. The chloride that is in that space had to come from the pit; is that correct?

A. No. Now, you know, we didn't measure chloride. I measured soluble salts.

Q. The soluble salts, then, are in that range and came from the pit?

A. I think that's a fair assumption.

Q. In the transport of those soluble salts out of the pit, did not that transport significantly -- there's a not. I will back up.

A. Thank you.

Q. In the transport of those soluble salts out of the pit, was the concentration in the pit significantly reduced?

A. Interesting question. I don't know. I have got a ball of salt. I am taking salt out of the ball. I am letting it go down in the soil below the ball. Do I reduce the concentration of the salt in the ball? I rephrased the question. Is that okay?

Q. Yes, you always have my permission to rephrase my question.

A. Did I do it correctly?

Q. If it isn't correct I will rephrase my question. Yes, that is the sense of the question.

A. In theory, if you take salt out of a mass of salt you would reduce the concentration of the salt in the mass that you started out with. There was a caveat on his question. Did it significantly reduce the concentration of the salt in the pit contents? I don't think so. I don't think so. I think you got so much salt in those pit contents

that if you had a measurement -- the question is if I had a measurement of the salt 45 years ago and instead of having married I would have gone out there and measured the pit contents, what would I have measured? I would have a number. What would the number be 40 years later? Dr. Neeper, I think it's less, but I don't think it's significant. I don't think you could measure the difference. That's my answer.

Q. I will ask the question in a different way. In the distance below the pit with an EC very roughly equal to six, it's maybe three times or more the depth of the thickness of the pit.

A. Okay.

Q. I would infer that there's three times as much soluble salts in that region as there is at that concentration in the pit. That is, it had to come from somewhere; is that correct?

A. Yeah, that is correct. That's correct.

Q. Very good.

A. Interesting question.

Q. Both of us would love to work on it. In reclamation, I understood you to infer that it is crucial that the land surface be properly treated, be reseeded correctly and be revegetated?

A. To become revegetated.

Q. That it must be revegetated in order to prevent the upwelling of salts or soluble items.

A. I don't know if I said that but I agree. It is our responsibility to revegetate these sites, and I say "ours" like, you know, I own an oil well. But I think as a scientist and a person in the field, I think it's my responsibility to do everything I can to help people to reclaim these sites. And whatever the consequences of all that are, which is many, many consequences of reclaiming that, I think it's our responsibility to do that.

Q. I will agree with that. What I'm getting at is, is it necessary to establish vegetation of whatever form you would like at the top to achieve the water cycles that will prevent this potential updwelling of salt?

A. No. No, it's not. If you didn't have any vegetation, and I know of situations like that where we have virtually no vegetation, the vegetation affects all these cycles and has a tremendous impact on it. But will these phenomena we are talking about, saturated or unsaturated, will the rain rain and will the rain go in the soil and the salts move, yeah. You know, soil physicists, one of their

biggest problems in life is they don't like vegetation on the soil because it gets in their way and they model these all the time without vegetation. So does this happen without vegetation? Sure. Just us plant guys want vegetation out there.

But in answer to your question, no, that's not the only -- that's not -- let's see. I'm sorry, I was using the "not," wasn't I? This will all happen without vegetation, and it happens differently with vegetation. I'm going to leave it there.

Q. I am left not understanding, because you gave us a very good exposition on vegetation. I understand you to say revegetation is not necessary.

A. No, don't you say that. Don't you say that.

Q. Then revegetation is necessary?

A. Yes, it is.

Q. Thank you. Does the rule require revegetation?

A. Yes.

Q. May I read from the rule, sir?

A. Okay.

Q. "Reclamation of disturbed" -- this is 19.15.17.13 F C 3 of the NMOGA proposed rule on Page

39. Now, what it says, since we are all reading it, I don't need to read it aloud. It is talking about reclamation of all disturbed areas no longer in use. So it's clear my question will apply to the areas not needed for trucks and maintenance, no longer in use.

It says, "Disturbed areas have been either built on," a building, "compacted, covered, paved or otherwise stabilized so as to minimize erosion," and then it says, "or a uniform vegetative cover has been established." I note the word "or." Does the rule, sir, require revegetation?

A. I guess not. It says, "compacted, covered, paved or otherwise stabilized in such a way as to minimize erosion to the extent practicable, or a uniform vegetative cover." So it says you can do these things or you can do those things. That's the way I read it.

Q. That's the way I read it. This morning I understood you to say that compaction is one of the worse things you could do in terms of reclaiming the site.

A. Compaction is extremely limiting to the success of reclamation, yes.

Q. Should the rule then strongly suggest

compaction as a means of reclamation as it does in this case? It's one of the choices.

A. Is that what you meant to say? You said is compaction strongly recommended?

Q. I will rephrase the question and I will thank you for pointing out the lack of clarity. Several choices are given in the rule for reclamation. One is built on, one is compacted, one is covered. So if I were an operator, I could compact the site and say I have done what the rule has required me to do. Is that something that we should have in our rule or should that word not appear in our rule in that form?

A. Dr. Neeper, you are asking me a question that -- and I don't mean this in any derogatory way. I honestly don't. This is a question that I think an attorney should answer and not a scientist. Because I can think of instances where the landowner has said, "When you get finished with that site, I would like to put something there and I would like it just compacted to the compaction it can be compacted to because this is what I'm going to do later." So the landowner is happy.

If the rule is being interpreted -- and I don't really want to interpret it here. I will tell

you about veg and water and salts and all that, but you are asking me to make an interpretation of this rule. And I don't know if I'm smart enough to do that. So, you know what? I'm going to say, Dr. Neeper, it makes sense to me that there should be an allowance to do revegetation if that's what we want to do.

And I don't think anybody ought to get away with murder, of course, and do something that's wrong. Wrong is never right. But I'm not really good at reading this kind of stuff and making interpretations, so I don't know how to answer your question. I'm about to say, "Dr. Neeper, I don't want to answer your question" or "Dr. Neeper, I don't know how to answer your question," but one of those is what I want to say.

Q. Very good. One final question. You used the term equilibrium?

A. Equilibrium.

Q. Equilibrium. Does that imply that a steady state has been reached between opposing kinds of forces for opposing kinds of motions to where thereafter things may change a little but not significantly?

A. Dr. Neeper, that's generally accepted as

equilibrium, a steady state. That's right.

Q. And that is what you see or what you say you see in some of these gradients in the soil after some period of time?

A. Yeah.

Q. You are seeing a steady state?

A. Yeah. That's right. There is a steady state in some of the things that I described today, yes.

Q. And because you see that steady state in those selected cases, do you feel that is generally true particularly when the concentrations are much larger?

A. Do I feel -- I just want to make sure I am understanding the question. Do I believe that if it's a steady state that it is still a steady state even if the concentration is higher? Is that what you are asking?

Q. That you will come to the same kind of steady state, the same kind of profile, even if the concentrations are much larger?

A. Just for clarification, concentrations of the kind of things we have been talking about today, salts and --

Q. Concentrations of soluble salts?

A. Yeah. Dr. Neeper, I can think of numerous examples where the concentration of the salt is much higher than the what we talked about today and they have reached a steady state.

Q. Thank you. No further questions.

EXAMINATION BY THE COMMISSION

CHAIRPERSON BAILEY: Commissioner Bloom?

COMMISSIONER BLOOM: Good afternoon, Dr. Buchanan. If you could turn to Page 38, I just wanted to check in on something on the proposal. Under B, you are lining out human health and going to public health.

THE WITNESS: I am on that line.

COMMISSIONER BLOOM: Do you see that? Do you know why -- do you know the reason for that change?

THE WITNESS: I don't.

COMMISSIONER BLOOM: If you would turn to Page 39 then. Go down to the bottom. The previous language is lined out and going down to No. 2 at the bottom of the page it says, the second sentence, "The operator shall obtain vegetative cover that equals 70 percent of the native perennial vegetative cover (unimpacted by overgrazing, fire or other intrusion damaging to native vegetation) consisting

of at least three native plant species," and it goes on. One of the things I noticed is when the section is rewritten I don't find anywhere that "native" is included.

THE WITNESS: Oh.

COMMISSIONER BLOOM: Is NMOGA and IPA proposing to remove native from the requirements?

THE WITNESS: Seems like it, doesn't it?

COMMISSIONER BLOOM: Yeah.

THE WITNESS: Just for the record, I'm really big on native.

COMMISSIONER BLOOM: Just wondering why somebody might want to do that.

THE WITNESS: I'm just so anti-introduced species that you can't stand me. I am really a supporter of native vegetation. Maybe it's an oversight, but I would think native would be important here.

COMMISSIONER BLOOM: Also on the very top of that page, it's now B, "compacted" is lined out.

THE WITNESS: Yes.

COMMISSIONER BLOOM: And that is just because in your opinion compacted soils don't reestablish as well?

THE WITNESS: No, you don't want compacted

soils.

COMMISSIONER BLOOM: Dr. Buchanan, turning to your presentation, I think you showed us three different field studies that have been done. What parts of the state were these in?

THE WITNESS: Northern, western New Mexico in the Farmington area.

COMMISSIONER BLOOM: Would you expect different results in different parts of the state?

THE WITNESS: Not really. Just slight differences because of the amount of precipitation. You might see something a little different, but the mechanisms are all the same. Why I say that and comfortably say that is because as you look at studies across the western states from Canada to Mexico and North Dakota, South Dakota, et cetera, et cetera, we are all finding -- we, as these people who have been doing this research in these areas -- as you look at the published literature, very few people are finding migration of salts much more than 12 inches and they find it at four and six and eight and ten inches, and it's just kind of all through the west. So would it be any different in New Mexico? Probably not. Throughout other places in New Mexico, probably not.

COMMISSIONER BLOOM: That's all. Thank you.

CHAIRPERSON BAILEY: Commissioner Balch?

COMMISSIONER BALCH: Good afternoon, Dr. Buchanan. I have been told I mumble so if that causes a problem for your hearing, let me know.

THE WITNESS: I will come sit by you if you want.

COMMISSIONER BALCH: In Slide 17-14 and 15 which were basically just the tables of data from the Mertz and the Weatherby sites, the bottom portion on the post part of those figures, the gray area where you have the pit material, there's no resampling at that interval or below?

THE WITNESS: McFarland did not resample. He did not resample the pit contents when he sampled the soils, so there's no data. Dr. Neeper's question could have been answered very simply if McFarland had taken that data, but he didn't.

COMMISSIONER BALCH: Your study did look at that but 40 years later?

THE WITNESS: Unfortunately, I wasn't there to get the earlier data. You know, we just get caught between things sometimes.

COMMISSIONER BALCH: Perhaps you can find

an appropriate funding agency to pass this by.

THE WITNESS: I would think I could.

COMMISSIONER BALCH: In Mr. Arthur's testimony the other day -- I think you might have been in the room -- he described a failed revegetation effort.

THE WITNESS: Sailed?

COMMISSIONER BALCH: Failed revegetation effort that led to erosion and the pit being exposed.

THE WITNESS: Yeah.

COMMISSIONER BALCH: And I think that your testimony has already presented guidance on the design of revegetation plans to avoid that. But is there anything in the existing or proposed modifications that would lend to a validation of the revegetation effort at some point in the future?

THE WITNESS: I thought there was something about it being monitored after the revegetation is established.

COMMISSIONER BALCH: I think I saw in the grayed-out area that there was a one or two-season --

THE WITNESS: Oh, yeah. Maybe it's not in the rule, but it's becoming a part of the

requirements in the state of New Mexico. The Bureau of Land Management, for example, is requiring monitoring and documentation of the success of -- and their guidelines are pretty well written. That isn't what I meant to say. They are written in such a way that I think it meets the requirements to just show and establish that revegetation is being measured in a way that it shows whether it's successful or not.

COMMISSIONER BALCH: You have reached the 70 percent limit?

THE WITNESS: Uh-huh. Now, I think that's what that says, reaches 70 percent. So that's a measure of success, a measure of monitoring at a later date. I guess it doesn't describe exactly when, but it says 70 percent. So at some point you have to show success. By the way, that gets really complicated and you don't want to go there today, but it takes a while for that vegetation to become established as something that's going to be sustainable. So in a while we can take those measurements and document whether it's going to be sustainable or not.

COMMISSIONER BALCH: I'm going to ask you a couple questions about sampling just because I'm

curious and I hope you have some answers for me. A sample is a finite measurement of a finite volume. So if you have a volume of soil that is comprised of 100 cups of material, you can go in with your cup and scoop out a sample and make a measurement from that and you will get one data point. If you take all 100 cups and sample them you will have a distribution of values or whatever it is you are measuring, perhaps a bell curve or some other distribution. That will give you an average, a standard deviation, confidence intervals and a range of data.

THE WITNESS: Absolutely.

COMMISSIONER BALCH: For regulatory purposes, I would like to understand how I am supposed to look at sampled data. Maybe you have some insight. Is it the value of the measured sample that is important? Is it the average of several samples or is it the maximum value that could be obtained from all 100 samples as addressed by a rule or regulation?

THE WITNESS: Single sample, average or maximum, okay? This is going to take a little bit to answer this.

COMMISSIONER BALCH: Sure.

THE WITNESS: When what I am sampling is isotropic, meaning it's the same in all directions, so I have an ice cube and I used this example a lot when I was teaching. If I have an ice cube how many times do I have to sample the ice cube to establish that it's made up of water? One time. All the ice in the ice cube is like all the other ice in the ice cube, so I only need one sample. In that example there's no maximum, if you will, or there's no minimum, and the average is the same as one sample.

Perfect world. The world is not perfect. The world is not made up of ice cubes. So you introduce a situation that I'm sampling something that is anisotropic, meaning it's not the same in all directions. So I attempt to take samples in such a way that I can characterize what I'm sampling. That's pretty important, that I have a goal in mind of where I'm going with this.

If I want to see worst case, then I want the maximum number. I want to get a handle on the maximum, so I'm probably going to have to take quite a few samples to establish which of those is the highest. The problem with that is it may only represent a very small portion of the population. So I get all caught up with the maximum and I go oh,

my golly, the sky is falling when it's really only a very small portion.

This is a lot easier to do on the ground. I am measuring vegetation because I don't have to dig holes. If I am doing it on the ground and I have vegetation, how many samples do I have to have to characterize the vegetation on that? And soils is just so much harder than vegetation. If I had known better, I would have stayed in botany.

So what is your goal? You have to think about that, and you have to be careful when you establish the maximum value.

To establish a mean there's a couple ways to do that. One is arithmetically, and that would be I take a bunch of samples, I get an analysis of that. I take those values, add them up, divide by the number of samples and get a mean. We do it all the time. And as you described, mean, bell curve, standard deviation, confidence intervals, et cetera.

To shortcut that we often take samples along a transect, if you will, and we get about five or six or 10 or 12 or 50 and we put it all in one big bag, take the bag to the lab and analyze it and that is the mean. Like it or not, it is the mean, as long as I got the same amount of sample at each

location, and I have a mean but I don't have standard deviations or confidence levels or variances. I don't get any of that.

Now, are you asking me what's the best thing to do?

COMMISSIONER BALCH: Well, I am asking you if you have a regulation that says you can't exceed two parts per million of something, how do you know that the value represents that adequately?

THE WITNESS: Turns out that's a wonderful question, by the way. That's a great question. I have been asking myself that question for about 40 years. Let me try to answer it one way, and I can promise you there's 101 ways to answer the question but here is one of the ways.

When I am looking at vegetation, I am sampling that and I'm trying to demonstrate that. I don't want to have more than two parts per million of whatever I am measuring. I can't have that. Why can't I have that? If it's vegetation, quite often vegetation compensates for this. And the mean, ever how I get it, it's not a bad number because the plant will avoid that two parts per million. It can only live in one part per million and it will find a way to avoid the two parts per million.

What if the mean is two parts per million? I have a serious problem. I may have parts in that sample -- I'm sorry, parts in that population that are not two parts per million but when I get the mean I get two parts per million. So I have pieces that are higher and pieces possibly that are -- well, not possibly, it's lower.

I think you have got to think about -- and I don't mean to be smart here -- I think you have to think about what am I trying to accomplish here? What am I trying to protect? Am I protecting a human? Am I protecting a cow? Am I protecting a plant? Am I worried about some four wing saltbush out there or concerned about a human? And I think -- and I know this is biased because I am a human -- I want to see a lot of data because I don't want to be exposed to something as a human. If I were a four wing saltbush I probably wouldn't care too much. Because I am confident that the four wing is either going to die or live. If it dies, who cares? We will plant another one and the other one will figure it out. But when a human dies, you know, that's serious stuff. I want to be protected.

So in trying to answer that question, I think you have to very seriously look at what you're

trying to accomplish and what's your goal. If it is involving the health of humans, then I guess you try to get a mean and a standard deviation. What will come from that, obviously, and you know this as well as I do, in all likelihood you will find the maximum in that population or you will have a very good estimate of the maximum in the population so you want to sample it to death.

If it's not too serious and it's something -- I'm okay with means a lot of the time. I work with means a lot or something that gives -- we do this all the time in mine reclamation. I told you earlier I have sampled thousands and thousands of samples of spoil, and we have taken them in increments, established means and standard deviations. We have taken composites.

Let me answer -- let me help you with this. And I think maybe this is the better answer of all the things I have said. When I start out and I don't know nothing, I want a lot of samples and I want means and standard deviations. When I am a student of all of this, I want to know as much as I can find out and I would probably want a lot of data.

When I'm not so much the student and I am

more of the expert in this field because I have looked at lots of data, then I start to feel more comfortable with means. Is that at all helpful?

COMMISSIONER BALCH: If you are a regulator going out to a site and taking a measurement, you have stepped away from the mean perhaps at that point?

THE WITNESS: Yeah. I'm a regulator and somebody hands me a mean, I mean, I have a mean. That's all I got. I don't have anything else but the mean. What do I do with it? I would be careful with it, I guess. I would want a whole bunch of means. I shouldn't have said that, but I would be careful with the data. I think you have to be very careful with it.

COMMISSIONER BALCH: So one thing we are tasked with doing as regulators is to assign a value of something that we have to observe, not exceed or in some other way interact with.

THE WITNESS: Yeah, you do.

COMMISSIONER BALCH: So I think you want that sort of number to come from, like you said, the learning experience, the large sampling and then also from experience.

THE WITNESS: Somehow I agree with that.

I shouldn't have said somehow. I agree with you.

COMMISSIONER BALCH: I know we talked about your Phillips study a number of times. I think that slide may still be up, the cross-section.

THE WITNESS: You want the graph?

COMMISSIONER BALCH: Yes, please. In your direct testimony you referred to something as a salt bulge.

THE WITNESS: Salt bulge?

COMMISSIONER BALCH: Yes.

THE WITNESS: Yes, I referred to that in the native pit, the blue line. Do you want me to help you with that?

COMMISSIONER BALCH: Well, I guess what I am trying to observe from this slide is you have do higher concentrations below the pit, pretty much all the way through the salt bulge, and at the bottom of the salt bulge it goes back down to ground level. Is there some mechanism that causes that salt bulge to be in that location in the profile?

THE WITNESS: Yes. Now, you know, you got to take the pit contents out of your mind on that blue line, right?

COMMISSIONER BALCH: I understand that's a natural feature. I want to understand what the

natural mechanism is that causes the salt bulge to be where it is in the background profile.

THE WITNESS: If there's any one answer to the question it would probably be the natural precipitation that occurs at the site. That bulge is, for the most part, driven by the precipitation that falls at that site. If we were at a wetter site, that bulge would be deeper. If we were at a drier site, that bulge would come closer to the surface.

COMMISSIONER BALCH: So let me ask you to be predictive. You can refuse, of course. If you went back here in another 40 years, assuming you were still happily married for then 85 years, would you expect to see the salt from the pit site to have changed the profile of that salt bulge?

THE WITNESS: Not the native. In 40 years from now the native, where it is today will probably be where it is 40 years from now. Where will the bulge be underneath the pit contents?

COMMISSIONER BALCH: Yes.

THE WITNESS: I believe it would be a little lower. I believe that there would be a -- because the pit contents are so close to the surface, 20 inches, the water will continue to move

through the pit contents and will continue to take salt out of those pit contents and there's a gradient for those salts to come out of the pit contents and move below the pit contents. And there will be a continuance of salt moving out of the pit, moving into the soil, and it will try to move down.

I'm not comfortable -- and I will tell you, I'm not comfortable as to how far and those kinds of things. I have spent very little time in my career looking below the pit contents. And I say that figuratively. I spent most of my time in the upper five feet of the profile, and I don't know much about what happens below five feet. I'm just kind of speculating that the salt will continue to move out of the pit contents. It will move into the soil and there's any number of possibilities of what will happen to that salt. And I'm a little uncomfortable testifying as to what it will do.

COMMISSIONER BALCH: Sure. I'm actually interested in having you clarify your comment on concentration of pit material above, and I think you alluded to having a desire to elaborate. I'm very curious as to what you would have said. I think this was in reference to the amount of chlorides in the material over time.

THE WITNESS: Oh, okay. Just so everybody in the room knows what we are talking about and maybe we don't care about them but I know you care, so let's get this straight. That you have pit contents and it has salts in the pit. If the salt in the pit were ten times higher than it is -- there's another pit next to it and it's ten times higher. Would the salt above the pit contents be ten times higher in the soil that we use to cover the pit contents? Did I capture the question?

COMMISSIONER BALCH: Right.

THE WITNESS: Good. And I said -- when I said that before -- and I don't in any way mean to say this in any derogatory way or embarrassing to you, but I'm used to looking at blank looks when I talk to people because they don't understand a thing I'm saying. I spent 20 years at the university doing that and I saw three blank looks and I said, "Oh, my goodness, I don't think you understand that."

So you are asking the question what will happen. What is going to happen here is the mechanisms that are allowing that salt to rise have to do with saturated and unsaturated flow, and we have been around and around on that today.

Just because the salt content is higher in those pit contents doesn't necessarily mean the concentration will be higher in the native soil. It just means that there's a gradient and that the salts will want to migrate up. But the part that I want to share with you is it's raining all the time. As the rains come down and they resaturate that soil, it will move the salt back towards the pit contents. Then there will be a period when the material comes up again. Then it goes down. It comes up and goes down. And the mechanisms that are driving the salt concentration are largely the phenomenon of saturated and unsaturated flow, not so much the concentration of the pit contents.

So to make the statement well, if it's ten times higher then the salt concentrations above would be ten times higher? No, you can't say that. In all likelihood they wouldn't be. In all likelihood they would be maybe higher. I don't really know, but maybe not too dissimilar because of the mechanism that is lifting the salt and driving the salt back down and that's what's really driving the bus here.

COMMISSIONER BALCH: Thank you. I do have one --

THE WITNESS: I see a sparkle in your eye like you understood what I said.

COMMISSIONER BALCH: I think I am learning something about soils, and at the risk of not leaving anything for Commissioner Bailey I have one last thing that I would like to do. An exercise, if you will. Mr. Gantner's slides, No. 6. I think we referred back to that a couple of times. It has to do with changes in the siting criteria.

Now I'm going to ask you for your opinion. I know some of the answers but I would like to have them on the record. Low chloride fluids, the modifications are asking for a decrease in depth between the base of the pit and groundwater to 25 feet. Based on your experience, are you comfortable with that as a protective limitation?

THE WITNESS: Like I said, I don't know much about what happens down there. I'm not a really good soil physicist in that realm, but I'm pretty comfortable with that. Yes, I am.

COMMISSIONER BALCH: Do you think the 50 feet provides substantially more protection?

THE WITNESS: Yeah, if it's 50 feet it takes -- I mean, 50 would be substantially more. It provides more protection. I think the question

might be is it necessary, and now you are beyond my expertise.

COMMISSIONER BALCH: Well, I'm going to ask the same question for the changes in distance to watercourses. You alluded to closer water tables near watercourses and then wetlands, I think, it would be similar. Basically the same question. What's your comfort level with changing those requirements? Let me ask it this way. Is the old requirement too conservative?

THE WITNESS: It's really hard for me to answer that because it's so distant from things I really know about. It seems that way. It seems conservative.

COMMISSIONER BALCH: Is the new modification not conservative enough?

THE WITNESS: I think it's conservative enough, but I'm not comfortable at all talking about this because I'm not really good at what happens at depth, and I know the theories and I know the principles and things and I know what people have told me, but I don't have much experience in this at all. I really virtually have never sampled at those depths of 50 or 75 or 100 feet so I'm really going to --

COMMISSIONER BALCH: Well, for a watercourses and wetlands, 100 or 300 or 500 feet, that's more of a lateral change which could be occurring at the four-foot interval that you are very familiar with.

THE WITNESS: Yeah. Depends on, you know, where that water table is relative to the watercourse. I have done some work in southern New Mexico where we were along watercourses. We were, you know, several hundred feet from -- well, 100 to 300 feet at different locations, 100 to 300 feet, and the water table was well below 12 feet, deeper than we could dig with a backhoe. But there were evidences of water having been at a higher elevation at some time in the history of that soil.

So in that particular instance, very gravelly. The water table was at about five or six feet and we were probably -- at 300 feet, I don't remember seeing any evidence of the water table. At 100 feet, that particular one instance -- and I can't remember how to describe it all to you, but it was a flowing stream and the water table -- we couldn't find the water table but there was evidence it had been within about six feet of the surface at one time. That's just one instance and one thing.

I know that isn't very helpful but I don't think I am very helpful here to you.

COMMISSIONER BALCH: Well, thank you for your testimony.

CHAIRPERSON BAILEY: I will have to admit that I thoroughly enjoyed the exchange between you and Dr. Neeper.

THE WITNESS: What I was hoping you were going to say is you liked my tie.

CHAIRPERSON BAILEY: That, too. Why not. You repeatedly said soluble salts would never migrate to the surface.

THE WITNESS: Correct.

CHAIRPERSON BAILEY: But in your part of the world near Bloomfield I often saw at different times of the years a white crust on the surface of the land. What would that be?

THE WITNESS: You do. You see it pretty regularly. Sodium sulphate, by the way.

CHAIRPERSON BAILEY: Which is a soluble salt?

THE WITNESS: Very soluble. When you are there next time tell whoever you're with, "That's sodium sulphate," and they will think, oh, how smart you are. That is a result of a very high water

table. I have dug in that vicinity. Somebody wanted to build a house and we looked at it. It wasn't even 24 inches to water. So what happens in that situation, and why those salts are at the surface is because the water table is so high that the water is able to capillary those 20 or 24 inches to the surface. So it has a saturated zone at that depth.

I did a lot of work at White Sands at one time at the Air Force Base and the missile range, mapped soils, and they were trying to make vegetation grow. You may not know this, but there's a lot of salt at the surface. Oh, my goodness, how did all that salt get to the surface? At first I didn't know and we started digging with a backhoe, and pretty much throughout the Air Force Base, the deepest the water table ever gets is four or five feet. But the greater majority of the water table is less than 12 inches from the surface.

So what happens is that water, as you might know or don't know, doesn't matter, is very, very salty. Some of it is saltier than the ocean. And the salts -- again, that's calcium sulphate in that case, which is not as soluble as sodium sulphate but it's pretty soluble, it is migrating to

the surface.

Turns out there are many, many salts in that water of the White Sands and extreme, extreme electrical conductivities, and that water was just able to capillary up about 12 inches and take those salts and there was just crusts of salt on the surface. It didn't allow vegetation to grow, that was for sure.

CHAIRPERSON BAILEY: Your Slide 17-7. Now, there are quite a few factors that are going to play into this. Evaporation rates play a big part.

THE WITNESS: Correct.

CHAIRPERSON BAILEY: Evaporation rates are not the same in the San Juan Basin as they are in the southeast, are they?

THE WITNESS: Evaporative transportation is a little higher in the south than it would be in the north, yes.

CHAIRPERSON BAILEY: So a lot of your discussion has been geared towards the San Juan Basin.

THE WITNESS: Yes.

CHAIRPERSON BAILEY: So the soils are quite different in the southeast also, aren't they?

THE WITNESS: Yeah. Yeah. There's -- I

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don't know, over 1,000 soils in the state of New Mexico and as you go across the state they are very different.

CHAIRPERSON BAILEY: So we are going to have very different climate, very different vegetation and very different impacts as far as revegetation success?

THE WITNESS: Different approaches to getting reclamation to work, yes.

CHAIRPERSON BAILEY: So the recommendations that are part of the proposal, are they geared towards revegetation of the San Juan Basin or are they geared towards the southeast or both?

THE WITNESS: Both. Four feet. Chairman, I have said this before and I know this is going to go on the record and it's okay if it does. I believe in all the years that -- you give me 12 inches of soil, I can reclaim most sites. If you give me two feet, easy peasy. If you give me four feet I virtually have no problem reclaiming most anyplace in the western United States, whether it's southern New Mexico or northern New Mexico. In northern New Mexico, that's where most of my experience is, most of my experience in reclamation,

but I have consulted in reclamation all over the west. Generally speaking, if we can get about 12 inches of topsoil we can get reclamation to establish.

I'm delighted to see four feet of material because it makes it so much easier and it will be -- we can be as successful in the southern part of the state as the northern part of the state with four feet of material.

CHAIRPERSON BAILEY: Which brings up my next question. You used alkali sacaton and four wing saltbush as examples of salt-tolerant native species?

THE WITNESS: Yes.

CHAIRPERSON BAILEY: Are those species native to the southeast also?

THE WITNESS: Four wing will grow throughout the state of New Mexico. It grows all the way from central Mexico to northern/middle Canada. Four wing is a very flexible, pliable, genetic species that grows in lots of spaces. There's a number of grasses -- there's a salt grass that grows in southern New Mexico that is extremely salt-tolerant. Much more tolerant than anything in the northern part of the state. That doesn't mean

anything but it's called disticulus. It's a salt grass that's very successful in establishing itself in salty soils, probably more salt-tolerant than alkali sacaton. Some don't come to mind right now, but when I lived in southern New Mexico I did some work down in the Texas/New Mexico border and yeah, the soils are different, but there's a lot of different shrubs down there than there are in northern New Mexico. And those shrubs, although they are different, they are very salt-tolerant. Creosote, for example.

The mesquite is a very tolerant species. There's a grass -- and I apologize -- I can't remember the name right now, but it's a sister to alkali sacaton, but it's a plant that's very similar to that and it will grow in the southern part of the state and in very salty soils.

CHAIRPERSON BAILEY: In the southeast we have caliche very close to the surface.

THE WITNESS: Yes.

CHAIRPERSON BAILEY: You also talked about calcium carbonate as forming a barrier at some point below the surface of the lands. Will that calcium carbonate or caliche layer form a barrier for salt migration either up or down?

THE WITNESS: Caliche and calcium carbonate are one and the same. Caliche is just a cemented form of calcium carbonate. When it's truly caliche, it has essentially sealed at that depth to which it occurs. There's essentially a sealing, and water, momentarily, will move down and it will stop momentarily at that zone.

What's happened over the thousands of years is the carbonates have been moved. They can't move down and they precipitate out and you build up a layer of calcium carbonate and you build up this caliche layer. Turns out, caliche has a propensity to crack and water will find those cracks and it will maintain those cracks. So what happens is water will go below the caliche.

Turns out, plants will find -- creosotes is a classic example -- will find those cracks, if you will, or those openings and will capitalize on that. As much as we think caliche is continuous from the roadside, and for all intents and purposes, it appears to be continuous, but it's not continuous. So water does move down and roots move down and plants move through it. So your question is will the salts build up on top of the caliche? Yeah, the calcium carbonates will tend to. The more

soluble salts will tend to move with the water and tend to move down. That's in the native, natural, undisturbed, situation. When we disturb that site we destroy the caliche and it no longer acts anything like it did in the native state.

CHAIRPERSON BAILEY: Slide 17-19. Do we have any indication what the depth to water is?

THE WITNESS: Here?

CHAIRPERSON BAILEY: Yes.

THE WITNESS: I don't know. I know there's somebody in the room that knows. It's about 20 miles, 15 or 20 miles south of Bloomfield just due south out by Angel Peak. Whatever the water table is in the Angel Peak area is about what the water table would be here, and I would guess well over 100 feet, if not deeper.

CHAIRPERSON BAILEY: Is there any correlation between the location of the salt bulge and the depth to water?

THE WITNESS: Not in this case, no.

CHAIRPERSON BAILEY: We had discussion earlier concerning construction of pits on the angle of repose. Now, you advocated stability.

THE WITNESS: Advocated what?

CHAIRPERSON BAILEY: Stability in the

topography.

THE WITNESS: Yes.

CHAIRPERSON BAILEY: Is the angle of repose necessarily a stable topography?

THE WITNESS: No. You know, there's a whole bunch of things I could say about that, but I'm just going to tell you no, just because it's an angle of repose doesn't mean it's stable.

CHAIRPERSON BAILEY: On Page 2 of Attachment A we discussed the definition for life-form ratios.

THE WITNESS: On Page 2?

CHAIRPERSON BAILEY: Yes. Do we need to insert the word "native species" within that definition?

THE WITNESS: If I were you, I would.

CHAIRPERSON BAILEY: On the whole, would you say that the soils of southeastern New Mexico are sandier than the soils of the San Juan Basin?

THE WITNESS: No.

CHAIRPERSON BAILEY: It's hard to generalize?

THE WITNESS: That's a really, really hard question to answer because almost every soil, every kind of soil in terms of soil texture -- sandy,

clay, et cetera -- exists in the San Juan Basin. Nearly every one of those soils exists in the southeast and southwest -- well, the southeastern parts of New Mexico. It's just -- you can find sand dunes in both places. You can find beautiful prime farmland soils in both places. You can find playas and clay soils. If you asked me to find a soil and you gave me the criteria, I could find it probably in any corner of New Mexico. I don't care what criteria other than don't mess around with elevation, but if you wanted a certain texture of soil, I bet I could find it in practically every county of New Mexico. That's a bit of an exaggeration but it's not too far off.

CHAIRPERSON BAILEY: But on the whole where we do have sandy soils, we would have lower water capacity?

THE WITNESS: Yes. Sandy soils have lower capacity to hold water than soils that are more loamy, yes.

CHAIRPERSON BAILEY: And faster and deeper migration of chlorides?

THE WITNESS: Yes. Water will move deeper in a sandy soil than it will in not sandy soil, yes.

CHAIRPERSON BAILEY: Do you advocate when

we are rebuilding the surface on top of the pit, that there be a course layer of material put on top of the pit contents?

THE WITNESS: How do you know that? You are pretty smart. I think you know -- not only did you say the right thing but I think you know what you're talking about. If you put a course layer above -- you change the dynamics tremendously as to what happens with the flow of water. You know all that stuff we have been talking about today? Just throw it out the window because this changes the world when you have a gravel layer. You said course fragments?

CHAIRPERSON BAILEY: Yes.

THE WITNESS: Did you say course fragments or rock?

CHAIRPERSON BAILEY: I said course material.

THE WITNESS: You just change the world when that happens. And what you do when you do that is you change all the dynamics of this water moving up and down. Now, there are probably very few people in this room that are going to believe what I'm about to say. But if I have a gravel layer and I have a loam soil above it and the water is moving

down, most people on Quiz Question No. 8 will say the water will just move rapidly into the gravel.

Stops like a brick. You have these huge pores and that soil has to be completely saturated above the gravel before one drop of water will go into the gravel. So it changes the dynamics. All the little drawings I did, here comes this saturated zone. Well, as long as it's saturated it would move into the gravel. But if it's anything but saturated it will stop when it hits the gravel layer. For all intents and purposes, when you stop the water you stop the roots.

So now I'm going to address your question from a reclamation standpoint and not from a physics standpoint. That's the physics behind all of this. Here is the reclamation part of it. If the gravel stops the water, then I'm going to stop the roots, and I don't want to do that. In my life, I don't want to stop roots. I want the roots to go down.

I am okay with the gravel in the soil. If it's mixed in I'm okay and that's fine and it doesn't change the dynamics too much. So your question is would I recommend putting gravel or course fragments or course material over the top of these pit contents, and the reason I would do that

is to keep water from going into it. I don't believe I would recommend that. I have made such recommendations of using gravel to stop water, but for other purposes. I think I want those roots to be able down into those pit contents and extract that water out of there so my answer to your question is no, I don't believe I would recommend that.

CHAIRPERSON BAILEY: How about for those plants such as grasses, native grasses, whose roots stay within the top two feet as you indicated?

THE WITNESS: Yeah. So you have four feet of material and a gravel area. The grass roots will never get down there anyway, so Bruce, what are you talking about? Because if anything I got across to you I told you the grass roots aren't going to get down there anyway so why don't you put a gravel layer and stop the water?

Yeah, it's okay with the grasses. If that's all you ever had was grass probably it would accomplish -- if that's what you want to accomplish, that's what it's going to accomplish. What I'm concerned about is the shrubs, which most likely would grow below four feet and would start doing things -- they would chase water that's deeper than

four feet. What it will do is cut the shrubs off. For all intents and purposes you're not going to get any root growth beneath the gravel layer.

I have to think about that. My first reaction to that is I don't think I would do that. I think it's going to be something that we will wish we hadn't have done sometime later is what I think will come of that. It answers some problems, some questions, and does some things. We know exactly what it's going to do. I have to think about that a long time before I would make that recommendation, so I'm going to say no, I wouldn't recommend that.

CHAIRPERSON BAILEY: Okay. I must have written it down wrong, because I wrote down that shallow soil encourages shrubs.

THE WITNESS: No, you wrote that right. If you have shallow soil over spoil material, the grasses don't do very well. I don't exactly have an answer for you but I will tell you what I observed and I don't exactly have an answer for it. We will get almost a complete dominance of shrubs and particularly a few species of shrubs. And I don't know exactly why, but I think they have a higher tolerance to the material below that four inches of soil and I think they move into that spoil and

thrive on that. And I think that's why the shrubs are there.

Maybe the grasses aren't there because they don't thrive and do real well with just four inches of soil. They will go into the spoil. No question they will do that. But I don't think they can compete with the shrubs. The shrubs so out-compete them and they don't get established.

So yeah, you wrote it down right and that's right. But shrubs in a normal, not spoil, not pit contents, just a good old American soil -- or good old New Mexican soil, the shrubs will root deeper and they will root as much as three to four feet. Some will go as deep as 12 to 15 deep and some not that deep. But yeah, shrubs root deeper but when they are competing for a place in the environment they will out-compete grasses on a shallow soil. That's two different concepts going on here.

CHAIRPERSON BAILEY: And a prime example is sagebrush?

THE WITNESS: Sagebrush is very interesting and I know a lot about sagebrush. Want to know a lot about sagebrush?

CHAIRPERSON BAILEY: This may not be the

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best time.

THE WITNESS: There's three sub species of sagebrush. You are talking apples and oranges when you talk about sagebrush. Don't you ever generalize about sagebrush because it is the worst plant to ever generalize about. You will get me to very rarely generalize about sagebrush because it does not behave. It's the most misbehaving child in plants that is out there and it's because there are three sub species and most people don't know that.

Now I'm going to retract what I said and I'm going to generalize. Sagebrush roots down about a meter, 36 inches, but it will root very shallow and it will root very deep. There is instance after instance that it will grow at 12 inches of soil and do fine. It grows at 12,000 feet. It grows at 1,000 feet. It does not know what the elevation is. It doesn't know what latitude it's at and it doesn't know what longitude it's at. It's a crazy plant. So sagebrush is kind of a fun plant to study because you can say something and nobody can refute it. If you are going to take up another study in your life and you want to do something, don't study sagebrush. Go do something else.

CHAIRPERSON BAILEY: I will take that

advice and I thank you for your testimony.
Mr. Hiser, do you have redirect of your witness on the questions that were asked?

MR. HISER: I do. Not very many.

REDIRECT EXAMINATION

Q. I think the most important one is the one that you and Commissioner Bloom raised about native versus non-native and what is NMOGA doing given the testimony that native species are the best.
Dr. Buchanan, when I am looking at the term native, is that term susceptible to more than one interpretation?

A. Yes.

Q. So is it possible that a person can very zealously apply the term native and mean only those species that were present in that particular location as opposed to a broader area?

A. Yeah, that's commonly done, in fact.

Q. If I take that extremely narrow definition of the term native, what does that do to your ability to reclaim that site?

A. Well, you are limited by seed source. The very first thing that comes to mind is you are limited by seed sources because you have to get seed sources from the very vicinity of the site and you

can't use some native -- some other native from some other place. You start thinking well, all I can grow here is those eight or twelve species that are growing at this location. There are other native species that will do quite well at that site.

What I'm trying to get away from is the introduced species, the stuff from the Mediterranean, and those have proven -- crested wheat grass is the classic. Lehmann lovegrass is a classic. That's in Arizona. What a mistake we made when we introduced that species. There's a whole bunch of reasons why and you don't need to know.

But when we introduce a non-native in that context we introduce a species that doesn't behave in that environment the way a native will behave in that environment and down the road we are going to pay the price for it. Let me just get to the end of the sentence. It won't sustain itself.

Q. And so if the Commission has an interest in looking at native species, is the cautionary note that you would share with them really that we need to use regional -- sort of a regional approach to native so you have a larger plat or toolbox, if you would?

A. Yeah, bigger toolbox.

Q. And then within that, that you really believe that the life-form ratio as opposed to the species concentration is the best way to do that?

A. Yes, I do.

Q. If we turn to the proposed rule there's another question, and I can't remember -- maybe it was from Dr. Neeper. It might have been one of the commissioners -- and that was about reclamation in an agricultural area. Turn to Page 39. This is Attachment A, Page 39. If I can direct your attention to No. 4, the last blue section above the gray. This section here talks about alternative regulatory or contractual requirements. It says, "The vegetation reclamation obligations imposed by other applicable federal or tribal agencies or imposed by specific agreements with surface owner shall supersede these provisions and govern the obligations of any operator subject to those provisions."

Does that provide an out where there is another applicable regulatory scheme or sufficient arrangement may be made with the surface owner where you are in their pasture or you're in their strawberry garden about how that would be reclaimed?

A. Yes, it certainly does.

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Q. And is that a important part of reclamation when you are looking at the proposed end use?

A. That's the first thing you learn when you go to school and you start talking about reclamation. You have got to get to the end use. That's the first thing you think about is the end use. That's what you teach people. The end use is everything so you want to satisfy that end use. If it's agricultural, it's agricultural or whatever it is. Yes, that really is important.

Q. And I think Mr. Dangler asked about the studies that you had done and whether you participated in these systematic studies?

A. Which ones?

Q. Mr. Dangler is the attorney for the Land Department. He asked you if you participated in any systematic study across the state of pits, systematically across the state.

A. No, I haven't.

Q. You said you did not. He then asked you if -- let me ask you this way. Do you believe that the studies that you have done would be representative of the results across the state?

A. Yes, I do.

Q. Even though it hasn't necessarily been systematic as he would define it?

A. (Witness nods).

Q. I believe that completes my redirect.

CHAIRPERSON BAILEY: Your witness can be excused.

MR. HISER: Thank you. This would complete NMOGA's direct case.

CHAIRPERSON BAILEY: Then we will begin with testimony of Ms. Denomy after a ten-minute break.

(Note: The hearing stood in recess at 2:50 to 3:00.)

CHAIRPERSON BAILEY: We will go back on the record. Mr. Jantz, I understand you have one witness?

MR. JANTZ: That's correct, Madam Chair.

CHAIRPERSON BAILEY: And you have made your opening statement?

MR. JANTZ: I have. I would like to call Ms. Mary Ellen Denomy.

MARY ELLEN DENOMY

after having been first duly sworn under oath, was questioned and testified as follows:

DIRECT EXAMINATION

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BY MR. JANTZ

Q. Ms. Denomy, could you introduce yourself to the audience and the Commission.

A. I am Mary Ellen Denomy. I am a CPA. I live and work out of the Piceance Basin in Colorado. I have an accreditation as an accredited petroleum accountant, a certified mineral manager, a certified fraud deterrent analyst, a certified forensic financial analyst, and I am the only one in the United States with those four credentials.

Q. Let's talk about your academic background a little bit, Ms. Denomy. Where did you go to school?

A. I went to school at Wayne State University in the city of Detroit.

Q. What did you study while you were there?

A. My major is in accounting and I have a bachelor of science with distinction.

Q. What sort of course work goes into a bachelor of accounting?

A. Financial reporting, accounting, all the economic courses as well as your usual basic English, science and math.

Q. Okay. And after you graduated, where did you go to work?

A. Where did I go to work? My first job was doing income taxes and then I have also taught high school for a small period of time and then I started my own accounting practice in the city of Grosse Pointe Woods, Michigan.

Q. What kind of experience have you had in the oil and gas industry?

A. Well, I began working for an family that had an extensive number of gas wells on their property. During the course of my employment with them, I became trained as an accredited petroleum accountant, which encompassed going to many places across the United States to get tested for eight different parts, to be tested for competency.

Q. And can you explain what it takes to become an accredited petroleum accountant?

A. Well, you need to do extensive study and then you also need to be tested that your competency is up to par to pass. The eight parts are: Audit, operations -- you need to know how the wells produce. You need to do financial reporting, which is something that most accountants come equipped with before they even go into oil and gas. You need to know oil and gas law, oil and gas tax, oil and gas revenue, oil and gas joint interest billing,

which is expenses that are charged between two companies, and you need to know oil and gas management, which includes mergers and acquisitions and how to manage the oil and gas companies.

Q. Was that eight?

A. That's eight.

Q. Is this a national accreditation?

A. It is a national accreditation and there are just less than 200 accredited at that level.

Q. Let's talk a little bit more about your experience. You talked about representing this one family. Have you represented other people? Have you worked for other people in the oil and gas context?

A. Yes. I worked for one family but I am also currently a consultant for four different oil and gas companies. I do their revenue, their audits, I do their royalties, I do their taxes and I'm pretty much the accountant go-to for all of the expenses as well as the income and the tax liabilities that have to do with it.

Q. And what kind of companies are these? Are these like BP or are these small companies?

A. No, they are are probably in the range between five million and ten million dollar

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companies. They are the small independents.

Q. Do you represent mineral interests as well?

A. I also represent mineral owners, a large number of them as well.

Q. What do you do for folks like them?

A. I will do audits if companies will allow me to go and audit their records. Most mineral owners in their leases don't get the right to go audit but sometimes the larger companies like Chevron or BP may be willing to allow them to come and look and see if the income and expenses that have been charged to a mineral owner are exactly the way they have been put on their royalty checks. And I also do, you know, about 100 tax returns for mineral owners as well privately, tax returns.

Q. Have you worked for governments?

A. I am also currently employed and a consultant for two counties in the state of Colorado.

Q. What do you do for the counties in Colorado?

A. I do oil and gas audits on the tax paid to the counties.

Q. Do you have clients or have you had

clients in New Mexico?

A. I have.

Q. And you currently had clients in Colorado, I assume?

A. I do. I actually have clients from Pennsylvania through California.

Q. Can you tell me what a certified mineral manager does?

A. Certified mineral manager is a certification that requires passing three tests that involve basically more for the mineral owners rather than the oil and gas companies. What is a spacing unit, for instance, and you are very familiar with a spacing unit situation, but it is a certification that shows that I understand spacing units, I understand leases, I understand how people should get paid and the taxes that go with private mineral owners.

Q. Have you testified as an expert witness before?

A. Numerous times.

Q. In what contexts?

A. I have testified back in 2007 in front of this Commission for the first Pit Rule hearing. I have testified in front of the Colorado Oil and Gas

Commission several times on spacing and down-spacing for well sites. I have also been an expert witness for a number of court cases where I have been the expert for the mineral owners as well as a working interest owner.

Q. And so just to be clear, you were qualified as an expert in the Pit Rule before this Commission before?

A. Yes, I was.

Q. I would like you to take a look at Exhibit 1 to OGAP's prehearing statement. This is your resume, is it not?

A. It is my curriculum vitae.

Q. Your CV?

A. Yes.

Q. Is that a true and accurate representation of your CV?

A. It is.

MR. JANTZ: I would like to move Exhibit 1, OGAP Exhibit 1 into evidence.

MR. FELDEWERT: No objection.

MS. GERHOLT: No objection.

MS. FOSTER: No objection.

CHAIRPERSON BAILEY: It is admitted.

(Note: OGAP Exhibit 1 admitted.)

MR. JANTZ: And at this point I would like to qualify Ms. Denomy as an expert in petroleum accounting.

MR. FELDEWERT: Madam Chairwoman, may I question the witness about her background a little more thoroughly.

CHAIRPERSON BAILEY: Yes.

VOIR DIRE EXAMINATION

BY MR. FELDEWERT

Q. Ms. Denomy, I understand that your training is in accounting, correct?

A. Yes.

Q. And that it appears from your resume that most of your professional experience has been limited to accounting and auditing type issues.

A. Yes.

Q. For example, if I go to your Exhibit No. 1 and if I go to your section with work experience and I start on Page 3, it looks like you were a staff accountant dealing with payroll and tax preparation issues for three years, correct?

A. That was in 1980, yes.

Q. Then you did general tax preparation for a long period of time, ten years?

A. Yes. That was my own office.

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Q. Then if I continue forward, you were a staff accountant for a period of time?

A. Yes.

Q. And then you did some kind of staff accountant work in 1995?

A. Yes.

Q. Now, at that point in time you didn't have any experience with oil and gas issues?

A. That is correct.

Q. All right. So then we look at your -- continue on with the background. You became, looks like, a comptroller in 1996 for looks like a fairly well diversified family business; is that correct?

A. That's correct.

Q. And a comptroller, as I understand it, is a person who generally supervises the quality of accounting and reporting for, in this case, a family business?

A. That is correct.

Q. Your resume indicates for this particular family business you did their accounting, you did their taxes and you did their payments?

A. That's correct.

Q. For a long period of time. Twelve years?

A. Yes.

Q. And so then your self-employed consulting work began about what, four years ago? 2008?

A. Yes.

Q. And that was when you first started getting some exposure into, at least for some companies, oil and gas type accounting?

A. That is incorrect.

Q. You did some with the family business?

A. I did a lot with the family business.

Q. And that was your oil and gas accounting work?

A. Yes.

Q. Comptroller work?

A. It was part of my comptroller work. When you have a small family business you are expected to do everything. I have driven the ambulance, I have tested pit water, I have counted four feet of cows and divided by four to figure out how many cows got sent, so I was well diversified. I was more or less everything in addition to an accountant.

Q. I understand. You said you did do some work for some oil and gas companies. Can you name those companies?

A. I sure can. Apollo Operating, WWF, LLC, Gadeco, LLC and Grynberg Petroleum.

Q. Do any of those companies operate in New Mexico?

A. Yes, they do.

Q. Which ones?

A. Grynberg does.

Q. What part of the state?

A. Northwest.

Q. And did you do work for him in the northwest?

A. I did.

Q. Is that up in the San Juan Basin?

A. Yes.

Q. And then with respect to your expert witness testimony, I think you said you testified about spacing issues and you mentioned some court cases.

A. Yes.

Q. What was the nature of your expert witness testimony in those court cases? Was it royalty accounting?

A. Not in all of them, no.

Q. Okay.

A. In the Celeste Grynberg, et al. versus Williams Production, Celeste is the owner of the company listed and that is a working interest owner.

Q. So joint interest billing issues? Is that what you were covering?

A. Expenses as well as income.

Q. So again, you were testifying then as an expert in accounting?

A. Oil and gas accounting. There's a difference.

Q. Well, in terms of the subject matter.

A. In the way it's done.

Q. Okay. One of the things I didn't see and I wanted to make sure I wasn't missing anything is you did not -- you are not an economist?

A. I am not an economist.

Q. So you have never been trained in any of the social sciences that will normally be associated with someone who is a professional economist?

A. I am not a professional economist. I am an oil and gas accountant.

Q. What you bring to the table here today then is your experience as an accountant and an auditor with some oil and gas experience in those two fields?

A. Yes.

Q. Now, you have never owned or operated or managed an oil and gas company other than what you

referenced here as the family business?

A. I have never owned an oil and gas company.

Q. Never been involved in decisions about where to drill?

A. Yes, I have.

Q. Have you been in decisions about where to allocate capital?

A. Yes, I have.

Q. When you say you were involved in decisions about where to drill, what was the nature of those decisions?

A. Location as well as income.

Q. So you made a decision from an accounting perspective whether that particular site and the potential income from the site made sense?

A. That is correct.

Q. Any other exposure?

A. I also do mineral valuations and I have done about 100 of those.

Q. You are doing, again, accounting work with respect to what the expected value of the minerals may be?

A. That is correct.

Q. And how much it may cost to get them out of the ground?

A. That's correct.

Q. Have you had any experience on what the effect the current Pit Rule has had on any allocation of capital for any company?

A. No.

MR. FELDEWERT: Madam Chair, on behalf of NMOGA I have no objection to Ms. Denomy testifying on general accounting issues.

MR. JANTZ: She was offered as a petroleum accountant, expertise in petroleum accounting.

MR. FELDEWERT: We have no objection to that characterization of her expertise.

CHAIRPERSON BAILEY: Any other discussion? Then she is accepted as an expert in petroleum accounting.

MR. JANTZ: Thank you, Madam Chair.

DIRECT EXAMINATION CONTINUED

BY MR. JANTZ

Q. Ms. Denomy, I understand that you have a PowerPoint presentation.

A. I do.

Q. So rather than me ask you questions and you give me answers, why don't I just turn you loose and if I have any questions about the need for clarification or anything like that, I will just

interrupt. Is that okay?

A. That's great.

Q. So please.

A. Okay.

MR. FELDEWERT: Before she begins, Madam Chair, I may have some objection or concerns about specific slides. So when we get to that particular slide, before she testifies I would like to address those concerns.

CHAIRPERSON BAILEY: You can voice your concern at that time.

MR. FELDEWERT: Thank you.

A. Before I start, I would like to make a comment, if I may. As much as Mr. Arthur yesterday said that money is not significant, this is what drives an oil and gas business is money. What is required of a business is to achieve ethics, and ethics includes environmental protections as well as maintaining good relationship with their customers and each other.

It is a really difficult combination to try to make sure that this and this come together, and I'm going to try to do my best to go through what has transpired over the last couple years since the first Pit Rule hearing.

If we look at rig counts and those kinds of things that have happened since the first hearing in 2007, we had 1695 rigs in 2007. In 2008 those increased, and this is nationally. In 2009 those decreased nationally by 42 percent. This information can be -- and I have it on all my slides where the information came from. That's from the Energy Information Administration. That was the annual review done in 2010. As you can see, in 2010 there was an increase again of the rig count.

Q. Ms. Denomy, can you explain what the Energy Information Administration is, just for the record?

A. It's the arm of the government that keeps the statistics on rigs, how much gas is produced and prices across the United States.

Q. That's the federal government?

A. It is the federal government.

Q. Thank you.

A. In addition to that, these are the statistics for New Mexico for 2007, how many rigs they had going, and then how many were in Colorado, and you can see in 2009 both states dropped significantly in the number of rigs that were produced. 2010, they made a come-back again, and a

little bit more again in 2011. Actually, New Mexico has made a greater come-back than Colorado has after the Pit Rule hearing.

Q. Just again for the record, Ms. Denomy, what exactly does rig count signify?

A. How many wells are being drilled. Then we need to look at what were the prices during those particular years. 2007 it was $6.21. 2008 it was $10.79. And again, this is from the EIA or the Energy Information Administration. In 2009, that price dropped to $3.45, and it did so for the nation, not just for the state of New Mexico or the state of Colorado. In 2010 it's come back a little bit. 2011 it's dropped, and this morning's price was $2.62.

So when Representative Stickler said the income has dropped, it's dropped between 2008 and 2009 a third in the price. Even if we had the same volume, you would only get a third of the income.

Now, in New Mexico, the EIA states that in 2007 it was $6.48. It's very similar to the national average. Citygate is, at the point where gas is sold at, let's say, Albuquerque to the consumers. That's what EIA has published as their prices being paid.

Now, moving on, New Mexico production each year. New Mexico has the natural gas production as of July of each year because I have the information from 2011 through July. It has continued to go down since the Pit Rule went into effect even though the rig count has gone up.

Now, we are going to see in a couple slides why that might not be the full picture.

Moving on, here is the oil are prices. If you look at 2007 oil prices, 2008, 2008, 2009, 2010, 2011 and this morning it was at $92.63 so we are hovering around $100 a barrel. Moving on, you can see the oil production has increased. That is common across the United States.

When I do accounting for gas companies or mineral owners or government agencies across the United States, everybody is focusing in on the oil, and that's the reason why most people are looking for jobs in North Dakota in the Bakken field. It is an oil field. Gas prices, $2.62. It is not economic to drill a gas well. But oil or gas that is high in natural gas liquid, the propanes, the butanes that can be extracted are the areas that the companies are focusing in on and not necessarily looking at what are the rules and regulations in

that particular area, but they are heading to where they can make the best dollar.

Us accountants would be the ones to tell them that's where you drill. We hold our leases as much as we can in the -- well, companies are allowed to drill because they have leased the property, whether it's with the federal government or with a private individual. And leases only last for a certain period of time unless a well is drilled and then it lasts until the well stops producing.

So if you have a lease of, let's say, 600 acres with a particular individual and it says it will expire in three years, if you drill one well it will last until the well expires, which could be 30 years down the road. So you drill for what you need to hold the lease and then you go to places where you are actually going to make money. And money is where is the price, where is the infrastructure.

Now, New Mexico is really good with infrastructure. We have the pipelines, we have a way of getting the gas out of the state of New Mexico. But the prices for natural gas where most of the drilling has happened in northern, northwestern and in any of the shale potential plays, that's natural gas that will be coming up.

No one wants to drill at the price of $2.62. In Colorado, my county that I live in, had 60 rigs in it in 2009 at the beginning. It has 16 now. So it's the same issue whether you are in Montana, in Colorado, in New Mexico, in Oklahoma, because they are primarily gas-producing states.

If you talk about Pennsylvania, you talk about some of the areas in Texas, they are oil-producing states and there is a great need to get the oil out because that's where the price is.

This is just a statistics showing the New Mexico wells spudded and spudded, everybody knows, is the wells that are started. It went up again in 2010 regardless of the Pit Rule that was put into place in 2008. You can see in 2009 it went down, just like everything else across the nation did. In 2010 it went back up. Same with permits. They went up again in 2010.

That's a little timing, but all of the statistics that were shown on the first slides are all on one page. I have put in red the year 2009 where everybody and everything and everywhere, the prices, the permits, the rig count, the national prices were all in the negative and it had nothing to do with any other issue other than the economics

of the nation. Prices went down and there was no place to sell the gas.

2010, things started to come back. Same with 2011. It's the same statistics that were on each of those individuals one. I tried to put them on one to show you that everything in 2009 was reduced that year.

Okay. This is also very small. Hopefully you might have a paper copy in front of you there, and I need to find mine because I can't see that from here.

This is a small presentation where a working interest owner, one of the companies that I do work for, would come to me and say, "Look, tell me if I'm going to make money on this well. Am I going to make money on this well? Here are the criteria. It's 7200 total depth and we need to see is this a well that's going to make money even at $3."

Q. Excuse me, Ms. Denomy. Is this information on this spreadsheet, is this based on your actual experience?

A. This is based on my actual experience.

Q. Thank you.

A. And it's just a sample.

Q. Okay.

A. It is not all the wells being produced.

MR. FELDEWERT: Madam Chair, I have to -- I'm looking at this particular slide and there's a number of figures and representations made. At this point I don't think she has laid a foundation as to where these numbers came from, unless I understood you to be saying that -- can I question her about this?

CHAIRPERSON BAILEY: No, not until she is through with her direct testimony.

MR. FELDEWERT: I guess at this point I object to this particular slide until a foundation is laid as to where the numbers came from.

CHAIRPERSON BAILEY: Would you care to respond?

THE WITNESS: I think in my explanation of where the numbers came from I will probably answer most of the questions if I'm given the opportunity to describe how the numbers are -- where they were derived from.

CHAIRPERSON BAILEY: That's fine.

A. Starting with -- well, I'm a person that does a good number of mineral valuations. So it is important for determining how much income can be

produced from a well to figure out what is the volume that that well can be expected to be met. So I will approach the party in the firm that does the petroleum engineering and say -- or the geologist and say, "What do you think in this area that the volume will be?" And in this particular instance, the estimate that was made by the petroleum engineer was they believed there was a million MCFs that could be estimated to be expected out of this well. So that is where the first number of a volume came from.

Now, on the price, it is something that, looking at historically and looking at future prices that the Energy Information Administration has projected for the next 20 years, $3 is a conservative price to be put into there to say is this going to make money or isn't it.

Q. Now, Ms. Denomy, could you explain that a little bit more, the process of estimating the price that you used to value this well? You say Energy Information --

A. The Energy Information Administration in April every year puts out what they believe is the projected prices for the next number of years.

Q. Okay. Is this a typical practice for

petroleum?

A. It is a typical practice. They do that every year. You know, it is projected to be in the threes, $3.40, $3.70 as the years go on. So just to make sure that -- you know, accountants are very conservative so we wanted to go on the low end. $2.62 right now would be what is close to $3. We would hope that over the course of the life of the well that we would at least achieve $3. This is the first draft to just see can we drill this well.

$3 times a million MCF is three million dollars. That's what we can expect. Now, talking to the engineers and also looking at historic data in that region where this well would be drilled, about 5 percent of the MCFs produced are also produced as condensate, as an extra add-on to that particular well in that area. So the projection of about 55,230 barrels, and it's based on the percentage of oil production in 2011 in that region for the number of wells that are producing, 55,000.

Now, I also use the Energy Information Administration and also the Colorado Oil and Gas Commission projections that show historic prices for oil. It was running over $100, but $90 seems to be a conservative amount. Multiplying the 55,000

barrels times $90 gives you $4,970,000. Adding the two together you start with the income of the well.

Now, keep in mind, again, this is just to see is this well going to be worth the time to have somebody actually do the work to see if it's going to make us how much money and what percentage income we are going to get as a return on investment.

Total well costs. You go -- you know, both of -- many of the working interest owners are engineers themselves, and often when I have to do projections like this I will seek their guidance. We saw a little earlier what they call an AFE. That is a projected amount that the owner or departments, if you have a little bit larger business, departments will put their input in and say okay, it's going to cost $5,000 a day to drill, it's going to cost this much to complete, this is how much, this is how far things have to go with pipelines, so we will project to you about a million seven that this well is going to cost at 7200 feet.

Then my historic knowledge of going through all of the monthly lease operating expenses, how much is being expensed every month for the pumper that comes to check the well site, the amount of chemicals that are used to keep it from freezing,

any special equipment that goes on, repairs that are done, the meters are checked, the calibration average about $1500 a month for this particular company that is represented in this item.

$1500 a month is pretty representative in all the companies that I -- you know, they can have months where it's $800 a month. Overhead gets put in there. Also other expenses that are unusual sometimes, where they have to clean the roads out or something along those lines with snow in the wintertime.

On the average about $1500 a month. So if you did $1500 a month and the $1700 original cost, the cost of producing the well is about $2,200,000.

Q. Ms. Denomy in the cost column, would that be where regulatory compliance with something like the Pit Rule would be --

A. The Pit Rule would go here.

Q. Are those generally itemized?

A. They are itemized just like we saw with Mr. Sauck's AFE earlier today. They are itemized on what kind of items those are.

Q. Okay.

A. Subtracting one from the other, the net expected per well is $5,700,000.

Now, that's just the basic. You have to get the gas from the well site to someplace where people are going to buy it. In order to do that you have to pay gathering fees, processing. You have to pay a marketing fee. Roughly in this particular company it is about 25 percent of the income is being spent on gathering, processing and transportation to get it to market. That leaves the net income expected per well of about $4,200,000. Now, that's the well's total expected. It will make money.

So if that point is shown to the owner of the oil and gas company, at that point he says, "Okay, so tell me really how much of that is going to be mine." Now, there is a process that needs to be done and that is how much gas is going to be produced this year, next year, the following year, the following year, and then you have to bring all of those expenses back to today's dollars by doing a present value.

In addition to that, the $4,200,000 may have some what they call burdens. They always do, because they are the lease royalty owners that have to be paid. They could be anywhere from 12 1/2 percent to 25 percent, so in that $4,200,000 you

will not, as the working interest owner, necessarily get all of that money for you.

So you need to subtract the burdens, the other people that you have to pay out of that well, and then you have to calculate -- then you start looking at things like okay, where is the well located? Is it located in the state of Texas, the state of New Mexico, the state of Colorado? Because every state has a different tax schedule for their production taxes. For example, in New Mexico it's 3.75 percent for severance tax. In Colorado it's a graduated scale of up to 5 but then they get a credit for ad valorum, so it's about 1.7 by the time you are done taking your deductions. Texas has incentives.

So where the well is located? You start looking at things like what are the additional costs that have to be paid? Are there costs for local communities? Because that happens in some locations, too, where the communities require a pad expense or something along those lines. So after you determined your burdens, you also have done your present value bringing it back to today's numbers, you look at what the decline rate is at the first couple months of the wells that are located in the

area. You end up with a number, and then you look at is that number acceptable to invest in that well.

For instance, if we took this one and as an example said well, let's say we have 20 percent we have to pay out for royalty owners. That would bring the 4.2 million or thereabouts down to about 3.3 million. Just to be conservative, make sure we have the taxes, conservation taxes, severance taxes included, we subtract 15 percent for taxes on the 4.2 million, and then you end up with a net of about 2.8. Then you have to take that back in the present value.

Now, I have not done a present value table because it is time-consuming. I have to look at the decline rates. But I have looked at the several hundred mineral valuations I have done, and on the average over a 30-year period, which most wells produce that long, about 55 percent at the 10 percent present value rate, which is the same that Duff & Phelps use in Texas or Walt Pearson, the small engineer, uses in the state of Colorado.

So 10 percent present value brings it down to about 55 percent of that amount. So this owner can expect, out of spending 2.2 million, about 1.57 million over and above his expenses, and that's

basically what this is about.

You know, if you look at it, it's done to show that yes, there is income coming. I added the bottom line showing if we have this many wells producing and everybody had this much coming in and Representative Stickler said it was more like 5.4 billion in one year and 5.6 billion, so in New Mexico it's probably not quite as high as this and it will be a lot less this year because the prices are so low. So it's just a sample, and there's a lot more work that needs to be done after that 4.2 million is prepared.

Q. Now, generally this is sort of an initial estimate, right?

A. Yeah. Are we going to make money at $3, and most owners that own small businesses, that's how exactly they say it.

Q. Over time, have the projections you have done like this been pretty accurate?

A. Yes. A lot of the mineral valuations that I have done for future production I have had phone calls from people going, "How did you know I was going to make that much this year?" Because you do it and then show them what they are going to make in 2009, 2010, 2011, 2012. Yes, and it is a science

that you plug in numbers based on the area, the decline, and what you can put your hands on on price predictions. That's about all you can do. It is a guess.

Okay. Moving on, looking at just some of the other states that have looked at closed-loop systems, and I need to tell you in the state of Colorado most of our operators are now using closed-loop systems. As a little anecdote, a week ago I was sitting across the table from a representative from a small -- well, they are not very small. It's Antero Resources, and his statement to me was, "We always go pitless and we always use a closed-loop system and we are doing it in anticipation of the EPA requiring it in 2015."

MR. FELDEWERT: Madam Chair, I'm going to object at this point. She is testifying about some conversation she had with some individual at some unknown point in time. That individual is not here so it's hearsay. We are about to reference the slide that has no foundation. I don't know where this came from. I don't know what document it comes from or what time frame. So I think we are getting into an area of hearsay without any foundation.

CHAIRPERSON BAILEY: For part of your

objection, I think you will have the opportunity to cross-examine at the appropriate time. For the other part of your objection, could I hear more?

MR. JANTZ: Which part of the objection would you like to hear argument about, Madam Chair?

CHAIRPERSON BAILEY: Without foundation.

MR. JANTZ: Without foundation.

Q. Ms. Denomy, can you explain where this information came from on this slide?

A. This came from the presentation that the Oil & Gas Accountability Project presented about the Texas oil and gas findings on the closed-loop system.

Q. And do you know the source for their quote?

A. I don't remember.

Q. Okay. Would you be willing to find out and supply that to the Commission?

A. I certainly will.

MR. JANTZ: If that's acceptable, Madam Chair, we can do that.

CHAIRPERSON BAILEY: That's acceptable.

Q. In terms of the conversation you had, would you like to hear arguments on that as well?

CHAIRPERSON BAILEY: Please.

MR. JANTZ: First of all, hearsay is an evidentiary objection. Rules of evidence don't apply in this hearing. It's an informal rule hearing. The only consideration is the consideration of relevance. The Commission can put whatever weight it wants on the veracity of the statement from Ms. Denomy.

Q. However, Ms. Denomy, if you feel so inclined, please enlighten us.

A. It was done at a public meeting.

MR. FELDEWERT: Madam chair, may I interject here? First off, she can say this is from some API document. She doesn't know the source where -- what was it? OGAP document. She doesn't know the source of where the information came from other than OGAP. We don't know when the statement was made or made by whom, so I have a real problem if they intend to admit this particular slide as some kind of substantive evidence, number one.

Number two, to have a witness in any form sit on the stand and say, "Well, I had conversations with Joe and I had conversations with Jim and they are telling me this," I mean, first of all, the evidentiary value of that is slim to none, I would submit. Secondly, we have no opportunity to

determine the veracity of what she is saying. So I would object to any testimony premised upon some conversation Ms. Denomy had with some individual at some point in time. There's no possible way for us to know about that, number one, or cross-examine her on that. Particularly with respect to this document, I can't cross-examine on it. I don't know where it came from.

CHAIRPERSON BAILEY: Is there other discussion?

MR. SMITH: I think the offer was made to identify where this came from and get more information at a later time. Pending that, I think you can let her talk about this, but she is going to have to come up with the source of it later on. With respect to the hearsay, it is a rule-making. I would let it in and you can ignore it if you want to but I don't think you need to rule it out.

CHAIRPERSON BAILEY: With the understanding that we will have further information on the source of the document, then the objection is overruled.

MR. JANTZ: Thank you, Madam Chair.

A. Okay.

Q. Closed-loop systems in Colorado?

A. Closed-loop systems in Colorado. I sit on a committee in my local community, to give you a little background, where that discussion happened, at a public meeting where as a member of the oil and gas committee for my community the party that was representing Antero stated that fact. It is also information that I have due to the fact that I am the accountant for one of the working interest owners that is in a joint agreement with several other operators. That is a practice that is paid for and used consistently by Noble Energy as one of them and so I know that for a fact because we pay the bills to that company.

The Minutes of the oil and gas committee meeting are probably available if I can have an opportunity to talk to the chair of that committee. So if those have to be provided, I probably could get them for you.

Q. Let's turn to Slide 13.

A. This one was from the Oklahoma Department of Environmental Quality findings.

MR. FELDEWERT: For the record, I have the same objection to this one. We will not have an opportunity to verify the veracity of the statement or cross-examine the witness so we would object to

its introduction.

MR. JANTZ: It's clearly from the Oklahoma Department of Environmental Quality.

Q. Can you say when, Ms. Denomy?

A. I don't remember the date. I don't remember the date.

MR. FELDEWERT: Do we know what time frame?

THE WITNESS: I believe it was -- I don't want to say until I get the source. I will have to go back to my records and get the source.

MR. FELDEWERT: But at this point you have no idea what the source is?

THE WITNESS: No, I don't remember.

CHAIRPERSON BAILEY: I believe that these questions are better served as cross-examination after she has completed her primary testimony. If you would continue.

A. Okay. The Environmental Protection Agency. I do have the source cited at the bottom of that one, and this is from the Overview of Final Amendments to Air Regulations for the Oil and Gas, Natural Gas Industry Fact Sheet that was sent out on April 17th, 2012 and this is the source of both this slide and the next slide.

What I was trying to show with this particular slide and the next one is that the federal government has looked at whether or not there are any cost savings made by requiring some environmental protections. There are programs that the Environmental Protection Agency looks at capturing VOCs, the volatile organic compounds; that they have done the study and found these are also cost savings. So these are the facts that the Environmental Protection Agency has used to come up with their new rules that will be presented by 2015.

Okay. Now, looking at the next page, this is a sample taken from various companies that I have done the joint interest billing for. Some of them use earthen pits. Some use central pits and some use the closed-loop and these are the costs they have incurred; for example, for drilling water, completion water, trucking and the savings that they have maintained in mud reuse.

Q. Excuse me, Ms. Denomy, the earthen pits, are those lined or unlined?

A. Lined.

Q. Central pits?

A. That's the equivalent of our multi-well FMPs here.

Q. Okay. So those are lined as well?
A. They are lined.
Q. Thank you.
A. And then the closed-loop is a closed-loop system. The central pits have become a little more expensive than just leaving the pit on-site. Now, what these central pits are, are areas where a large number of wells are being trucked to that centralized pit. Virtually it's an area where it would be called a waste pit. We have a lot of large pits that are adjacent to well sites and the production of wells now are running most of the time about 20 to 25 wells are drilled in one location. There are some locations up to 64 wells are being drilled, but you need a pit that is very large in order to accommodate all of the liquids that come out of the actual well sites themselves.

So the centralized pits are not on location, which is a little different than what Mr. Arthur was trying to project yesterday, which is more along the lines of a pit that is handling more than one well.

Now, when I hear the term fluid management pits, in Colorado and in other states those centralized pits are used to separate the water from

oil from any of the chemicals that are used for processing. So when you say management pits, that's usually what I would use in my head to say that that's a well that does that kind of separation. Your normal pits that are alongside a oil and gas well, they don't do that kind of separation. They don't do it right there, so these are central pits that are located usually pretty far from where the drilling is because there's a lot of trucking and a lot of water that needs to be moved to those pits.

Okay. What are we talking about if we decide to change the rules and discontinue helping promote the closed-loop? The closed-loop system comes with tanks and equipment, and as an auditor for county governments, I look at personal property tax. And that's a tax that's being charged on those tanks and equipment as well as the drilling equipment. So if we change the rules to encourage less use of the closed-loop system, we are also encouraging less taxes to be paid on the equipment that goes along with the closed-loop system and then changing it to the fact that we are going to change it to centralized pits instead of the closed-loop system so we won't get any personal property taxes from the closed-loop equipment.

I think it was alluded to a little bit this morning during the public comment that jobs are going to be lost. I would like to suggest -- and one of the companies that I have done some accounting work for has been pushing natural gas vehicles, and that would be one of the suggestions that that company and a lot of the think tank colleges in the state of Texas would like to say. If we use natural gas in our trucks, it would eliminate the pollution situation. It would also provide a source of use for the natural gas, which should hopefully bring that $2.62 up.

But if we discontinue using drivers, water haulers, you are going to have a lot more jobs lost in the state of New Mexico than what has happened because of the economy.

The next slide says "Earthen pits create waste." And just to make sure you understand what I'm talking about, I do have a jar of pit water here and it contains hydrocarbons. Those fluid management pits extract the hydrocarbons from it. They sell those hydrocarbons and there is money that is made from this water. A lot of the wells that are on the west end of the state of Colorado drive their pit water to Utah and Utah has got a plant

that extracts the hydrocarbons and they actually make more money from the hydrocarbons that they extract from the pit water than they do from charging the drivers .60 a gallon. So digging the oil back into the ground is a waste. It is a waste. You know, 1,000 barrels of condensate wasted at $90 is $90,000.

Q. Is it my understanding that the closed-loop systems are better at recovering that fluid?

A. It stays in the closed-loop and is taken to a processing plant and that is extracted and then sold. At $90 a barrel, this little jar is worth about $10.

The cost of cleanup of earthen pits. This example, I have the privilege of doing taxes for the truckers. Most truckers are self-employed. They don't necessarily work for the company; they have their own private company. So their average rate is $100 per hour. And this particular situation happened in Piceance Basin where the oil and gas commission made the suggestion that they needed to clean up that pit and remove the soils and take it to a place where it can be -- actually Utah -- that would accept it.

So the drivers were getting $100 per hour to clean out this pit that had managed to hold 64 wells worth of stuff, and it took about 1,000 hours. There were trucks lined up -- because it's an eight-hour drive back and forth, so it really did cost about $100,000 to clean up this one particular pit. This cost would be diverted to the citizens and the government of New Mexico in the future. If we don't do it now, it needs to be done at some point, so it's either now or in the future.

Q. Now, Ms. Denomy, in this instance did the company not pay for it?

A. The company did pay for it. They did pay the $100 per hour for all the trucking cost moving it. But if they had just dug it up and walked away, somebody has to pay that cost at some point.

Q. Okay.

A. And just a reminder, and I know it's been alluded to a little bit here. BP had a spill of five million barrels.

MR. FELDEWERT: Madam Chair, I'm going to object to the line of testimony and the slide. What happened in the gulf has absolutely nothing to do with what you are considering here today. She has, again, no foundation for these numbers. We

shouldn't go into what happened in the gulf.

CHAIRPERSON BAILEY: Would you like to share some relevancy?

MR. JANTZ: I believe this is just to demonstrate the potential cost of cleanup. It's an analogy and that's clear, and it may be an imperfect analogy and certainly the Commission can take that for what it's worth.

MR. FELDEWERT: This witness has no background to testify about the cost of cleanup in the gulf or what was involved.

MR. JANTZ: Based on public information?

THE WITNESS: Based on public information.

MR. FELDEWERT: There's no citation to any public information.

CHAIRPERSON BAILEY: We will sustain that objection.

Q. Very well. Let's take the next slide, Ms. Denomy.

A. The relevance of the next slide is based on what that particular cost was.

MR. FELDEWERT: I would object to this as well.

A. So I think the relevance is probably not an accurate thing to put into the testimony.

Q. Okay.

A. But I will say that the $100 per hour of cleanup is probably an appropriate amount to look at. If we had 500,000 gallons --

CHAIRPERSON BAILEY: Is there an objection to this?

MR. JANTZ: This was to the prior slide.

CHAIRPERSON BAILEY: Which we have disallowed.

MR. JANTZ: No, the one prior to that, Madam Chair.

MR. FELDEWERT: Can you bring it up?

MR. JANTZ: Sure. The one of the cost of cleanup of earthen pits?

THE WITNESS: Yes, it's up.

A. So if we would apply that to cleanups that happen for spills and we had a hypothetical amount of 500,000 gallons that would be disbursed. Now, keep in mind, most wells use about a million gallons to drill and complete, so if we had 990 wells that were spudded in -- I think it was back -- can we go back to the beginning slides here? New Mexico spud rate. 990 wells spudded in 2011 and that would mean 990 million gallons of water. If only 5 percent of that at 500,000 happened to spill, we would probably

expect to spend about $30 per gallon in cleanup and somebody has to pay that. So it's either, you know, us or, you know, the government or the landowner that it happened.

That will conclude my slides, but I would like to make a little summary of what companies do when they look at trying to drill a well. They look for certainty. They look for what are the rules and regulations in this particular place and this particular place, and what is the ease of accommodating those rules. Because they all cost money and I'm the kind of person that's behind them saying this costs this and this costs this and this is what it's going to cost you.

Once a company is comfortable with what a particular rule is, they become accustomed to doing it that way. When you start to take rules and make them more complicated and say, "Okay, if the value of this is this much, then you have to do this. And if the value is this, you have to do this." I have seen this many times with people trying to make sure that they do the rules right. I also have seen it on the government's side when I worked for the counties when they have had to go look at inspections for particular wells in their area, that

it is very hard to determine, and it costs more time and time is money.

So having more of a standardized rate of how you do things and keeping that certainty costs less money because it's done, it's produced and you know what you need to do.

Compliance costs money. When things become complicated, it costs more money to find the compliance. And I think that's about all I have.

Q. So let me ask you a couple follow-up questions. There's testimony earlier this week about capital allocation. Companies have a fixed capital budget and in order to allocate -- when allocating that capital budget they have to spend a certain amount on environmental compliance, and I believe the testimony was as the cost of environmental compliance rises on behalf of the Pit Rule allegedly, that capital allocation doesn't go to drilling new wells. Do you have a comment about that?

A. Well, normally a company will say at the beginning of the year either they have the financing or they have the cash flow that they can start to drill wells. So they will say, "In 2013 we are going to spend ten million dollars on new well

drilling. Now, here are where our leases are located. We have leases in Wyoming and New Mexico, we have some in North Dakota." Then they will say, "Okay, but we have leases that are going to expire within a certain period of time." So they need to cover those leases in that particular year first, so they will look at that as the first criteria that they go to use their money for capital expenditures.

Now, not having any leases that will expire, they will then look at where am I going to make the most money, which that includes cost as well. But if you look at wells that are drilled in the state of New Mexico, you can drill wells. Our gentleman this morning had a cost of $224,000 on his well. Or you can go to the Bakken Field and spend two-and-a-half to four-and-a-half million dollars on one well. What is it going to produce?

So that decision is made usually on where do you have your leases and then what can you spend. Now, granted when there is more expense you can't drill as many wells, but the expense you are looking at is folded into your AFE just like it would be in Oklahoma if they were drilling at 15,000 feet or in the Bakken where they're drilling for oil wells or in Wyoming when they have to do certain things on

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higher mountains.

So it is not always the driving force to say, "Well, we have to spend extra money on a closed-loop system here."

Q. Has it been your experience with your clients that the cost of compliance with the Pit Rule is a driving force for New Mexico?

A. No.

Q. Just for the record, what is AFE?

A. Authorization for expenditure. It's the budget.

Q. And you mentioned Mr. Sauck's calculation of the cost for drilling that he presented to the Commission earlier today.

A. Yes.

Q. Could you comment on that, please.

A. Well, I do see that it did cost him more money in the reclamation expense between --

MS. FOSTER: I'm sorry, I object to this. The witness, Mr. Sauck, was here earlier and Mr. Jantz had the opportunity to cross-examine him at that time. Now he doesn't have the opportunity to respond to what Ms. Denomy is saying. So I think it's inappropriate for them to try and look at that letter that was put in when Mr. Jantz had the full

opportunity to question the witness at the time.

MR. JANTZ: Mr. Sauck placed that information into the record. Ms. Denomy should be able to evaluate it.

MR. SMITH: That's right. They can cross on it.

CHAIRPERSON BAILEY: Objection overruled.

A. I'm just looking at the numbers that he presented.

Q. Sure.

A. He had two wells that he said one was done prior to the Pit Rule and the second after. And you can see on the first page of his letter that the reclamation cost that he had was zero in Federal 15 No. 1.

Q. I'm sorry, zero for reclamation cost?

A. That's what the document says.

Q. Is that typical in your experience for reclamation costs?

A. No.

Q. Okay.

A. And then the well that was drilled after the Pit Rule was in effect, which was in 2010, was $76,979.85. So I went upstairs and I look at how much production was produced from the well from the

day it started, which was May of 2010. So it was producing for --

Q. I'm sorry, when you say you went upstairs?

A. Here.

Q. You went to the --

A. To the OCD where they have the production records available.

Q. Okay.

A. So I went and looked at State Com 32 No. 2, the well that was drilled in 2010. In the year 2010 the well started producing in May of 2010. It produced 15,617 MCFs of gas. In 2011 it was 25,000 and then for the first two months of 2012 it was 1600.

At the rates that the EIA has posted for New Mexico, I just did a rough estimate at $4 for 2010 of 15,617; $4.50 for 2011 and $2.62 for the first two months of 2012. The well has recouped $194,674 roughly. It cost him $224,000. The criteria that most companies look at is will a well pay itself out within three years. This will will pay itself out in three years. It would have paid itself out at 133,000 in the second year, so the additional costs are just putting this well into the norm for everybody else.

Q. So what may have been an exceptional well is now a typical well?

A. Yes.

Q. All right. I think that's it for this witness.

CHAIRPERSON BAILEY: Mr. Feldewert?

CROSS-EXAMINATION

BY MR. FELDEWERT

Q. Yes, I have a couple questions about the slides. Could we go to the earthen pits create waste slide? Now, Ms. Denomy, the volume of condensate that you have here, where did that come from?

A. It's just an example.

Q. You pulled it out of the air?

A. Just an example.

Q. Are you aware of what companies in New Mexico are doing with their cuttings from the closed-loop system?

A. They are taking it to a facility to be taken care of.

Q. What type of facility?

A. I don't know.

Q. You don't know?

A. I don't know.

Q. As far as you know they could be taking it to a land farm?

A. They could.

Q. Which means no oil would be recovered then, correct?

A. Their cuttings are not the liquids. This is the liquids. The cuttings are not liquids.

Q. Agreed, but in terms of companies that are using closed-loop systems, they could be taking their waste almost anywhere, correct? For disposal?

A. They could be.

Q. But there's no basis for this particular number that you have on this slide of 1,000 barrels?

A. Just a value.

Q. So it's just a numerical calculation?

A. That's right.

Q. If we go backwards, are you aware of the obligations of this Commission with respect to their statutory duties to prevent waste, protect correlative rights and provide for reasonable protection of groundwater and public health and environment?

A. Yes.

Q. Part of the enumerated duties is not to ensure that there's any increase or decrease of

property taxes, is it?

A. That is correct.

Q. So that has no relevancy to their determination from a legal respect?

A. Correct.

Q. And did you do any kind of a job study when you say that there's going to be lost jobs associated with the NMOGA's proposed amendments?

A. No.

Q. So there's no foundation for these statements made in this particular slide?

A. There is validation from my experience but not using the NMOGA's changes to the rules.

Q. Okay. Now, going to the next slide, the previous slide, now, I think you testified that this was sample numbers that you pulled from various companies?

A. Yes.

Q. Is that right?

A. Yes.

Q. Okay. Can you tell me what companies were involved here in pulling this data?

A. I cannot.

Q. Can you tell me --

A. It is confidential.

Q. It is confidential?
A. That is right.
Q. Which means you can't tell me which company it came from and you can't tell me what time frame was involved?
A. That is correct.
Q. So you don't have any backup documents here today to support any of the numbers that are shown in this particular slide?
A. I cannot disclose them.
Q. Can we go back to the Excel spreadsheet. Average well income cost for a well at 7200 TD. Now, you mentioned, I believe, Ms. Denomy, this data came from some client?
A. Yes.
Q. Can you identify the client for us?
A. No, I cannot.
Q. You cannot?
A. I cannot.
Q. Did you have authorization from the client to use the data here today?
A. Yes, I did.
Q. But you cannot tell us who the client is?
A. That is right.
Q. So we have no way of ascertaining and

verifying the source of the information?

A. That is correct, other than my experience.

Q. With respect to any of the numbers on here, is this just a sample well?

A. Yes.

Q. Are these costs associated with an actual AFE?

A. No.

Q. So this is a hypothetical circumstance that's not based on any particular -- any actual situation that you have encountered?

A. That's correct.

Q. Now, have you looked at NMOGA's proposed modifications to the Pit Rule?

A. To some degree.

Q. What degree?

A. Very minimal.

Q. Very minimal?

A. Yes.

Q. Would it be fair to say then that you don't have a real good understanding of what NMOGA is proposing with respect to its particular amendments?

A. That is correct.

Q. You are aware, are you not, that NMOGA is

proposing to add to the permitting process multi-well fluid management pits?

A. Yes.

Q. Which you have seen in Colorado?

A. Yes.

Q. And indeed, it's one of the pits that you have seen utilized by your clients?

A. Yes.

Q. To their benefit, correct?

A. Yes.

Q. And those types of pits do allow the recycling of produced water?

A. Allow the recycling?

Q. Provide the opportunity?

A. Yes, but they are also permitted separately in the state of Colorado from regular.

Q. Are you aware of the NMOGA provisions of providing for that within this rule?

A. I am aware that they are using the same rules covering their FMPs as they are the regular pits.

Q. My question is are you aware it would be subject to its own separate permitting process?

MR. JANTZ: Objection. She answered to the best of her knowledge.

Q. So you don't know?
A. I do not know.
Q. So then you are not here today to address any specific rule change that has been proposed by NMOGA?
A. That is correct.
Q. And what we have here then, as I understand it, is just a hypothetical situation that you have presented to us for what purpose?
A. For what purpose?
Q. Yes.
A. To show the economics of a well.
Q. Of any hypothetical well?
A. Yes.
Q. Are you you aware Ms. Denomy that the lifetime production for a well that you have on your sheet of 25 to 30 years, would you expect that lifetime to apply to a well in the Permian Basin or do you know?
A. I can't, off the top of my head, tell you yes or no.
Q. Is that a lifetime number that we can apply across the state of New Mexico?
A. On the average, yes.
Q. On the average?

A. Yes.
Q. Based on what?
A. Based on the wells that I have worked on, both in Union county and in San Juan County and Rio Arriba County.
Q. What well did you work on in Union County?
A. I have clients that are in Clayton and Mescalero.
Q. Are they producing oil and gas?
A. Yes.
Q. They are? In Union County?
A. Yes.
Q. It's not carbon dioxide?
A. It is carbon dioxide.
Q. And you are saying that those wells have a life of 25 to 30 years?
A. Yes.
Q. Now, with respect to your million cubic feet number here, that's not typical for a basin Fruitland coal well, is it?
A. I cannot tell you.
Q. Did you testify at the last Pit Rule hearing?
A. I did.
Q. Do you recall testifying at that time that

a million cubic feet number that you have here, which was the same number you had at that time, is not typical for a basin Fruitland coal well?

A. I may have. That was five years ago.

Q. Would it assist you if you looked at the transcript and that testimony?

A. If you say I didn't, I said it wasn't a Fruitland coal -- I mean, I don't know.

Q. My question is would it assist you in recalling if you looked at the transcript and your testimony?

A. Possibly.

MR. FELDEWERT: May I approach the witness?

CHAIRPERSON BAILEY: Yes.

Q. Would you please turn to Page 1513 of this transcript?

A. Top or bottom number?

Q. Are you there? Would you read Lines 1 through 7?

A. I think I have answered the same way today as I did then. I said I do not know.

Q. Would you read Line 4.

A. "It is not."

Q. Okay. So at least at that time you

testified a million cubic feet would not be typical for basin Fruitland coal well, correct?

A. Correct.

Q. You said, I think the one you testified to now, that it's not typical for a deep morrow well in southwestern New Mexico. You don't know one way or the other?

A. That's correct.

Q. Now, the total well cost that you also have in your hypothetical spreadsheet would not be applicable to any shallower or deeper well; is that correct?

A. That's correct.

Q. This is, as you said, 7200 TD?

A. That's correct.

Q. Would you agree with me that the drilling and completion cost can vary depending on the region that you are in?

A. That's correct.

Q. And the depth?

A. Yes.

Q. The type of formation involved?

A. Yes.

Q. And that you would have different water disposal issues depending on what type of well you

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work?

A. Whether it's coal bed or deep well, yes.

Q. Did your spreadsheet here take into account any disposal cost?

A. Yes.

Q. Where would that number be?

A. It would be in th $1500 per month.

Q. $1500 per month --

A. That's produced water. The 1,700,000 includes the disposal of water that's the drilling water.

Q. Okay. And of that amount, can you tell us what was associated with your hypothetical disposal cost?

A. Not off the top of my head. I would have to look at it.

Q. Can you tell us what amount was associated with your hypothetical cost of disposal of the drill cuttings?

A. Not off the top of my head. I would have to look at my documents.

Q. Does total well include any other permitting costs that the companies incur?

A. Yes.

Q. Can you give us an amount associated with

the permitting cost?

A. $5,000.

Q. Of your 1,700,000?

A. Yes, which includes the drilling title opinion.

Q. Where does that number come from?

A. The owner of the company, and that was typical of what they have to pay.

Q. And you can't tell us what company it is?

A. That's correct.

Q. This typical well scenario that you presented here, this is not a well in New Mexico, is it?

A. That is correct.

Q. This is a well in Colorado?

A. It is.

Q. Can you tell us what formation?

A. Williams Fork.

Q. As an accountant, I think you testified that you look at the money, correct?

A. That is correct.

Q. And what you look at is where it's cheapest to perhaps drill?

A. That's usually not my decision to determine where to drill.

Q. But it's a fact that you look at it in terms of cost. When you are recommending a decision to a client you look at what is the cheapest location to drill a well, do you not?

A. Again, I have to go back to where do they have the right to drill first.

Q. You look at the cheapest location where they have a right to drill?

A. Normally that's not always the issue.

Q. Okay.

A. It's where is there infrastructure, where do I have availability for marketing, where do I have gas lines that I have access to, the ability to move the gas to market. It is not based on where is it the cheapest.

Q. Do you look at the rate of return?

A. I do look at the rate of return.

Q. What do you normally recommend as a rate of return to your clients?

A. Well, using the present value of 10 percent.

Q. So using the present value you recommend a rate of return of 10 percent?

A. Yes.

Q. That takes into account the risk of

drilling, right?

A. Yes. Most of my clients are drilling in an area that they are not wild catting.

Q. You gave us some historical statistics.

A. Uh-huh.

Q. And you provided a quote from what you represent to be the Texas Railroad Commission and a quote from what you represent to be the Oklahoma Department of Environment, correct?

A. Yes.

Q. Is there a reason why you didn't include information about wells in Texas and Oklahoma in your historic stats?

A. I did not expand it to Texas and Oklahoma for any particular reason.

Q. And you testified that -- I think you said your clients have not seen the current New Mexico Pit Rule as any kind of an impediment.

A. They have not voiced that to me at all.

Q. They haven't voiced it to you?

A. Correct.

Q. Have you asked them?

A. No.

Q. You didn't ask them before coming to the hearing?

A. No, I did not.
Q. How many clients do you have that operate in New Mexico?
A. One.
Q. Who is that?
A. Grynberg Petroleum.
Q. I'm sorry, you testified to that. So when you say your clients haven't voiced it to you, you are really just talking about one?
A. That's correct.
Q. But you haven't checked with Grynberg Petroleum to find out what their position is with respect to the New Mexico Pit Rule and what effect, if any, it's having on their decision-making on where to drill?
A. No, I have not. They are a working interest owner so they don't really get much say.
MR. FELDEWERT: That's all the questions I have.
CHAIRPERSON BAILEY: Ms. Foster?

CROSS-EXAMINATION

BY MS. FOSTER
Q. Good morning, Ms. Denomy.
A. Good afternoon.
Q. Yes, it's been a long day. My name is

Karin Foster. I am the attorney and executive director for the Independent Petroleum Association.

A. Yep.

Q. So let's get started here. Getting back to -- is it Grynberg Petroleum?

A. Grynberg.

Q. You said they are only a working interest owner?

A. That's right.

Q. As a working interest owner, they don't make decisions on where to drill, they just have to go along?

A. That's correct.

Q. So they would have no opinion on increased regulatory cost?

A. They really don't have a stake in it. I haven't asked them.

Q. And you mentioned that you worked for a company that has drilled wells in Rio Arriba County?

A. No, I didn't say that. I said I have clients in Rio Arriba County, which those are mineral owners, not working interest owners.

Q. Thank you for the clarification. Looking at your slide which is entitled New Mexico and Colorado Rig Count, you noted that the rig count in

New Mexico is up 17 percent in 2011; is that correct?

A. That is correct.

Q. Now, I think you even said on your direct testimony that New Mexico had stronger rebound than even Colorado?

A. Yes.

Q. Now, that New Mexico number, is that for the entire state of New Mexico?

A. That is for the entire state of New Mexico.

Q. And comparing it to Colorado, what is the primary fossil fuel that is drilled for in Colorado?

A. When? We have a Niobrara field of oil that's being produced in Weld County right now, so right now the push is for oil.

Q. I understand the push is for oil but would you say that Colorado is mostly a natural gas-producing state?

A. With the exception of the Rangely field for the most part it is a natural gas-producing state.

Q. So this rig count as of 2011, 81 is the San Juan and the Permian?

A. It is for the state of New Mexico.

Q. Do you know how many rigs are running in the Permian Basin in 2011?
A. I don't have that statistics.
Q. How about the San Juan Basin?
A. I don't have that statistics.
Q. Now, looking at your next slide, the natural -- let's go to the New Mexico Citygate natural gas price. Explain to me what you mean by Citygate again. I'm not familiar with the term.
A. It is the place where gas is bought.
Q. By whom?
A. Usually a city or one of the -- it is the Citygate -- it's the place where gas has to be reduced in pressure to be taken to consumers.
Q. So you are saying consumers. Would that be like a large utility?
A. It could be a large utility but it could also be residences.
Q. But don't residences they usually purchase through a utility like the New Mexico Gas Company?
A. They do.
Q. And the New Mexico general fund, as you know, is heavily reliant on fossil fuels. Are you aware of that?
A. That is correct.

Q. And the numbers that the New Mexico Legislative Finance Committee uses, are those the Citygate numbers?

A. No, they use the numbers reported by the companies as their actual income less the expenses that are allowed.

Q. Would they not base it on the San Juan Blanco price?

A. They would base it on -- no. The oil and gas companies must report every year their own personal income and pay tax on it.

Q. But the Legislative Finance Committee does not go out to individual operators and get numbers.

A. Well, they get the numbers from the severance tax department.

Q. So you are saying they don't use the San Juan Blanco numbers?

A. They shouldn't be basing their financing on the San Juan numbers. They should be basing it on actual numbers. Because this figure says $3.04 in 2009. There may be some companies that are small and don't have the ability to sell it at $3.04, and there may be other companies that are able to sell it for for $4 because they have long-term contracts. So if the State of New Mexico is basing it on an

index price or a Citygate price and doing their budget based on that, they are not really looking at how much money is actually made by the oil and gas companies here in the state of New Mexico. Every company has a different contract. This is just an average. This is an index price. That's the average of everybody.

Q. I will get back to that in a minute. All right. Are you aware of what the Blanco price is today for natural gas?

A. I did not look up the Blanco price today. I have a national price at $2.62. I do not have the Blanco price as of today. I would have to look it up and I can probably do that in about five minutes.

Q. Would it surprise you it was around $2.20?

A. No, because the 2.62 is a Henry Hub price.

Q. As an accountant, you do keep track of the index prices?

A. I do.

Q. So for whatever reason you decided to cite the Citygate prices here?

A. I did.

Q. Is that just because you went off the EIA numbers?

A. That's right. They don't provide a

location number at the EIA.

Q. But wouldn't it be relevant to have the numbers of exactly what New Mexico operators are getting on average index price? If you are trying to report to this commission the New Mexico numbers, wouldn't that be more useful?

A. Well, I wasn't trying to show that the company is actually receiving that amount. And again, we go back to even if I looked up at Inside Ferg the Blanco Hub's price for that particular day, that doesn't mean that company makes that much money. It is an average of everybody reporting to that location. And sometimes there's only one or two companies reporting to that particular location on a day so it's not reflective of actual income. No number in an index is actual income.

Q. And the same thing looking at your slide, New Mexico oil prices as of July each year.

A. Yes.

Q. You used the New Mexico crude oil first purchase price?

A. Yes.

Q. Is that the same concept as your Citygate?

A. Yes.

Q. And why wouldn't you use the Henry Hub on

that?

A. That's not the -- Henry Hub doesn't do a posting for oil prices.

Q. Okay. Then what would you use instead?

A. Most of the time -- well, these prices were ones that were he closer to New Mexico. The $2.62 that I quoted today is Henry Hub but the EIA actually has the New Mexico prices for oil that they published. If I was to use the West Texas Intermediate, it's not as good as numbers that are actually New Mexico oriented.

Q. When you say not as good --

A. Well, EIA took a survey and decided that these are the prices that New Mexico received. These are not the West Texas Intermediate, which is the closest index price that we would go to.

Q. But again, wouldn't it make more sense to go to --

A. West Texas Intermediate?

Q. No, look at the numbers that the Legislative Finance Committee, for example, relies upon for the state or the numbers that are relied upon by maybe New Mexico Tech to report to a New Mexico oil and gas commission?

A. I would assume those agencies that

reported to the New Mexico Tech should do the same reporting to the EIA.

Q. That's an assumption.

A. It's a requirement.

Q. Looking at your New Mexico wells spudded, your percentages here from 2007 to 2011, looks like you went from 1700 wells spudded down to 990.

A. Yes, that's only through November 28th.

Q. That, again, is for the entire state, correct?

A. That is for the entire state.

Q. And there's no differentiation from the San Juan, which is natural gas, and the Permian, which is oil?

A. That's correct. That's why I talked about having additional oil production in one of those slides.

Q. Looking at your Excel spreadsheet, I'm just a lawyer so something like this with all these numbers on here really scares me. So trying to understand it is tough, so bear with me here.

A. Okay.

Q. You wrote here in your column one million MCF. Isn't that a VCF? Just for clarity, just so I understand where we are in terms of your volume that

you say this well produces?

A. Yes.

Q. Okay. And you mention that this is in the Williams Fork formation in Colorado?

A. Williams Fork.

Q. So looking at this, this is primarily a natural gas well?

A. Yes. With some production that comes as oil condensate extra.

Q. And you stated that you got the 5500 barrels of oil based on 10 percent?

A. It's five.

Q. Five percent?

A. Roughly, and it was other wells that were producing in the area that came up with that percentage.

Q. Now, looking at your $1500 per month lease operating expenses, you stated that was the cost of hauling off water?

A. Produced water. Produced water after the well has already producing gas.

Q. Okay. And how much does it cost to haul off produced water per barrel?

A. Depending on where the location is, it can range anywhere from .62 do $1.15 per gallon.

Q. Per gallon?
A. Per gallon.
Q. Now, what was the working interest percentage on this well?
A. I don't remember.
Q. What was the net revenue interest percentage?
A. The net revenue interest? It would be the same as the working interest.
Q. You don't know that either?
A. I do not.
Q. That's because this is completely hypothetical, this well?
A. That's correct.
Q. And your total deductions, that doesn't include royalty cost, does it?
A. No, and I explained when I did this that they are a burden that would be taken off the 4.2 million.
Q. So that's not included in the total deduction?
A. Right, it is not. Those are the only taxes, transportation and gathering.
Q. And what type of land is the well on, federal, state, local?

A. Fee.
Q. Local. Okay. And it's in Colorado?
A. It is.
Q. And this is an independent producer?
A. Yes.
Q. So, therefore, they have no pipeline, correct?
A. That is correct.
Q. So they would have to pay a third party for gathering, processing --
A. That's where the 25 percent rate comes in.
Q. So if I understand this correctly, you are saying that this is going to be a hypothetical 25 to 30-year well with a net income of $143,000 a year?
A. Yes. But that is not what belongs exactly to that particular owner.
Q. No, but this in your hypothetical, your profit here --
A. Is $143,000.
Q. Now, okay. Your $1500 per month lease operating expense, that includes sending a pumper out?
A. Yes.
Q. Additional equipment on your well?
A. Additional equipment?

Q. You mentioned in direct testimony that the $1500 was additional expenses like extra equipment that you had to put on?

A. That's correct. Like Glycol tanks to keep from freezing. Those kinds of things.

Q. How much does a Glycol tank cost?

A. I don't know off the top of my head.

Q. How much would a pumper per month cost you?

A. Pumpers usually do a number of wells at one time so their wages or contract fees get allocated to a number of wells in a particular day. It could be somewhere around $1500 a month for 15 wells, so each well would be allocated $100.

Q. In this example, this hypothetical, what ad valorum and severance tax did this well make?

A. This one is paying a 9 percent rate for a combination of conservation tax, ad valorum and severance tax.

Q. That's a Colorado right?

A. It is.

Q. Do you know what the New Mexico rate is?

A. 3.75.

Q. That's just the severance tax?

A. I don't have the taxes off the top of my

head.

Q. Do you know how many other taxes we pay in New Mexico. There are a total of seven.

A. Yeah. You have a conservation levy, you have an emergency fund and you have ad valorum and you have severance tax and I don't know the other three.

Q. Okay. And on this well did you do discovered cash flow analysis?

A. Discovered cash flow? I don't think I understand the question.

Q. It's basic economics on a well.

A. Well, and that's what I described, that it was a present value that I allocated back when I got to my bottom line and said okay, it's only going to produce 1.5 million in actual present value today. Because on the average at a 10 percent present value rate it's about 55 percent of the total after you paid all your expenses.

Q. A 55 percent total profit?

A. Yes. No, it's not total profit. It's 55 percent of the net afterwards.

Q. After taxes, et cetera, and costs?

A. And burdens, right.

Q. What's the suspended drilling cost for the

AFE that's represented here?

A. Suspended drilling cost?

Q. Yes.

A. In other words, the -- give me a chance. I need a drink. I'm trying to find the word in my poor head. It's a well that never produces. So I think this one ranged about $300,000 for a well that doesn't produce, and I can't remember the word.

Q. Dry hole?

A. That's it.

Q. So this was a dry hole?

A. This was not a dry hole.

Q. Your hypothetical?

A. It was not a dry hole.

Q. All right --

A. You asked me a question about did I assume it was a dry hole cost.

Q. You mentioned that the rate of return was 10 percent?

A. Using the present value of 10 percent that's what the rate we would -- we would hope to get a 10 percent rate.

Q. That's what you would go to your investors for and say you get a 10 percent rate of return on this investment?

A. Right.
Q. That is before income tax?
A. This is before income tax.
Q. Okay. Looking at your Oklahoma Department of Environmental slide, do you know with reference to this well what formation this was from?
A. I do not.
Q. Do you know what the depth of the well was?
A. I do not.
Q. Do you know what type of well, horizontal or --
A. I do not.
Q. Use of air drilling, would you be using air drilling? Isn't that a significantly different cost structure?
A. It is. And this is only -- I am only quoting from Oklahoma's Department of Environmental Quality findings. This is not my statement.
Q. So you don't know the efficacy of any of these statements. You don't know actually if there was a hole size reduction in these particular wells? You are just quoting it for some report?
A. I am quoting it from an Oklahoma Department of Environmental Quality.

Q. Moving to the next slide, what is a green completion?

A. A green completion requires that -- well, in the terminology that we use in the state of on Colorado it's pitless, it uses a closed-loop system and it removes all the leftover waste from the well site.

Q. Okay. But this is for Environmental Protection Agency which means that you are dealing with air quality issues, correct?

A. That is correct.

Q. And so does the rule that we are looking at here before the New Mexico Oil and Gas Conservation Commission today, does that have anything to do with air quality?

A. It does not. Wait. Do you want me to open this?

Q. Do you want to do it for dramatic effect? Sure.

COMMISSIONER BALCH: I am hoping it's blackberry jam.

THE WITNESS: It's not.

A. It's safe pit water and I can't open it. It's a good thing. I realize this doesn't have to do with air quality. But it doesn't mean the EPA

between now and 2015 isn't going to look at the issues of soils and anything else.

Q. But green completions really have to do with not flaring before you actually -- the EPA would prefer that you didn't flare. In other words, this fact sheet that is out here has to do with EPA Subpart W and Subpart quad O, correct?

A. That's right.

Q. It has nothing to do with drilling or solids whatsoever. It has to do with greenhouse gases?

A. That's right.

Q. And the same thing for the next slide. Greenhouse gases and nothing to do with solids management?

A. That's correct.

Q. Looking at your cost completion slide -- actually, before we get to that, you mentioned there was a gentleman that said that he always goes pitless?

A. Yes.

Q. And he is with Antero System?

A. Antero Resources.

Q. Do you know where Antero Resources drills their wells?

A. I know they have them in Colorado. They have drilled in the Barnett Shale and they have drilled them in -- I believe they have some in the Marcellus Shale now, too.

Q. Let me ask you this: A closed-loop system, what is your definition of a closed-loop system?

A. They take all the drilling liquids and put them in the tanks.

Q. And --

A. And haul them off.

Q. Is there any sort of solids control equipment that goes with that?

A. There is solids control equipment that goes with that.

Q. Is there any liquids control equipment that goes with that?

A. There is.

Q. How about flowing back into a tank during a workover? Would that be considered a closed-loop system?

A. Flowing back into a tank? That's normal procedure.

Q. Would you consider that to be a closed-loop system?

A. Yes.

Q. Why? It's not during the drilling operation.

A. It's not during the drilling operation but it is a closed system. It's not a closed-loop system that you've been drilling, but in a rework or in a completion if you use a tank that's enclosed it's hauled off and taken care of from there.

Q. Would you interpret a closed-loop system to be is any time we put anything in a tank?

A. No. Only when the drilling is done.

Q. Only when the drilling is done. Thank you for the clarification. So in Colorado, what do operators generally get to do with their cuttings? Do they have to bury them?

A. They --

Q. After using the closed-loop system. I should clarify that.

A. I cannot tell you off the top of my head. I pay the bills. I don't know what they do with the cuttings. I think they leave them there actually.

Q. They leave them on-site. Do they land-farm them on-site or do they build berms with the cuttings? What do they do with the cuttings in Colorado?

A. I am trying to remember the well I just saw. I think they just bury them.

Q. Okay. So on-site burial?

A. Yes.

Q. So what you are representing here is your clients use a closed-loop system to drill the well. They put everything into a tank, a steel container on location, and then they just dump it on the surface when they leave?

A. No, it's taken to a waste facility.

Q. Wait a second. You just told me you leave them on-site, the cuttings.

A. The cuttings; not the water, not the liquids.

Q. What do you use the closed-loop system for?

A. The liquids.

Q. So you still have a pit for your cuttings?

A. Yes.

Q. But you have a closed-loop system for your fluids?

A. Yes.

Q. And you haul off the fluids?

A. Yes.

Q. So there is a pit on location?

A. There is a pit on location.
Q. For the cuttings?
A. Yes.
Q. I appreciate your statements, by the way, that all rules cost money and that small operators, because I do represent the small operators, that companies do need to be comfortable with the rule before they decide to operate and invest in the well. And with that in mind explain, since you represent some small operators, how is it that a company would feel comfortable? Are we talking about certainty in the rule?
A. Certainty in the rules.
Q. How about having proscriptive time frames?
A. Proscriptive time frames. You know, when it is a rule that can be -- yes, proscriptive time frames would be fine.
Q. I think you made the statement that time is money.
A. Yes.
Q. Therefore, an operator -- it would be beneficial for an operator to know how long it would take, for example, to get a permit?
A. That's correct.
Q. And it would be useful for an operator to

know that if they need to ask for a variance or exception to a rule how long that's going to take?

A. Yes.

Q. Looking at your cost comparison sheet, and I understand this is from a Colorado well?

A. Yes.

Q. Talk to me about your centralized pits here. You made the statement that centralized pits in Colorado are used to separate your solids from your fluids?

A. Yes.

Q. So is that like a horseshoe-shaped pit? How would you separate?

A. No, it's a rectangular pit. It's more like a lake.

Q. More like --

A. A lake. It's big.

Q. But you can put solids in that lake?

A. You can and they do and they aerate it to release the water into the air and then they clean it out and start all over again.

Q. Can you tell me how many acre feet those lakes are?

A. I can't.

Q. In your closed-loop systems cost here, I

see that you have an $80,000 rental of closed-loop equipment cost?

A. Yes.

Q. $5,000 a day --

A. Yes.

Q. -- for 16 days. How deep with this well?

A. Between 7,000 and 8,000 feet.

Q. And I see that your costs for trucking are pretty low, $1300, which means that you left your cuttings in place?

A. Yes.

Q. So the $1300 is for hauling off the liquids?

A. Yes.

Q. And you also have a negative cost here, savings on mud reuse.

A. Yes.

Q. If you are a small independent operator if and you are only drilling one well, would you achieve this cost benefit, the $17,000 credit here for drilling one well?

A. No, you wouldn't.

Q. So this is for large companies with a multi-well program?

A. Or working interest owners that get to

participate in wells that are large operators.

Q. Okay. And are centralized pits normally billed to working interest owners?

A. The cost of them are.

Q. And how would the cost be distributed on the construction of a centralized pit then?

A. They are asked -- well, it depends on the centralized pit. Often there is a fee for using the centralized pit that is charged back to the working interest owner.

Q. Okay.

A. As opposed to the construction cost.

Q. Now, you are saying these centralized pits are similar but not similar to the multi-well fluid pits we are recommending here?

A. It is not exactly the same. The way Mr. Arthur pointed it out yesterday is more like our normal pits that companies use today, and that is one pit servicing a number of wells that are located on the same pad. Centralized pits are actually ones that are put out into a separate location and trucks are driven to that location with all the fluids, whether it's produced, drilling. Everything goes into the one pit.

Q. Then you have this huge centralized pit.

What happens when they are going to close it? They leave the cuttings in place?

A. They haven't closed it it in 12 years so I don't know what's going to happen.

Q. So they are putting a lot of waste from wells in that one pit?

A. They are.

Q. Do you know if the pit is lined?

A. I can't tell you. I haven't walked it.

Q. But here in New Mexico, particularly if you are a small operator and you're drilling one well, you would have one pit, a little pit for one well just for those cuttings?

A. That's right, but if you're going to be doing more than one well on a pad site, why would you excavate more than one -- a pit for every well?

Q. Well, I mean, that depends on the permian statement we have, right?

A. Yes.

Q. So that's the answer to that question. I'm a little bit confused on your lost economics here.

A. Okay.

Q. Now, I have to apologize because I was writing and you were answering questions if for Mr.

Feldewert so you might have answered this question already. You are aware that in this proposal by IPANM and NMOGA that we are not banning the use of closed-loop systems?

A. You are not.

Q. So the personal property tax on closed-loop systems would still come back to the State because closed-loop systems would still be a business decision and used by businesses here in New Mexico.

A. It would seem to me, though, that there would be no reason to spend this amount of money to change the rules if everybody was going to continue to use the closed-loop system. There's got to be an intention to use something other than the closed-loop system.

Q. Right. But wouldn't you agree since you do the businesses and pay the bills for companies that if there is an economic benefit to use the closed-loop system because of maybe where a well is located or maybe they are close to a disposal facility or something, they could still use the closed-loop system?

A. They sure can.

Q. So the property tax from centralized pits

doesn't really apply in this case either because we don't have centralized pits in New Mexico so therefore there's no loss.

A. That's correct.

Q. So you can cross that out?

A. It wasn't a loss.

Q. You are saying these are loss economics. You are implying that this is money that the state is already getting.

A. That's right.

Q. Your slide that the earthen pits create waste.

A. Yes.

Q. Again, it's very confusing. You seem to be implying that we are mixing hydrocarbons with our cuttings that are floating on top of water. Explain that to me, please.

A. Most of the places that have earthen pits that I have driven past -- this came from an earthen pit. This came from an earthen pit that was done right after drilling, and I took the water out of it.

Q. Okay, and that is a centralized pit that has how many wells?

A. No, it's not a centralized pit. It was a

pit that was right alongside the particular well.

Q. And you don't know how many wells were disposed into the pit?

A. Yeah, 16.

Q. Sixteen wells?

A. Uh-huh.

Q. Over what period of time?

A. Let's see. It was 18 days for each well so about six months.

Q. So what you are saying is you have seen a sheen on top of that?

A. Absolutely.

Q. Are you aware in this rule there's a provision to use a boom if necessary?

A. That's for spills.

Q. Or to pick up a sheen on your pit.

A. Again, we are talking waste. If you pick it up with a boom you are not going to take it to a location to get the oil processed and sell it.

Q. Is there any provision in the rule that requires picking up oil from the surface?

A. No.

Q. No.

A. That's why I say that's waste.

Q. Okay. What about all the cuttings we

bring to the location, the centralized facility here in New Mexico like a system total recovery or R260.

Q. Then it should be recouped and sold as oil.

Q. Do you know if they do or don't?

A. I don't.

Q. They do.

A. But I think these rules are looking to change that.

Q. Did you see that in the rule?

A. Just from the general discussion that's been going on the last couple days.

Q. If you can find that in the rule I would like to have you point it out to me.

A. Okay.

Q. Now, you looked at the AFEs that were submitted by West Largo Corporation.

A. Yes.

Q. I was a little confused.

CHAIRPERSON BAILEY: Ms. Foster, do you think you have many more questions?

MS. FOSTER: This is my last little section. I think it's five or six questions. Would you like to take a break?

CHAIRPERSON BAILEY: I think it would be

appropriate to take a ten-minute break.

(Note: The hearing stood in recess at 5:00 to 5:07.)

CHAIRPERSON BAILEY: Ms. Foster, if you would go ahead and complete your cross-examination.

Q (By Ms. Foster) Looking at the West Largo AFEs that were submitted, there was one well drilled on October 15, 2007 and the other one was drilled on January 1, 2010. Do you know when the Pit Rule was implemented?

A. May of 2008.

Q. Okay. So the operator here would have had to adhere to the requirements of the Pit Rule under the 2010 well?

A. That's correct.

Q. And you mentioned on direct examination, you made the implication that this operator had zero reclamation expenses.

A. That's what I said because the first page shows zero.

Q. What is Code 6100? Isn't that accounting code normally used to reflect reclamation costs?

A. State location, permits and damages?

Q. Yes.

A. Not normally.

Q. Not normally?
A. That is a predrilling expense.
Q. But the AFE as listed is up until precompletion?
A. But Code 6100 that says state location, permits and damages are expenses that are spent prior to drilling normally.
Q. And --
A. Not reclamation.
Q. Okay.
A. And the reason why I say zero is because his letter states "Reclamation, zero. Reclamation, $76,979.85."
Q. All right. So the reclamation then is his hauling cost?
A. That's what he is claiming in his report.
Q. Right. So then on the 2010 well he had $76,000 of hauling cost whereas in the 2007 well he had no hauling cost because he did not need to use a closed-loop system and he left his pit on the site.
A. Right. I don't see any expenses in any of these categories for reclamation on the 15 No. 1 well.
Q. But that would be after fracking and after completion, correct? Reclamation?

A. Yes.
Q. All right. So wouldn't it belong on this AFE?
A. No, because reclamation is part of an AFE.
Q. So an operator picks up the cost of reclamation and doesn't send that to his working interest owners, the cost of that?
A. Sure he does.
Q. So it should go on an AFE?
A. That's right. It's not on this one. That's all I'm saying. I was not making a comment. I was saying that he had zero cost on the 15 and 76 -- I meant that he has a $76,000 expense for reclamation.
Q. Which is really the hauling cost?
A. That's what he is calling disposal and hauling.
Q. In comparison of these two AFEs, this is all during the drilling phase only of the two wells, correct?
A. That's correct.
Q. So the 2007 well had a cost of $128,623, correct?
A. That is correct, according to this report.
Q. According to this report. And the 2010

one had a cost of double, 224,000?

A. That's correct.

Q. So to drill two similar wells in the San Juan at comparable depths had an increase cost of $100,000 because of the Pit Rule?

A. That is correct.

Q. That's what the West Largo --

A. That's what this says.

Q. Thank you. Now, you said you went upstairs and used the OCD computers to look at the production from this well?

A. Yes.

Q. And did you look at the additional cost like how much water this well produced?

A. No.

Q. Did you look at the cost of hauling off water?

A. I did not.

Q. Do you know what the royalty rate was for this type of well?

A. I do not.

Q. And you mentioned this was three years for payout. Why is that?

A. Well, the income looked like roughly about $195,000 for the period that was here. 2010, '11

and '12.

Q. But you don't have -- what was the word you used -- the burden. You don't know what the burden is in this?

A. I don't have the burden. I'm just looking at whether the well paid out, not whether the operator made money.

Q. But in your AFE, your hypothetical well, you have to look at the burden which means you have to look at the taxes, you have to look at the cost of the pumper, you have to look at the cost of hauling off water, and you didn't do that in this West Largo case, did you?

A. No, I did not.

Q. And do you know if a compressor was used on this West Largo wells?

A. I do not know.

Q. Do AFEs normally reflect environmental and regulatory cost?

A. Yes.

Q. So if an AFE's costs go up, the profitability of the investment goes down, right?

A. Yes.

Q. In your hypothetical well you said that the profit of your operator was $143,000?

A. Per year.

Q. If you look at the West Largo case with the increase in cost due to the Pit Rule of $100,000, that means that in your hypothetical cost your profit would only be $43,000, correct? It's math and I'm just a lawyer. I apologize.

Q. No, because my hypothetical is for a 25 to 30-year production. This is only looking at a snapshot of three years. Not even three years, 21 months.

Q. Right. But we have an actual number from a real company, not a hypothetical company --

A. You don't have 25 years worth of his numbers of income either.

Q. But you said the average on your hypothetical was $143,000 on a profit of the well?

A. Over the course of the 25 years. Not in 21 months.

Q. So the overall --

A. You do not make money in the first couple years because you have to pay back your own personal expenses that it costs to drill.

Q. So then what you are saying then is the profit of the well is $140,000 over 23 years for that hypothetical well?

A. Yes.

Q. So if you have an increased cost year one of $100,000 because of the Pit Rule --

A. You are not going to make money in the first couple years. That's why I'm talking about making your return of your income, the expense for the well. You are not going to make money in the first year of production.

Q. What you are saying is an increased cost of $100,000 for wells are going to make significantly more wells uneconomic in New Mexico?

A. No.

Q. Under your AFE?

A. No, I did not say that.

Q. You are saying you are not going to make money on your wells so less wells will be drilled.

A. You are not going to make money on any well in two to five years at $3 an MCF right now.

Q. So less wells are going to be drilled.

A. Well, less wells are drilled because the price is so low. If the price was $10 they would all be drilled.

Q. Plus an extra cost of $100,000 because of the Pit Rule. I have no further questions of the witness, thank you.

MR. JANTZ: Does the witness get to answer the question though?

THE WITNESS: Was there a question?

MR. JANTZ: It was sort of a statement.

THE WITNESS: That's okay.

CHAIRPERSON BAILEY: We will take a break and reconvene at 9:00 o'clock in the morning. We will now take public comments. I believe we do have some people who have signed our sheets for public comment. Caren Cowan.

CAREN COWAN

after having been first duly sworn under oath, was questioned and testified as follows:

CHAIRPERSON BAILEY: Would you please state your name and place of residence?

MS. COWAN: My name is Karen Cowan, executive director of the New Mexico Cattle Growers. I live in Albuquerque, New Mexico. I first want to thank you, Madam Chairman, and members of the Commission. No matter how this works out you have to be the toughest people I have seen.

I also want to point out that probably in a very bipolar nature we have worked with both NMOGA and OGAP as we work through this to try to find where the middle ground is and how to serve

everybody, and we appreciate all of that as we move forward.

This is an extremely complex issue. In my written testimony that I sent you I pointed out the specifics. I think here I'm just going to summarize what it looks like after sitting in the back of the room for two-and-a-half days. But there are several primary components of concern for cattle growers.

Let me back up. I sat on the Pit Rule task force in 2007, as did two other of our members. In today's society most of the time we are told if everybody walks away unhappy from one of these processes, it was probably a good process. I don't necessarily agree with that, but I can tell you that nobody walked away happy from the last one. We didn't all get exactly what we wanted but we came up with a rule that we thought it was workable and the Association still supports.

There are five components of concern as we look at this rule: The siting distance from groundwater, the depth to groundwater, the modeling versus site specific data, on-site burial, and then as an addendum to that whether or not the burial is capped, and then increasing the chloride levels by five times.

One of the things that concerns me as we sit here is that there's no way to look at the cumulative data of all of those things. Any one of them might be okay, but when you put five of them together what is the impact going to be? Our members earlier today talked about the 100-foot distance from water. That's 33 yards. That's not very far.

As we look at multi-well -- we have been told that that will be corrected by where the well can be drilled. But as we look at multi-well containments, they can be placed anywhere they need to be and I am sure that every person in this room, every company in this room will do their best to do the right thing. I have no doubt about that.

Unfortunately, there's a bad guy, a rotten apple in every crowd that makes it difficult for people as we move along. It doesn't matter whether you are talking about ranchers or whether you're talking about the oil and gas industry. So I don't know how -- I don't envy you trying to balance the economic needs, which we believe are very real and very important, with the needs of the people who live on the land and the animals that they use to make a living and provide economies for rural areas.

As we listen to reclamation today -- by the way, Dr. Buchanan, I really like your tie -- and with all due respect, the plants that were being talked about that could live on top of reclamation, mesquite, those aren't the things that cows live on. Those aren't the things that will allow us to make a living. So we are extremely concerned about what can live once pits are done.

The multi-well pits are intriguing and the association hasn't taken a strong position one way or the other on that, but those pits are going to be closed the way we think all pits should be closed. They will have leak detectors and be completely moved away. So I think it is something to at least look at. You know, volume and depth are concerns as well.

The testimony throughout that I have been here for, there's a lot of "The thesis is, it should, I think," and those are not real certain words when you talk about the future of water in our state. It seems to me that we need more certainty as we look at -- I agree with Mr. Johnson on Monday. Water is going to be more expensive than any commodity that we need.

In closing, I will say that we are very

supportive of the need to oil and gas and for drilling. We probably use more gas than -- well, we compete with the oil and gas industry in terms of the miles that we put on dirt roads and we have to buy gasoline or diesel to travel on.

While humans are the most important thing, it takes water and plants and agricultural and other people for everything and it comes back to the balancing test.

Finally, even our president of the country forgot that we had an economic crash in 2008, but the loss of jobs in New Mexico had a lot more to do with a lot more things than just the Pit Rule, and I thank you for your time. If you have questions I would be happy to answer them.

CHAIRPERSON BAILEY: Any questions for this commenter? Thank you.

COMMISSIONER BLOOM: Quick question. Two. Your concerns about capping.

THE WITNESS: Thank you. That leads to one more thing. If you are going to bury -- I know that the liners get folded over, but when you grow a plant and leave it too long and you don't repot it, the roots find their way all the way around the place. So what's going to stop plants from going

into the pits and harming the integrity of the pits as they do that? I have heard -- there's been discussion about there still being moisture within the burritos, but we thought they were supposed to be completely dried. So there's some complexity and confusion in that.

Finally, do you want one of these things buried in your backyard? Because they are talking about burying them in our backyard.

COMMISSIONER BLOOM: Did you hear Mr. Buchanan's testimony today? I believe he said that with the 48-inch cap of earth that the grasses would wouldn't go down that far.

THE WITNESS: But shrubs and other things will.

COMMISSIONER BLOOM: That's it. Thank you.

THE WITNESS: Thank you very much.

CHAIRPERSON BAILEY: Sally Co? Would you like to be sworn?

SALLY CO

after having been first duly sworn under oath, was questioned and testified as follows:

CHAIRPERSON BAILEY: Please state your name and place of residence.

MS. KOE: My name is Sally Co and my place of residence is Las Alomitos, California. I'm a student at St. Johns College, a member of the Students for Sustainable Future, and I'm here to give a voice to the students. And in St. Johns College the campus is located up near Monte Sol in the mountain range of Sangre de Christos. We read lots of books there. It's a Great Books program. Just nature in general and the environment has been such an important source of peace for us. And so we feel that it's important to keep this in mind and mostly prevent any risks that can occur, particularly to water.

Because the Santa Fe river flows near our campus, and recently early this spring the river started flowing again. I think it was because of ice melted up near the mountains, and just with water there came so much life.

It was just -- just connected us and connected me with myself. And just to think if that water was contaminated, that sense of peace and life may be gone. It's painful to think about. So we hope you keep that in mind when compromising the Pit Rule.

CHAIRPERSON BAILEY: Are there any

questions of this commenter?

MS. GERHOLT: No questions.

CHAIRPERSON BAILEY: Thank you. Safa Pinkens.

SAFA PINKENS

after having been first duly sworn under oath, was questioned and testified as follows:

CHAIRPERSON BAILEY: Please state your name and place of residence.

MS. PINKENS: My name is Safa Pinkens. I live in Santa Fe. I'm also a student at St. Johns College with the Students for a Sustainable Future and I have been here for the past two years. And I'm so happy to be living in such an amazing area. Recently our sustainability club got together with the Climate Change Leadership Institute which Rob Parish leads, and because of that I learned more about the Pit Rule. So I learned that I really want it to be preserved for the sake of the land but more importantly, for the sake of the people who live on this land.

I feel that New Mexico was given an amazing opportunity with this Pit Rule, because when it was proposed there were so many concerns that the industry would suffer from the increased costs

imposed by the regulations and that would drive businesses away from New Mexico harming the economy. But when the Pit Rule was put into effect it seemed to me like the warning was false. And I read that drilling rig counts fell but only as much as they did in other states as a result of the recession. And the industry, obviously, has not left New Mexico.

So I think that the rule has been tested and proved successful and I think that that should -- keeping that in mind should be important when looking back at this rule and deciding about how it should be changed, because it has been tested and we can learn from that. And I know that it's tremendously complicated.

I'm glad even that the industry is still so active in New Mexico, because I realize that responsible oil and gas development is necessary for the health of New Mexico's economy; hopefully, in transitioning to renewable energy. But I think that the development of oil and gas should be focused on the long-term for the sake of the people and the environment and for the sake of the industry.

For example, closed-loop systems could save money in the future for the industry and the

current Pit Rule encourages their use. I think things like that are important to be preserved. It's so important that our water remains clean and soil uncontaminated because when looking at the regulations, how close a well can be to a water source, why pick convenience over people? It hasn't harmed the industry so far to move a little farther away and I don't think it will in the future.

If the land suffers, so will crops and so will the cattle, you know, that seed the grass. If the water becomes dangerous people won't want to live in New Mexico and then what good will it do to have a thriving oil and gas industry? It's a balance. The industry has to give to New Mexico before it takes from it.

It can do that by following the Pit Rule and supporting it in a way that supports the industry as well. I come from Washington State and water is abundant here. Here it's so precious and we have so little left.

Last year there was the fires and this year the drought is already coming and we can't afford to hurt the water we already have. So I guess I'm just asking please, when you are evaluating the Pit Rule and you take it apart and

look at it, don't take it apart just to weaken it and diminish its purpose. Take it apart and realize how those little parts are so successful and put it back together again and make it more efficient for the industry but also stronger for the people who it protects. That's it.

CHAIRPERSON BAILEY: Are there any questions of this commenter?

COMMISSIONER BLOOM: I have a question. Thank you Ms. Pinkens for coming in. When I was in college I didn't ever step out and get involved in a rule-making process so it's a big step so thanks for coming in today and sharing your comments with us. I know you are all towards the end of the semester probably. Did you get a chance to read through the proposed changes for the rule?

THE WITNESS: No, I did not.

COMMISSIONER BLOOM: Let me tell you, I think one of the things you find when you read it, it's like a book, starts with siting and permitting, reclamation, revegetation, so it might be something that you all would be interested in. When I was in college we could create our own classes around certain topics and I know St. Johns allows you to do things along those lines as well, I imagine. Does

it sound like something you would be interested in checking out at some point?

THE WITNESS: If I get the time. I know this summer I will have a bit more time. But is there a summary? I mean, I know that a summary isn't a replacement for reading the whole thing through and getting all the details.

COMMISSIONER BLOOM: I don't know. There's a summarized version that talks about the nature of the changes, but I think even with the edits it's about 43 pages so it's pretty short. Thanks for coming in.

CHAIRPERSON BAILEY: Any other questions? Thank you. Rob HIRSCH.

ROB HIRSH

after having been first duly sworn under oath, was questioned and testified as follows:

CHAIRPERSON BAILEY: Please state your full name and place of residence.

MR. HIRSH: Rob Hirsh and Santa Fe is where I live.

I know people have been here so long and I totally want to do this efficiently, but I just want to complete the comments I commenced yesterday and also submit them if I'm able to submit the full

comments. Is that allowed?

CHAIRPERSON BAILEY: Yes.

THE WITNESS: Great. I completely agree with -- first of all, I think it was brave of those students and I thank you for saying that and I also agree with Caren Cowan. This is a very complex issue. I also think that rules need to be evolved to keep up with advances in technologies, so that I recognize and agree.

I just wanted to say I am completing these public comments because we believe New Mexico should lead the country and the American industry should lead the world in sustainable oil and gas development. So it's very important to consider this an opportunity for integrity and leadership in the industry.

So the other comments I was hoping to add to are the -- just as follows: I think unfortunately, given the not necessarily complete objective nature of a commission, two of whom are appointed by administration, and the same could be said for a past rule that was enacted, that elections have consequences. I'm not naive about that, but I think that the consequence of amending this Pit Rule to this extent and degree is not only

harm to the groundwater and our Land of Enchantment but another consequence, ironically, I think, of the Pit Rule major amendment is that it will come back potentially to bite the oil and gas industry itself.

Because there may or may not -- I guess there may be some short-term cost savings for watering down the Pit Rule, but in the mid to longer term it's going to be costly, not only because of the testimony that was provided but because of the harm to public health potentially from groundwater contamination and a crisis of cleanup after the fact and a growing ill-will potentially from the public at large resulting in potentially lawsuits and a loss of trust in the industry.

I think that stop and start rule-making for environmental compliance is not a good formula for economic viability. I think having long-term certainty with reasonable and responsible regulations like the Pit Rule that exists is a very good thing for business because you can plan accordingly and development economically sound, sustainable development practices that prevent pollution, and these practices can even be marketed to the point of leading the world in pollution prevents technologies.

So I think amending this rule will take us backwards instead of forwards to a new era of responsible and innovative energy development.

And it's very likely that if this were majorly amended, subsequent administrations could very well restore a more vibrant Pit Rule, and again, it could be at our loss for being delayed in implementing cost-effective and significantly sound environmental compliance technologies now instead of letting other nations' industries effectively get a competitive advantage in this sector.

Then a quick couple detailed points although it's much more complex. But closed-loop systems are a constructive part of a solution that could grow from the Pit Rule that exists and the OCD should still issue permits for this practice. And a 30-day process for approval or else a permit is approved I think is an unsound recipe for environmental compliance.

If the oil and gas industry is pressing for maximum efficiency, they should contribute to a fund so OCD can be properly staffed to responsibly review all the applications. It's really crazy for the OCC to waive its governmental oversight in permitting, as oversight is one of the most

essential rules of government.

In conclusion, I would just say that it's vital in this hearing to amend the Pit Rule and in general that we together adhere to an ethic of stewardship in our environmental choices because the goal should be long-term energy viability. And I would hope that the industry takes proactive leadership in working with government and the environmental community and the scientific community to together lead a better way of cost-effective and environmentally sound technologies.

Lastly, energy alone does not advance New Mexico. The combination of responsible, clean and cost-effective energy advances New Mexico. Thank you.

CHAIRPERSON BAILEY: Are there any questions of this commenter? Thank you very much.

CHAIRPERSON BAILEY: That concludes our day today. The cases will be continued until tomorrow at 9:00 o'clock here in Porter Hall.

(Note: The hearing was adjourned for the day at 5:40)

REPORTER'S CERTIFICATE

I, JAN GIBSON, Certified Court Reporter for the State of New Mexico, do hereby certify that I reported the foregoing proceedings in stenographic shorthand and that the foregoing pages are a true and correct transcript of those proceedings and was reduced to printed form under my direct supervision.

I FURTHER CERTIFY that I am neither employed by nor related to any of the parties or attorneys in this case and that I have no interest in the final disposition of this case.

JAN GIBSON, CCR-RPR-CRR
New Mexico CCR No. 194
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