San Pedro Transcript

San Pedro River Hearing Tape Transcript of Hearing held in Bisbee, Arizona on June 7, 2013.

BEFORE THE
ARIZONA NAVIGABLE STREAM ADJUDICATION COMMISSION

IN THE MATTER OF THE NAVIGABILITY OF THE SAN PEDRO RIVER FROM THE MEXICAN BORDER TO THE CONFLUENCE WITH THE GILA RIVER, COCHISE, PIMA AND PINAL COUNTIES, ARIZONA	)	No.: 03-004-NAV

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ORIGINAL

A P P E A R A N C E S

BEFORE: WADE NOBLE, Chair
JIM HENNESS, Vice Chair
JIM HORTON, Member

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Others present were unidentified for the record.

(Commencement of electronically recorded proceedings.)

* * * * *

CHAIRMAN NOBLE: Good morning. We welcome you to the San Pedro hearing of the Navigable Stream Adjudication Commission. My name is Wade Noble, and I'm the Chairman of the Commission.

The meeting is called to order. May we have a roll call?

MR. MEHNERT: Chairman Noble.

CHAIRMAN NOBLE: Here.

MR. MEHNERT: Commissioner Miller is absent today, as he indicated he would be.

And Commissioner Horton.

COMMISSIONER HORTON: Here.

MR. MEHNERT: And Commissioner Henness.

COMMISSIONER HENNESS: Present.

MR. MEHNERT: We have three members present, and we have a quorum.

CHAIRMAN NOBLE: Thank you, Mr. Mehnert.

We want to introduce the newest member of the Commission, Jim Horton. Some of you may already know Mr. Horton, but we are glad to have him with us. If you ever want to talk to him about the laborious process of being appointed to the Commission, I'm sure he can take up

at least a day or two on how it took him months to get his appointment cleared, but we're glad to have him with us.

Next on our agenda is the approval of the executive session minutes of October 22nd, 2012.

Have the commissioners received those minutes?

MALE SPEAKER: We have.

CHAIRMAN NOBLE: Is there any discussion?

MALE SPEAKER: I have no discussion. I would move that we approve those minutes.

CHAIRMAN NOBLE: Without objection, the minutes are approved.

How about the regular session minutes of October 22nd, 2012? Is there any discussion?

Without objection, the minutes of October 22nd are approved.

We turn now to Item Number 6, the hearing regarding the San Pedro River. As I hope all of you know, we are here today on two issues, the navigability or non-navigability of the San Pedro River in its ordinary and natural condition prior to the State of Arizona's admission to the United States on February 14th, 1912, consistent with the Arizona Court of Appeals decision in State of Arizona -- State versus Arizona Navigable Stream Adjudication Commission.

And the second issue is the segmentation of the

San Pedro River consistent with the United States Supreme Court's decision in PPL Montana, LLC, versus Montana.

We've asked counsel, Mr. Breedlove, to give us just a brief summary.

MR. BREEDLOVE: Well, thank you.

We're here now again because of appeal of the Commission's 2005 determination on the Lower Salt by the State Land Department and others that led to a determination by the Court of Appeals that the Commission made an error in applying the navigability tests under A.R.S. 37-1101, Number 5, complaining ordinary and natural condition.

Subsequent to the appeal of the Lower Salt, the Center for Law in the Public Interest also appealed determinations of the Santa Cruz, the San Pedro, the Verde, the Upper Salt, and the Gila, which eventually has brought us here to take evidence on the ordinary and natural condition of the San Pedro on February 14th, 1912.

And then on October 22nd, 2012, the Commission voted to reopen the record on all six remanded cases.

The Commission also decided, subsequent to the U.S. Supreme Court's decision in PPL Montana, LLC, versus Montana, which was the U.S. Supreme Court's recently decided navigability for title case that clarified navigability for title -- that the navigability for title

test can apply to segments of a water course, the Commission would give parties an opportunity, out of an abundance of caution, to provide any evidence on segmentation that may not have been provided in the first round of hearings.

CHAIRMAN NOBLE: Thank you very much.

A few comments on procedure today. Since Mr. Henness and Mr. Mehnert are the only two that were here shortly after statehood --

MALE SPEAKER: (Indiscernible) I'm still here too.

CHAIRMAN NOBLE: The other three of us kind of are new to this, so we going to proceed kind of as well as we can -- we've been told how we proceeded in the past. There may be a few differences.

We have presentations that we will tell you which one is next and let you make your presentations. After the presentation is made, there will be an opportunity for questions from the Commission, from the Commission attorney, from anyone present who would like to ask questions of the presenter, and then we'll move on to the next presentation.

We're probably not going to close the record on this hearing for 20 days afterwards. We won't be taking any additional oral testimony, but memoranda, other

evidence, may be submitted in the 20 days following the hearing.

Any questions, comments, or concerns about that procedure?

If not, Mr. Mehnert, who is up first?

MR. MEHNERT: Well, we're going to call first on Mr. Win Hjalmarson. He has a PowerPoint presentation, I believe, that's going to last approximately an hour. So if you'd like to, go ahead.

Introduce yourself, and who you represent, and so on.

MR. HJALMARSON: I'm Win Hjalmarson.

CHAIRMAN NOBLE: It's not amplified.

MR. HJALMARSON: Oh, it's not amplified? Oh, okay. Good thing.

I'm Win Hjalmarson. I'm a registered engineer from Arizona; retired USGS; about 13 years private practice as an independent consulting river engineer. I've been on the committee in the National Academy of Sciences (indiscernible). I've been an adjunct professor with the University of Arizona for eight years. And I graduated Arizona State University. Now, I'm a grandfather seven times, and been retired for about five years.

And I'm here to -- at the courtesy of the

Arizona Center of Law in the Public Interest to basically share my investigation of the navigability of the San Pedro River with you.

My talk is a PowerPoint. It's an hour. It's a good example of what a PowerPoint should not be. The slides -- some slides are very technical. The reason for this is the PowerPoint is my report and my analysis on the river. So what I would like to do is I have a time I would like to activate it. And there'll be a few times where it'll be appropriate to maybe say something, and the rest of the time I would just like to turn it on and let you read it. So I hope you're all close enough to read it. If you're not, now is the time to move up.

MALE SPEAKER: Jim, can you see that?

MALE SPEAKER: (Indiscernible.)

MALE SPEAKER: That's not going to work for us, is it?

(Indiscernible - simultaneous speech.)

MR. HJALMARSON: Well, I've got to activate this thing.

(Indiscernible - simultaneous speech.)

CHAIRMAN NOBLE: Mr. Henness, can you see that?

MALE SPEAKER: Chairman (indiscernible).

CHAIRMAN NOBLE: Okay.

MALE SPEAKER: (Indiscernible.) So I'll just

listen to (indiscernible).

CHAIRMAN NOBLE: Very well.

MR. HJALMARSON: It should be going. It's about a 4,500-square-mile area, roughly 700 square miles in New Mexico. It flows north.

There's a gentleman actually along the river, a local citizen. And we're using the scientific -- and I was thinking this is a basic question. Our standard is as the commissioner read.

I've worked quite a bit with Stan Schumm. I was on this National Academy of Sciences committee with him for a couple of years, and I've worked with him on other situations. He's now deceased. But the title for this book he wrote explains the San Pedro River pretty well.

So I was hoping I could use the Land Department report. As it turns out, it didn't really apply to the new set of rules.

So the San Pedro River has been scouring or head cutting or incising and widening as a result of both natural and human causes.

So you had the Spanish settlement here way back, and it started in about 1897. And at one point they brought in large herds of cattle, thousands and thousands of cattle.

So the USGS shows the river as perennial. The contours here are really V-shaped, which is why the strong or a large amount of warm water coming in all along the river from recharge along the mountain fronts.

So I'm using the scientific method here -- you might notice it as you go through. And one of the main hypotheses is, is the river behaves like typical alluvial channelled rivers.

So we'll spend a lot of time looking at the history or the effects of humans on the natural conditions. I want to go over some important terms so we all are together, and then we'll get right into the meat of the report.

This basically tells it all. And where the system really started to change was probably in the middle of the -- of another Mexican settlement. Roughly around 1850 is where it's generally agreed that the human causes started taking effect.

Now, this is very important. When you make observations of the river condition, you have to be aware of the tomography upstream and diversions and so forth that are affecting your observations. So you may not be looking at natural conditions when you think you might be.

And another important thing here is in about the 1830s Mexican farmers were coming in from the Tucson

Presidio to farm this, and they had to have Mexican army guards to protect them from the Indians. So it was quite an important farming operation going on in the Tres Alamos area, which is a little downstream of Benson.

This just shows the complexity of how fast things can change. There were a hundred -- there's documented 144 diversions on this river. They may not have all been activated, but ADWR records show 144 potential diversions of water for agriculture.

This is where the one mine used 20 percent of the total runoff when it was operating.

Mr. Green of the Green Cattle Company started the operation here in about 1898. He bought the mine, and Cananea was up populating.

So a time trend has been determined, and it's rather recently affirmed, but there's other things causing the changes, other than this climate-caused trend -- trend -- small change in climate.

Cattle were very important in regard to the human effects on the watershed and on the river. There were two episodes of cattle involvement here, the Spaniards brought them in, but the Mexicans took them over, and then the cattle seemed to disappear and then they reappear by Europeans in the early 1900s.

This is kind of fun to look at. You never see

people do this, except unless you're an old engineer. But they could run 2 cfs if they were real polite and took turns for 24 hours a day. But if they all went in there to sleep for an eight-hour period, they could be taking 6 cfs out of that river.

Now, that's cattle, as far as you can see, coming across. There you can see some pretty active, you know, erosion and channel widening occurring here. Cienegas, of course, were springs, and quite a few of them have ponds, but they're generally marshy grass and weeds and so forth.

The accounts of the Mormon Expedition are pretty well known, because there was a lot of educated people that were part of the army and so forth, and so the records are better than many.

Mr. Pattie came in from Kentucky, and he came in twice: once in 1825, and then a second time in 1827. He trapped over 200 -- or 100 beavers the first time, and the last time he lost -- there's no account of it. But he went quite a ways up the San Pedro. We know he went by the Cienega de Mata (indiscernible), and they didn't -- there's all indications that he went quite a ways up, and he found a lot of beavers.

And I'm going to just finish talking about him. There's records where he built a canoe from a log. He

hollowed out a log. And he used the canoe to go back and forth across the river to set his traps and to pick up the beavers he dropped. And it's unclear whether he's talking about the Gila or the San Pedro, but he wrote this right at the mouth of the San Pedro. And the historic document is part of the records that have been given to this Commission.

So the primary records for this analysis are basically the U.S. Geological Survey reports. There are other records that's used also, but these form the core of this analysis.

Now, these reference here, this is for the subflow study. There's a subsequent report out that modified perennial. They cross-divided it as perennial/intermittent. I think there's one or two attorneys in the room that kind of forced that. I don't agree. I'm siding with the USGS document that it was perennial.

This is the Verde. This is about what it would look like. Some people don't have any idea what it would look like, and this -- that's roughly the median flow down near the mouth of the river. The median flow comes out, in that analysis, about 45 or so cubic feet per second, just to give you an idea what we're talking about.

When they read a USGS report and they say, wow,

they may predevelop, they made natural.

Now, this is pretty elementary, but it's important. If you're working with direct law, it's runoff that doesn't -- it's snow melt and storm runoff that doesn't enter the ground. And water that enters the ground comes up as the base flow. When it reaches the river, it's known as base flow. If it's natural, it's base runoff.

Generally speaking, the predevelopment San Pedro River was gaining all the way down, from the Mexican border all the way to the Gila River. But (indiscernible) there were small reaches along the ways, and a lot of it's related to the (indiscernible) recharge that were coming in all the way along the way.

And it's important to know that in regard to the well, any well in the watershed, in this watershed, that took a bucket of water, say, out of the ground, it's taking water that would have eventually gone to the river. That's a very important thing to keep in mind. Anytime you took a bucket of water out of that well, that's water that would have eventually gone to the river.

The San Pedro has three basic groundwater basins that are connected underground, and this represents (indiscernible).

This is very recent work. It's showing that

the river alluvium was acting as an aquifer too, but supplied base flow to the river. Most of the groundwater modeling that's available does not recognize that effect. It's modeling only the basin flow of the water. So there's an additional base flow component.

Okay. This is just the general slope of the valley, and in predevelopment times it also represents the slope of the groundwater, because it was issuing into that river all the way down. It shows a (indiscernible) slope there, right about at "The Narrows."

So this is the slope above and below, and here's the slope that gets -- it has the same velocity of 1.5. So we know it was a (indiscernible) river. And anyway, that river (indiscernible) slope, but the river creates to (indiscernible).

Okay. This is just showing the connection between two studies. This is the USGS study that defines the base runoff, and this is the USGS study that defines total runoff for predevelopment.

So this just defines my procedure. And what I'm saying here really isn't that important, but I'm using actual gauge records to determine the general shape of this (indiscernible) that I'm going to show you how I developed for different places along the river.

So the area under the (indiscernible)

represents the rock and the runoff. And the average annual runoff is represented here in the median. And then the base flow that's determined from one of those USGS documents I showed you is determined here. And when you know that information, you can determine the shape using the Tombstone gauge record as to broaden the shape.

This is a groundwater model of the upper part. There's also another groundwater model they did of the entire river.

These are the pie diagrams that represent the groundwater budget for each one of the little basins. And they did 74 basins all over Arizona and adjacent states. And one of the components was the base flow issuing from that particular basin into the river.

Okay. These are the three basins, plus the Aravaipa that I showed you.

Now, the base flow represented by that document is the flow that is exceeded 90 percent of the time. It's not the average annual base flow, it's the Q90. It's not -- engineers and hydrologists refer to it as Q90. It's 90 percent of the time that flow is equalled or exceeded. So it's down at the low end. It's occurring out there now. May and June is when you'd expect to see that, before the monsoons.

Okay. Just a little discussion about the

Cananea Mine. The purpose of it is to just show they were -- mines used water, and it's my estimate of it. But don't get excited, mining people, because I didn't use it in the analysis. It's just showing there was an effect, and I didn't use it. And it will demonstrate -- it demonstrates that my estimates of navigability are very conservative. The natural flow is probably -- could be considerably more than what I've used in this analysis.

That's 52 percent annual use there at that mine back in the early 1900s.

Okay. This is from Don Pool's report, it's a USGS report. And it shows acre-foot versus time. And this represents the waterways of the Cananea Mine, which starts here, and the Copper Queen, and here's the old Tombstone. Up here you have, at the peak of about 20,000, that represents about 14 cubic feet per second in the river. It's not taken into account in this analysis.

Just a point of information, the USGS reference of the Palominas gauge show a ten-year period that's missing. Go to the Boundary and Water Commission site, and all of the records are showing at that site, other than the books missing from World War II down here. Most people don't know that, but it's jointly operated by the USGS and Boundary and Water Commission.

Notice here we have a large base flow. The

Cananea Mine starts and the base flow is lower. Now, I'm not saying that's an effect, but you can see that something caused that.

Okay. This is how the average annual runoff was determined. A standard nationwide method was used to determine for how -- every hydrologic unit in the country, and Alaska, the same method was determined -- was used to determine annual -- average annual runoff for predevelopment.

A period of records from 1950 to 1980 was the base period they used, and they made whatever adjustments were necessary to convert it to predevelopment or runoff. So these are the hydrologic units in Arizona, and here's the two in the San Pedro.

Okay. I made a small adjustment. It's almost insignificant, but the Palominas stage is inside the U.S. a little bit, so I made an area adjustment right here.

The second adjustment here is more or less a computational one. The USGS method determined runoff to reach a hydrologic unit, but it didn't take into account the runoff from one hydrologic unit through the other hydrologic unit. And that the flood flow of the water spreads out through BEP. So there would be some losses to it. But it's already a wet channel, so the losses have already been -- most of the losses have been taken out.

But this (indiscernible) flow has -- you have to account for some additional loss to that. So that's all this is here. And it's more or less computational.

We don't know what predevelopment vegetation was, for example, so how are you going to do an accurate (indiscernible) on what the evapotranspiration was and so forth? So this is -- this is (indiscernible). When you look -- when I finish with this analysis, you will see that it won't have much effect. But I'm showing you I'm considering it. I'm not just sweeping it under the carpet.

And this is the estimate I came up with. That amount is lost, as the water from the upper unit rolls over the lower unit for each year.

So you have a gradient of groundwater coming in both sides, (indiscernible) into the river -- the cienegas and so forth all along this river. And I'm just demonstrating here that the water level will go up because of the upstream water coming across, and you get a small amount additional repeat, and therefore the runoff would be a little less. Then just simple addition of the two run offs for each unit.

So these are the average annual runoffs I used; however, I found that this river was not navigable at the upper end. So I showed Mexico there, but that -- that's

not used in the final analysis. It wasn't navigable up there, using the information I used.

This is a -- just a check for some. So this is going back to the (indiscernible). This is the hydrograph for the Tombstone gauge, and that's what I used to shape it.

And this is the flow relation for the upper -- the upper part, basically down just a little above The Narrows.

And down at the mouth, the base runoff -- a perennial amount of about 4 cfs is the minimum. You obviously can't navigate in 4 cfs, so I'll explain all of this. It's coming up.

This is an interesting point. It's kind of amazing that these numbers came out like they did. I didn't juggle anything. I was kind of surprised to see it myself, and you hydrologists in the crowd will probably -- probably be a little surprised too.

So I forgot Mexico, and now I'm looking at Charleston and on down.

The reason -- the reason you have this decay here or decreasing discharge is because of the way evapotranspiration occurs during a year. Maximum AG equals minimum base flow.

I'm relying heavily on this analysis that there

is a drought ongoing. And for what I've done here, the time frame doesn't really affect this particular analysis, the way I did it. It makes it a little more difficult, but it's not really a good (indiscernible).

This shows the balance between sediment size, slope of the channel, and amount of water. And it just shows that if you start altering one component, something else has to change to balance it. And so in a very general way it explains what the heck happened out here.

This will gag a lot of people, this next diagram, but anyway, it's a very significant diagram. It's used worldwide. If you have a single meandering channel, you can start thinking navigability. If you have a braided channel, you've got to start getting concerned about navigability.

So you prime the flow at three points along the river -- we've got the space, and we've got how it varies with time with the flow duration (indiscernible). Now we're looking at what it looks like. What does the channel look like? How big was it? How wide was it? How deep was it?

In terms of the scientific method, we've asked the question -- well, I've given background information, and we're making a hypotheses right here that this river behaves like a typical alluvial river.

And with that, we will make computations and then try to check it, and then we will apply everything. So it's fourth-grade scientific method.

This is a very important relation. It's very well defined by studies all over the world. It's pretty precise for a hydrologic-type equation. We all know that hydrology isn't all that precise. There's room in there. But that's a pretty good relation, the width versus discharge relations.

Mr. Ostergram (phonetic) developed this. He's a retired USGS guy, and he worked out of Tucson for many years.

So I have Charleston (indiscernible). And this is for the average annual discharge. So, you know, it goes up to about 45 feet wide for the average annual. Those higher flows will get wider.

So here's the best of the hypotheses -- and it's rather weak, because we know that there's man effects or human effects at this -- at this time -- but this is the only information I know that was measured to standards that survey was -- with the old eight-inch long chain, links of chain or whatever (indiscernible) -- I think it was eight inches, yeah.

But anyway, here's the result. Here's that median from my equation, and the commuted average annual

up here. And these measurements are shot in between. Now, the measurements are made along section lines, so they're not perpendicular to the flow. So this is the actual width of the river here, and the measured width is here. And this is the relationship here. And this shows that this is pretty darn good (indiscernible). Just look at the geometry.

This is just an (indiscernible) equation. I could have used what's known as reserve equations or hydrologic geometry, but I'm very comfortable with mine, and I've used this for 52 years. And I can work it real fast and -- and so forth. So this is -- this is just the amounts I used (indiscernible) and so forth. So only engineers would appreciate this.

So this is the cross section that I'm estimating. Well, we know that there's scour on the outside events, and they are shown on here, so we know it varies on a meandering stream.

Okay. This is measured depth versus discharge and measured velocity and -- versus discharge. If you know anything about navigability, this would be a bell ringer, where depth is going to be the problem, the limiting feature for navigability. The velocity is a piece of cake; not a problem for navigability. So here's the depth gauge in relation. So from zero to two and a

half-foot depth and for (indiscernible) it is equal (indiscernible). Same concept as what I showed you for discharge.

I haven't explained this all out clear, but what this is showing is -- is what I'm starting to say here is that I think navigability starts at Lewis Springs or shortly downstream.

And this is a diagram. Here's the Mexican border, and it shows where water is coming into the ground and then coming back out. No sign of a constriction right in here, that's rather impermeable material on the east side. So right from here on down is where I'm suggesting that the Commission consider navigability.

If I took those mines into account -- and I haven't shown the (indiscernible), but I can. But if I take those into account, I truly believe this is navigable all the way down. But I'm not going to go out on a limb. That was beyond what I set out to do here. I'm using mostly public information, and nobody's really analyzed that, that I'm aware of.

Some people think meandering channels are unstable, but just the opposite is true. It represents a river trying to adjust its slope to make everything stable -- to be stable.

There's our local resident. That was taken a

couple years ago. We got permission from his wife to show that.

MALE SPEAKER: Excuse me. Did you say two years?

MR. HJALMARSON: A couple -- it was something like that. Anyway, it was taken relatively recently, and his wife took it. And Joy -- Joy got permission to show it.

MALE SPEAKER: You're telling us that your opinion of navigability is from Lewis Springs down to the mouth, where it tends to be?

MR. HJALMARSON: That's what I'm suggesting, yes.

MALE SPEAKER: Okay. Thank you.

MR. HJALMARSON: This method, if you do -- if you look at similar studies in other states, this method has been used quite a bit on the navigability issues -- Oregon and so forth.

So it's not the channels that are -- a canoe and kayak could be put on something a half a foot deep. That's -- and they called out kind of a minimal method. I am not using that (indiscernible) for coming up with stuff.

So right here it shows we have acceptable conditions, and less than a -- less than a foot were even

marginal. Now, I didn't -- so I didn't use that part of the standard.

So once in a while you're going to get a big flood, and it's going to change your geometry and so forth. And if you have water in the river, under natural conditions, it'll heal itself -- and sometimes very quickly and sometimes it could take months or more. But generally speaking, it'll heal itself pretty good -- pretty fast. But you've got to have water.

This is natural and ordinary. Those curves represent natural and ordinary conditions throughout the year. 80 percent of the time I'm saying the river was navigable, using these standards.

I didn't set (indiscernible) because of that break in slope near The Narrows, but by saying that only the reach from Lewis Springs down is navigable, then I guess you could argue that I've said none of it. In other words, the upper 20 miles isn't -- isn't navigable.

There were beavers on this river. In fact, the earliest white man to visit it, Mr. Pattie, called this river the Beaver River because there were so many rivers on it -- beavers on it.

Now, of course, these are current conditions. The flow that -- the predevelopment was more than what you see here. Now, this is starting to chafe what's coming

up. But there's a meaning behind it, so it's not just a silly cartoon, but it's -- but the photos are not of the San Pedro. They're from other streams. I'm just making a point.

You could have a lot of beaver dams.

So they had 46 dams, and they all washed out in one monsoon flood. One beaver ended up in the Gila River, went down over a hundred miles, and the other one ended up near the mouth of the Aravaipa Creek. I guess the others stayed around or maybe got killed. I don't know. But they rebuilt the dams pretty fast.

MALE SPEAKER: How many beavers do you think that are around now?

MR. HJALMARSON: You know, I don't know. I haven't checked. I have no idea.

So I'm saying under the law -- okay. That -- that's it.

I'd like to clarify a couple of things. When the -- Mr. Pattie came into the area in 1825 and then came back -- because the beavers were so plentiful, he came back in 1827. When he came back, he didn't come down -- come back during spring run off. The first trip was in March, and one of his guys drowned and the horse drowned in the Gila River. He came back in September. So his expedition here represents two distinct times of the year.

When he went up twice, up the San Pedro, he talked about beaver, lots of beaver. But he didn't talk about the dams. He didn't talk about beaver dams. And you can read it for yourself. It's in the supplemental material. It's exciting reading. It's full of exaggeration and so forth. And that kind of detracts from the historic nature of what he did. But, you know, it takes kind of -- different kind of people to come into this area when it's so darned dangerous and remote.

So he didn't mention dams. So we know that beavers build dams on bank -- or lodges on banks and dam -- dig them pools behind dams. So we're not really sure what's there. If there was bank lodges, it would imply quite a bit of water. So it's interested me that dams weren't mentioned. There may have been -- may have been enough water there where the beavers decided just to go on the bank.

Before questions, there's one other thing. Have we passed these out?

Joy's going to pass you out an Arizona Geological Survey report. It's entitled: Historical Channel Changes on the San Pedro River. It's written by Gary Huckleberry. It's Open-file Report 9615, so it was written in 1996.

This is where the U.S. -- I'm making a special

point of this because this is where the Arizona Geological Survey had us in mind -- those of us that are trying to evaluate the navigability of the San Pedro.

For example, in the introduction on the bottom of the first page -- on page 1, it says, Because the State of Arizona's claim to ownership of river channels within its boundaries hinges on the navigability at the time of statehood. So that's the old rule. But this was written so well it applies to the present law.

This report is designed to provide baseline information on the historical physical characteristics of the San Pedro River channels and how they have changed through time.

And the second of three things I'm going to read to you is, at the last two sentences in the introduction it says, Apparently from the historical record, many of the geomorphous changes of the San Pedro River are linked to land-use changes, such as grazing, deforestation, mining, et cetera, within the valley. This report will avoid the debate over human and natural causes of channel changes, and instead focus on the river's historical geomorphology.

So it'll ease a lot of burden from us, us engineers that, you know, that we don't specialize in this type of work.

And then in the summary, I'll just -- the summary says that we're going to consider the human and natural causes of the head cutting and the erosion and so forth of this (indiscernible) to occur since 1850.

And I'm not going to -- and that's it.

And thank you.

CHAIRMAN NOBLE: Thank you, Win.

Do the Commissioners have any questions?

Mr. Breedlove, do you have any questions?

MR. BREEDLOVE: Just a more education, so for my understanding.

You mentioned -- well, in the reading materials that Joy had submitted and in your presentation, it sounds like there was a fluctuation of the stream or the river between braided and -- and a channel. So at some point -- you said at some times due to events there was a braided -- a braided river -- water course, and then at other times there was a -- and in fact, you're looking at me like that's not true. But it --

MR. HJALMARSON: You know what, I'm -- I'm listening. I have hearing aids.

MR. BREEDLOVE: Okay. Okay.

MR. HJALMARSON: So --

MR. BREEDLOVE: And I just wondered if you could expand upon, you know, what -- you know, if it's a

braided river, then I believe you said that it's -- it's going to be non -- tend towards non-navigability, and if it's not, if it's a channel, then it's going to tend towards navigability.

MR. HJALMARSON: Okay.

MR. BREEDLOVE: And it fluctuated in time between braided and a single channel. So explain to me how you determine, based on that information, that it was navigable or not navigable.

MR. HJALMARSON: Okay. That -- the scary-looking diagram that I showed you that worked -- that it -- based on the conditions of your particular river, you can plot most conditions on that -- on that relation. I can bring it up, if you'd like. But if you remember it, and I --

So if it plots below this line, then it's considered a man -- a single channel meandering. Now, and then if it's above, it could be a braided.

Now, when you have a lot of single channels where you have this rather uniform shape, of course, it uniformly changes around on the depths. But that's susceptible to navigation.

A braided channel is generally associated with ephemeral springs, so -- which you have a lot of here in Arizona. And what's developed out here in many places is

the braided channels. Now that the San Pedro has gone dry, there's no water to -- to heal it, then you're going to end up with this sand -- wide sand channel, and where you do have flow, it can be, you know, in many different places and very -- very shallow and wide.

Does that answer?

MR. BREEDLOVE: Partially. I'm trying to find the -- okay. Now, this is -- this is not your exhibit, but this is something that was submitted by -- by the Center. And it's on page 260 of the Huckleberry study, I guess. And it says that prior to the mid 1800s, the river flowed and -- over an unincised surface and have large areas (indiscernible). It contained a single meandering channel and marshes were common.

But then you skip down and it says, Following historic floodplain entrenchment, water tables lowered and marsh habitat declined, but the subsequent channel widening also created the wild braided channel conditions that facilitated the establishment of riparian forests of cottonwood.

So it -- so it's my understanding from reading this, that it was -- that it fluctuated, that sometimes it was meandering and some -- or a channel, meandering channel, and other times, you know, that after events it would turn into a braided recourse.

MR. HJALMARSON: You mean during predevelopment, under natural --

MR. BREEDLOVE: This is prior to the mid 18 -- to the mid 1800s.

MR. HJALMARSON: Prior to the mid 1800s? You would get braiding following large floods until it had time to heal itself.

MR. BREEDLOVE: How long does that take?

MR. HJALMARSON: Well, like I said, it varies. It depends on the size of the flood, the amount of destruction, and so forth. It could easily take a year or two on a major flood, but one of the biggest ever to hit the state was February 21st, 1891.

I flew over the area here for -- I was working for the USGS in the '83 flood, which really mellowed the river down at the lower end here on the San Pedro -- and it just tore it up. And if that had been a natural river when that thing hit, that kind of flood would -- might take some time to come back. But that's not natural and ordinary. That's something that just, you know, it -- it might occur every a hundred years or something, whatever.

So most floods, most (indiscernible) floods didn't just disturb things. You might end up with little reaches of braiding and so forth, but the river -- if you think of it, it wants to come back and heal itself, and if

it has the water to do it, it'll do it.

Now, that's partially true. Let me -- let me be a little more careful about that. If you have cattle all over that area, trampling of cattles -- trampling the hillsides and all of that, then what I just said is not true, because you've now disturbed the sediment. So whether it's purely natural, what I -- what I said is true. And there's studies all over the world that will support what I'm saying. So you can have short periods where it's braided, yes.

MR. BREEDLOVE: Okay. I just wanted clarification for my understanding. Thank you. That's it.

CHAIRMAN NOBLE: Anyone in the audience have questions for Win?

MR. HOOD: Good morning.

CHAIRMAN NOBLE: State your name.

MR. HOOD: Sean Hood.

CHAIRMAN NOBLE: And we will caution you on one thing. You're about to ask questions; you're not allowed to comment.

MR. HOOD: Understood.

CHAIRMAN NOBLE: You want to comment, submit it in writing.

MR. HOOD: That sounds great, Mr. Chairman.

I know there's several of us here who intend to have some questions for Mr. Hjalmarson. I don't think my questions would conclude by noon. I'm happy to get started now.

Another suggestion that Mr. McGinnis made, which I think is a good one, is it looks like we have several people from the community here who may want to make comments, and they may not want to be here all day. I'd be happy to wait until after lunch to let them have their say, so they can go about their day, if they don't intend to listen to all the cross-examination.

CHAIRMAN NOBLE: We will proceed in that way. So you can take your seat again.

MR. HOOD: Thank you.

CHAIRMAN NOBLE: Is Fred Davis here?

Mr. Davis, would you like to speak to us?

MR. DAVIS: Good morning. I'm Fred Davis. I live east of Tombstone. There's a branch there. I was born in Douglas. My parents were both born in Tombstone. My grandmothers were both born in Tombstone. One great grandfather, William Ford (phonetic), came to Arizona in 1867; another came in 1880, William Cowen (phonetic). My two grandfathers, Fred Bennett came to Tomb- -- Arizona in 1895. Bill Davis came to Arizona in 1897. So we've been around the area for a while.

My grandad, Fred Bennett, and his brother, Bill, bought the Montezuma house from their brother Ben Bennett, which was at Fairbank. They bought that in 1908. I've got the deed, et cetera. He also went to work for the Green Cattle Company as a wagon boss on the Boquillas in 1908. My mother was born in Tombstone, but resided at Fairbank when they were on the river.

I discussed quite a bit of stuff with my grandfather, Bill Bennett, about ranching in the early days and when he was running the Green Cattle Company. And at that time the San Pedro was a perennial -- I mean, it was an intermittent stream. There were lots of times they -- they were building tanks at that time because they did not have enough cattle water out of the river to water the cattle they were running.

They talked about the quicksand crossing -- whether it was wet or dry, sometimes that quicksand could be difficult. There were certain places you needed to cross. But it wasn't the water problems, it wasn't crossing deep water that was the problem, working cattle back and forth across the San Pedro. It was the sand.

I have one question. Win's definition of navigability is not what I was led to believe by Senator Griffin, is the item of discussion at the state level. I thought it was commercial watercraft that could

go up and down the river and turn around and go again. I don't think this river has ever had that type of navigability.

Thank you.

CHAIRMAN NOBLE: Thank you very much, Mr. Davis.

Anybody have any questions for Mr. Davis?

Thank you.

Andrew Smallhouse. Are you here?

MR. SMALLHOUSE: Yes. (Indiscernible.)

CHAIRMAN NOBLE: And Hanna?

MR. SMALLHOUSE: Yeah, Hanna.

CHAIRMAN NOBLE: Hanna, you better get up here.

MR. SMALLHOUSE: That's my daughter. I figure I'd get her used to it because I've been here -- this is my second time here. My grandfather testified and my dad testified and this is my second time testifying, so I said, Hanna, this is going to go on forever, so you might as well get used to it now.

CHAIRMAN NOBLE: Well, that's just today.

MR. SMALLHOUSE: Yeah. So our family came here in 1879 to farm ranch. And they started out in the Cochise Stronghold and moved down to the Redington in San Pedro -- along the San Pedro there in 1883.

And I'm not going to go into all the details

that my grandfather testified, because he knew -- he was born in 1906.

But I would like to Commission to review the information that my dad and we have supplied in the past. And I basically drove all the way over here to ask you to review that, and give Hanna some practice at doing this, because -- so she's got a little statement she wants to say.

HANNA SMALLHOUSE: Hi, I'm Hanna Smallhouse. I'm sixth generation on our farm and ranch along the San Pedro River. Even though I'm only 9 years old, I can tell you the San Pedro River is not navigable and never has been. It seems like you're trying to take away our land that our family has worked for six generations.

MR. SMALLHOUSE: And that's the frustrating deal about all of us driving all the way down here, is that it's not someone wanting to -- to transport commerce or something like this act was passed for.

It's an act that's being abused, like the Endangered Species Act, to take land -- grab land that we've privately owned for years.

There's no recollection. I've got memoirs and everything else. And you can do all the detailed studying and say it flowed or didn't flow, but there's memoirs -- you would think they would mention transporting goods or

so forth down the river, especially because they came from Cochise down that way. And they never mentioned coming down the river when they came. They came on stagecoach.

There's no mention in any of our memoirs about ever using it for transporting goods. And besides that, as a meandering stream with all the beaver dams in it, I think that would be highly unlikely.

And I just -- I wish -- I don't know how it works, but I mean, it's a -- it's a big amount of time for us to come up here and testify every time. And so we --

But I appreciate you listening to us.

CHAIRMAN NOBLE: Well, thank you. First, we have to find out if anybody has any questions for Hanna or her father.

MALE SPEAKER: How's my friend Stephanie doing?

HANNA SMALLHOUSE: Good.

MALE SPEAKER: Good.

CHAIRMAN NOBLE: Thank you, Hanna.

Mr. Smallhouse, thank you as well.

Are there any other local people who would like to speak that may have not turned in or -- a sheet asking that they request form?

If not, then we will return to where we were.

MR. HOOD: Thank you, Mr. Chairman.

Again, Sean Hood with Fennemore Craig. I'm

here on behalf of Fennemore -- I'm sorry, on behalf of Freeport McMoRan. Also with me today are (indiscernible) counsel for Freeport; Bill Staudenmaier, who you're familiar with, co-counsel at Snell & Wilmer; and Rich Patel (phonetic) who will be testifying, presumably this afternoon, or maybe next time (indiscernible).

Good morning, Mr. Hjalmarson.

MR. HJALMARSON: Good morning.

MR. HOOD: Are you able to cycle through various pages of your report as we go?

MR. HJALMARSON: Am I what?

MR. HOOD: Yes. Are you able to -- do you have the mechanical ability of if I -- if I say, Can we go to page 22, is that something you're able to do?

MR. HJALMARSON: We'll give it a shot.

MR. HOOD: Okay. If not, I have an extra copy, but I think it'll be better --

MR. HJALMARSON: Okay.

MR. HOOD: It'll be more efficient, I think, if you're able to do that.

MR. HJALMARSON: Oh, okay, okay, fine. You did notice the slide numbers in the lower right-hand corner.

MR. HOOD: That -- that would be my reference, is that -- is that okay for you?

MR. HJALMARSON: Okay. Good. Yeah.

CHAIRMAN NOBLE: Excuse me. I didn't -- I didn't catch your name.

MR. HOOD: Sean Hood.

CHAIRMAN NOBLE: Okay.

MR. HOOD: Thank you.

Mr. Hjalmarson, a little bit of background first. Have you been -- are you being compensated for the work you're doing on this?

MR. HJALMARSON: No, I'm not.

MR. HOOD: Why did you decide to do this for free?

MR. HJALMARSON: I'm a member of a club in the Verde Valley, and we're interested in rivers all over the state. And we were under the impression that the state was -- would hire John Fuller, like they have previously, and represent the San Pedro.

I know John Fuller very well, and I contacted him, and he said that the state didn't seem to have the money to support it -- or the interest or whatever. So I made an offer to him to assist him because I worked on the Gila, and the Gila -- the lower Gila and the (indiscernible) lower Gila were not -- it seemed to have been done to the proper standard originally, so we're not redoing it.

So I was going to help him out with some of the

sources -- the references and so forth. So we got involved there, and one thing led to another, and the president of our club called the Arizona Center for Law in the Public Interest, and she talked to Joy and said that -- or expressed our interest and what -- the next thing I knew, the president of our club asked me to call Joy. And before I knew it, I had volunteered to -- to do what I'm doing now.

MR. HOOD: Is it fair to say, sir, that you have a personal interest in the preservation of the San Pedro, as a recreational river?

MR. HJALMARSON: Well, I don't live -- I don't live in it -- live in this area at all.

I have an interest in the Verde. I live in the Verde Valley.

But no, I do not have a personal interest in the San Pedro.

I have experienced the San Pedro, as an employee with the USGS. I was the (indiscernible) in Southern Arizona, and I oversaw the operation of gauges and of scientific studies and so forth in the area.

I enjoy coming down here, because it's pretty golfing. I was also (indiscernible) specialist from '83 until I retired in '93. So I, you know, was interested in them doing measurements, et cetera, et cetera. I mean,

I've been to the area, and I thought it was a very beautiful area.

So, no, I don't have the -- I do not have a bias. When I started this study, I honestly didn't know how it would come out.

MR. HOOD: You made mention, and I missed it, what's the name of the club you're associated with that reached out to Mr. Tibial (phonetic)?

MR. HJALMARSON: The Verde River Citizens' Alliance. And the president is Anita -- I've forgotten her name. She's been married and divorced -- Anita Goss, G-O-S-S.

MR. HOOD: What's the mission of the Verde River Citizens' Alliance, if you know?

MR. HJALMARSON: We would like to keep water in the river. But we're involved in public education. We have a group of guys that clean up the river, just literally go down and take trash out of the river, and it's mostly in the state parks area. So it -- it's a variety of involvement, but we're -- we're interested in keeping some water in the river.

MR. HOOD: When I received an electronic copy of your PowerPoint late last week, the file said "Final." Did you have some drafts of your PowerPoint leading up to going final?

MR. HJALMARSON: Yes. I had a -- I had a PowerPoint for -- scheduled for the first scheduled meeting of the Commission, and it was put together real fast. I didn't have much time to do it. So when they rescheduled it, then I came back in and looked at it in much more detail.

MR. HOOD: When was your prior draft completed, approximately?

MR. HJALMARSON: It was, I don't know, roughly a week before that other -- that scheduled meeting, I think. I honestly don't remember, but I remember rushing through it, and --

MR. HOOD: What month are we talking about? I'm just not clear what meeting you're referring to.

MR. HJALMARSON: The what?

MR. HOOD: I'm not clear which meeting you're referring to. What month would we be talking about?

MR. HJALMARSON: When was that, March? When -- when did you guys change your date for this meeting? I believe it was March.

MALE SPEAKER: I don't remember.

MR. HOOD: That's fine. We'll move on.

Let's -- I want to just back up and talk briefly about the summary of your opinions. Did you go -- let's -- let's (indiscernible) this procedure, 169

(indiscernible). Do you know?

MR. HJALMARSON: Oh, okay. Oops, wait a minute. Okay, let me see. Oh, yeah, back this way. I'm running through the appendix right now, which I -- which I didn't show.

MR. HOOD: My page numbers for you, will, I believe, all be for your main PowerPoint, not the appendix.

MR. HJALMARSON: Yeah, okay. Hold on. Wait a minute, I got a little confused here. Okay. There.

MR. HOOD: Okay. So here you're talking about you -- it's your opinion that 80 percent of the time, in its ordinary and natural condition, the San Pedro is suitable for use of canoes and other small watercraft; is that right?

MR. HJALMARSON: The watercraft (indiscernible) federal standard, which would be canoes, kayaks, and I think it says flat-bottomed rowboats. It's very small, very small watercraft.

MR. HOOD: And this goes back to your calculation that 80 percent of the time the San Pedro, in its ordinary and natural condition, had a depth of 1 foot?

MR. HJALMARSON: That was the minimum, yes. Yeah, in my -- yeah.

MR. HOOD: Let's clean -- let's clean that up,

actually, because actually the 1 foot -- your depth measurements are maximum depth, not minimum depth.

MR. HJALMARSON: That's right. But --

MR. HOOD: So 80 percent of the time you had a minimum of a foot, but that 1 foot is actually the maximum depth of your channel?

MR. HJALMARSON: That's right. But based on the parabolic shape that you get in there, it's -- it's real close to about depth for quite some width. And all you need for this standard is roughly a width of about 4-foot, using that (indiscernible). So you need a very -- so it easily -- it easily meets that standard and that particular minimum width.

And this -- this partially -- this partially explains why I didn't use that other depth of one-half foot. So I -- I'm using that to -- to cover just what you're suggesting, and it is the maximum. It doesn't change very much, and then it gradually becomes less.

MR. HOOD: We'll come back to the -- the physical characteristics of a cross section.

Let's talk a little bit about these watercraft. What -- if we're talking about a canoe, what's the draw or draft that's required in a canoe, that you're relying upon in that table?

MR. HJALMARSON: Well, if Mark over here gets

in that canoe, it'll get down pretty deep in the water. If that little girl gets down in the canoe, the draft will be pretty small.

MR. HOOD: So if you have --

MR. HJALMARSON: The draft -- the draft of the canoe is usually only, what, two or three inches, maybe four.

MR. HOOD: Let's go to page 143, which you have -- you cite to this table.

MALE SPEAKER: Pardon me, Mr. Chairman. Is the reference to the slide number or page number?

CHAIRMAN NOBLE: Well, each of the slides are numbered. I guess that's what the reference is, so --

MR. HOOD: Yeah.

CHAIRMAN NOBLE: We're looking at --

MR. HOOD: Yeah, I can clarify that, because that's important for the record.

In Mr. Hjalmarson's PowerPoint presentation that was submitted, each page that was printed out is -- contains two slides, but each slide, in the lower right-hand corner, has a page number, and those would be the references in all five of these (indiscernible).

MR. HJALMARSON: Yeah. That's what I asked you when you started questioning.

MR. HOOD: So we're on page 143 of your

PowerPoint. Is it possible to make it bigger so everybody can read? I have a copy for me, so I can read just fine, but I don't know about anybody else.

MR. HJALMARSON: Okay. Hold on. Let's see.

MR. HOOD: Okay. You just had it a little bigger during your presentation.

MR. HJALMARSON: Oops.

MR. HOOD: That works.

MR. HJALMARSON: Yeah, but not on -- I'm back with the problem. Oh, boy. Let's see. Oh, I -- excuse me. I know what I did. I'm -- I need one of my grandchildren here because they could run this a lot faster than I.

Okay. Which slide was that again, now?

MR. HOOD: 143.

MR. HJALMARSON: 143, okay. Okay. Hold on. And -- okay.

MR. HOOD: The Table 1 runoff --

CHAIRMAN NOBLE: Excuse me. Win, you're going to have to sit a little closer to the microphone, because we're recording it, and if you get too far away from that microphone, it doesn't pick up, so our record is not complete. Could you do that?

MR. HJALMARSON: Yes, sir.

CHAIRMAN NOBLE: Thank you.

MR. HOOD: Mr. Hjalmarson, if we look at Table 1, which is at the top of page 143 of your PowerPoint, this lists the various craft and their required depth and their required width, correct?

MR. HJALMARSON: Yes.

MR. HOOD: Okay. And we talked briefly about draft and draw. And you said, well, that depends on who is in it. If you have a small child, it's going to require less draft. If you have a large person, it's going to be more. If you have equipment, if you have commercial goods, that draft is going to be greater, correct?

MR. HJALMARSON: That's true.

MR. HOOD: And this chart is for recreation craft, specifically, true?

MR. HJALMARSON: That's true.

MR. HOOD: And this is the height of standard that you spoke about during your presentation?

MR. HJALMARSON: Well, the Hiram (phonetic) standards are the ones I used, yes.

MR. HOOD: Did you do any calculations about how these required depths would change if you are involved in a more commercial process, like transporting goods or additional people?

MR. HJALMARSON: No.

MR. HOOD: In addition to the minimal depth requirement for any number of craft, you would agree that if you have additional physical characteristics of a stream, even if you have your minimum depth, you could still have a non-navigable situation. You spoke about braided channels being one, sandbars would be another, beaver dams we spoke about. Those are all things that, even if you have adequate depth, can impede navigation, true?

MR. HJALMARSON: Yes. But I -- throughout this, I have alluded to how conservative I've been in doing this. There is about eight different reasons -- there's eight different items where I conservatively, let's say, took the low value for navigability. And what I had in mind when I did that is the formation of sandbars. I remember specifically saying that this river gains and loses as it -- you know, along the channel, it does gain and loss. It definitely gains as you go downstream, but you can have regions where it'll lose.

I can (indiscernible) a slide that shows that. There's a real good model by the guy who is the head of the University of Arizona hydrology department. He modeled this river, and I can show you that effect, if you care to see it. It's in my appendix.

Do you want to see it?

MR. HOOD: No. Actually, I just want to make sure you answered my question.

MR. HJALMARSON: Okay. Well --

MR. HOOD: My question was -- hold on, let me ask my question again.

If you have impediments, those would impact navigability even if you have your minimum depth of water? Yes or no, I believe. They can impact navigability?

MR. HJALMARSON: They can impact it, but I have accounted for it.

MR. HOOD: You talk about 80 percent of the year having at least that 1 foot of flow, and again, that's the maximum depth at your cross section within the channel. Is it your opinion that you need at least 80 percent of the year to have that depth in order for there to be navigability?

MR. HJALMARSON: My calculations show that for a typical year, you wouldn't meet that criteria 20 percent of the time.

MR. HOOD: My question is, If you have a stream that is not 80 percent of the year you have your 1 foot or whatever standard depth you decide from, if you have a lower percentage of the year that you meet that minimum depth, at what point do you reach non-navigability, in your opinion?

MR. HJALMARSON: I didn't study that. I focused on the typical year for the natural and ordinary condition.

As you can see, let's -- the curves, the flow-duration curves are very flat. And when you take into account all these conservative approaches I took throughout the analysis, you can -- what I have here actually represents a minimum depth condition based on the (indiscernible)flow-duration curve. They could be considerably higher -- and they probably were.

And I would probably have to apologize to some environmentalists in the group who want this thing, you know, navigable, because I didn't really -- I didn't really take that into account, because I am aware of the conditions you're talking about. So I have accounted for it within this analysis.

MR. HOOD: Is the answer to my question, that no, you do not have an opinion as to what percentage of the year, whether there could be a percentage less than 80 percent of the time, that if you have your minimum depth, you have your navigable stream?

MR. HJALMARSON: And obviously in a non-ordinary year, like a drought, yes, the answer is yes.

MR. HOOD: You do have an opinion as to what percentage of the time you need to reach that 1-foot

minimum?

MR. HJALMARSON: No. I do not have a percentage of the time. I will say that if you have an extreme drought, then there would be a lesser percentage of time for navigability.

MR. HOOD: In your PowerPoint -- we can go to it if we need to -- but you talked about two little depth limits of navigability, and you spoke about that today, correct?

MR. HJALMARSON: Just generally speaking, that's the criteria. So that's -- let me end it in analyzing the depth. That's giving a reason for what I'm doing.

MR. HOOD: And you also indicate in your PowerPoint that too much velocity ruins navigability, correct?

MR. HJALMARSON: Correct.

MR. HOOD: If you have such navigability. And that's not as common here as it would be in other parts of the country?

MR. HJALMARSON: Well, no, I don't want to make a general comment like that. What we have is if you want to address what I did on this specific river, then I've showed that there is high flow in her during monsoon season, and you get up, you know, 5,000 cfs, I wouldn't

want to be on the river. Some people would love it.

MR. HOOD: For our region of the country, when we have the periods of time when velocity is too high for navigation, safe navigation, that velocity would occur typically in connection with monsoonal events?

MR. HJALMARSON: What did you say, the monsoon months?

MR. HOOD: It would typically occur in connection with monsoonal events.

MR. HJALMARSON: Yes. That's typically the source of the higher flows here, mostly because you won't get up much of a (indiscernible) typically. But I lived in Tucson for a while, and once in a while got -- you know, I'm aware (indiscernible) gets a small amount of runoff.

MR. HOOD: Mr. Hjalmarson, can you go back to Slide 4, please.

MR. HJALMARSON: 4?

MR. HOOD: Yes.

MR. HJALMARSON: You're really testing my --

MR. HOOD: After some additional background stuff, I try to keep it more or less in sequence. Thank you for bearing with me.

MR. HJALMARSON: The standard?

MR. HOOD: Yes. You cite to the 2010 Arizona

Court of Appeals decision, State v. ANSAC, correct?

MR. HJALMARSON: Yes.

MR. HOOD: And you also cite to PPL Montana, which is a decision by the United States Supreme Court, that was issued in 2012, correct?

MR. HJALMARSON: Yes.

MR. HOOD: Do you know -- have you looked at any other case law in connection with your work in this case?

MR. HJALMARSON: Well, I've read the original Defenders of Wildlife case, and I've read case law in Oregon, and, you know, yes, I've read other -- I've read other case law.

MR. HOOD: Do you have any familiarity with the case United States versus Utah, which was decided in 1931, relating to several rivers in Utah -- the Green; the Grand; the Colorado, for part of its duration; and the San Juan?

MR. HJALMARSON: That does not come to mind.

MR. HOOD: What about the Oklahoma versus Texas decision, 1922, related to the Red River?

MR. HJALMARSON: Again, it doesn't come to mind.

MR. HOOD: Okay.

MR. HJALMARSON: I'm an engineer, not a lawyer.

MR. HOOD: No, I understand. You cite to a couple cases, so I just wanted to get a sense. Then we'll -- and we will come back to those cases.

You say in your PowerPoint that you should consider all historic accounts as agreed; is that right?

MR. HJALMARSON: I considered all the --

MR. HOOD: Well, let me -- let me ask the question in a different way.

Would you agree with me, sir, that if we have historical accounts of the San Pedro in its ordinary and natural condition, we ought to be considering those, in these proceedings?

MR. HJALMARSON: We also -- you trailed off.

MR. HOOD: We ought to be considering those accounts, in these proceedings.

MR. HJALMARSON: Those accounts? Well --

MR. HOOD: If we had historical accounts of the San Pedro in its ordinary and natural condition, we ought to be considering those, in these proceedings?

MR. HJALMARSON: What I'm saying very strongly in here --

MR. HOOD: Sir, I'm not asking what you're saying. I'm asking if you agree with my statement, that if we have historical accounts of the San Pedro in its ordinary and natural conditions, we ought to be

considering them in these proceedings? Yes? No? You don't know? It may depend? I don't think it requires a long answer.

MR. HJALMARSON: I would agree with that, yes.

MR. HOOD: And did you take a look at the historical accounts that Mr. Patel relied upon in connection with his declaration that was submitted in this case?

MR. HJALMARSON: Yes. Not all -- well, not all of them, but I -- but the important ones I did, yes.

MR. HOOD: Which were the important ones you looked at?

MR. HJALMARSON: They were the observations of an old flow, in particular, and the ones where an estimate of the discharge was made.

MR. HOOD: When I got the electronic version of your PowerPoint, I did a couple of word searches. The words "commerce" and "commercial" just don't appear in your PowerPoint, true?

MR. HJALMARSON: Yes.

MR. HOOD: And "recreation" and "recreational" appear several times. I counted ten. The number doesn't matter. But you would agree that those variations on the word "recreation" appear several times in your PowerPoint?

MR. HJALMARSON: It's probably several times,

yes.

MR. HOOD: Mr. Chairman, is it okay if I approach the witness with a document?

CHAIRMAN NOBLE: Okay.

MR. HOOD: Mr. Hjalmarson, while we're talking about PPL Montana, which was decided in 2012 by the United States Supreme Court, I'm going to have you take a look at a couple of excerpts that I've highlighted. I'll probably read them, and you can tell me if I get them right.

If we look at -- if you look at the first page I have tabbed there, Mr. Hjalmarson, is there a -- is there an excerpt that is highlighted that begins, "Those rivers must"?

MR. HJALMARSON: Yes.

MR. HOOD: Okay. Those rivers must be regarded as public navigable rivers in law, which are navigable in fact, and they are navigable in fact when they are used or susceptible to being used in their ordinary condition as highways for commerce or which trade and travel are or may be conducted in the customary modes of trade and travel on water.

Did I read that correctly?

MR. HJALMARSON: Yes.

MR. HOOD: Okay. And you talk about -- in your PowerPoint you referenced this "ordinary and natural

condition" phrase, correct?

MR. HJALMARSON: That's true.

MR. HOOD: Okay. And the next clause is, and I quote, at highways for commerce, closed quote, true?

MR. HJALMARSON: Yes.

MR. HOOD: And that does not appear anywhere in your PowerPoint, true? I'm not asking why. Yes or no.

MR. HJALMARSON: That's -- yes, it does not.

MR. HOOD: Let's take another -- a look at another excerpt from PPL Montana, and I think it's actually the third tab, so I apologize for taking you out of order.

MR. HJALMARSON: Okay.

MR. HOOD: It should begin: "While the Montana court"?

MR. HJALMARSON: Okay.

MR. HOOD: Do you see that? Is that the page you're on, the highlighting begins: "While the Montana court"?

MR. HJALMARSON: Yes.

MR. HOOD: Okay.

MALE SPEAKER: I'm sorry. Where is -- where is it in the case, so I can --

MR. HOOD: Yeah, thank you. I should have done that before.

This is PPL Montana 132 S. Ct. at 1234.

And the prior quotation we've all heard a hundred times; it's the Daniel Ball law.

So this excerpt at 1234 reads: While the Montana court was correct in that a river need not be susceptible of navigation at every point during the year, neither can that susceptibility be so brief that it is not a commercial reality.

Against this background the present day recreational use of the river did not bear on navigability for purposes of title under the equal footing doctrine. The Montana Supreme Court's reliance upon the State's evidence of present day recreational use, at least without further inquiry, was wrong as a matter of law.

Did I read that correctly?

MR. HJALMARSON: Yes.

MR. HOOD: Okay. And let's then go to the middle tab, which would be the last excerpt I want to go over from PPL Montana. This is at 1233.

And it should begin, sir: "The Montana Supreme Court further erred."

Is that what you have in front of you?

MR. HJALMARSON: That's right.

MR. HOOD: The Montana Supreme Court further erred as a matter of law in its reliance upon the evidence

of present day primarily recreational use of the Madison River. Error is not inherent in the Court's consideration of such evidence, but the evidence must be confined to that which shows the river sustained the kinds of commercial use that as a realistic matter might have occurred at the time of statehood. Navigability must be assessed as of the time of statehood, and it concerns the river's usefulness for trade and travel, rather than other purposes.

Did I read that correctly?

MR. HJALMARSON: Yes.

MR. HOOD: Is it true, Mr. Hjalmarson, that for a stream to be perennial, it is going to need to receive base flow throughout the year?

MR. HJALMARSON: Every stream?

MR. HOOD: Well, we can restrict it to the San Pedro if that makes it easier for you to answer.

MR. HJALMARSON: Well, let's put it this way: If you want to ask a general question like that, there are navigable rivers that are -- where there's perennial flow from melting glaciers.

MR. HOOD: Okay. In our region of the country, if you have a stream that is considered perennial, that stream has to receive base flow year round, correct?

MR. HJALMARSON: There might be a remote

exception, but that's the general rule, yes, that the water has to be coming from the ground, or -- well, wait a minute -- or a large reservoir.

MR. HOOD: Okay. That doesn't apply here, true?

MR. HJALMARSON: I'm not aware of anything very large. There's now one in Mexico and, you know, a couple, but --

MR. HOOD: Let's move over to Slide 10 now, if we could. Okay. And on this slide you say, and you're relying upon USGS HA-664, true?

MR. HJALMARSON: Absolutely.

MR. HOOD: Okay. And it says that the USGS has defined the San Pedro River as perennial from the Mexican border to the mouth, right?

MR. HJALMARSON: Yes.

MR. HOOD: 85 USGS HA-664 consists of three plates; is that right?

MR. HJALMARSON: Yes.

MR. HOOD: And that's fancy language that a scientist or engineer would use for it is three sheets?

MR. HJALMARSON: Okay.

MR. HOOD: Right? I'm asking you.

MR. HJALMARSON: Sure.

MR. HOOD: Right?

Is it true that it consists of three sheets, three sets of maps within that?

MR. HJALMARSON: Yes.

MR. HOOD: Now, what you have here, the depiction that you have, that is a portion of the visual taken from Plate 3; is that correct?

MR. HJALMARSON: Yes. I believe that's a portion of Sheet 3.

MR. HOOD: And this slide does not provide the legend or the water budget that relates to this slide, true?

MR. HJALMARSON: That's true. However, those maps, the full maps were provided to the Commission. I have a copy of one here in the table, if you want to discuss it.

MR. HOOD: We may down the road. Thank you for that.

Do you have any understanding -- you may not -- did the USGS, in preparing HA-664, rely upon a map like Brown and others? All I can do is ask you whether you know. If you don't know, that's perfectly acceptable. If you do know, please --

MR. HJALMARSON: Let's put it this way, I shared an office many years with Tom Anderson. He's one of the authors of this, and I talked to Jeff

(indiscernible) for years.

Now, if you want an instant answer from an old guy like me who's been retired a while, then you're talking to the wrong guy.

Now, if you're going to give me time to answer it, I'll try to think about if I was ever aware of that. So you give me a little respect, and I'll -- you know, and I'll try to answer it.

MR. HOOD: Sir, if you perceived any disrespect, that is certainly not my intention.

MR. HJALMARSON: Don't hurry an old guy, please.

MR. HOOD: Sir, that's not my intention.

MR. HJALMARSON: Okay.

MR. HOOD: Honestly, all I'm trying to do is let you know, if you don't know the answers to my questions, I can't make you answer a question you don't have personal knowledge about.

MR. HJALMARSON: Give me a chance to think about it before you start correcting me, will you?

MR. HOOD: You bet.

MR. HJALMARSON: Okay. Say the question again, please.

MR. HOOD: Sure. Do you have any personal knowledge, as you sit here today -- because that's what

we're restricted to -- as to whether the USGS, in preparing HA-664, relied upon Brown and others, which is a map?

MR. HJALMARSON: I can't say that specifically for those two gentlemen that did it. No, I don't know.

MR. HOOD: You talked about -- well, let's talk about perennial streams.

You would agree with me that even if a stream is perennial, that does not mean that it is navigable if, for instance, it does not have adequate depth, it has impediments that do not permit meaningful navigation, et cetera?

MR. HJALMARSON: If you had paid attention to what I said here, the upper 20 miles is perennial, and I said it wasn't navigable.

Does that answer your question?

MR. HOOD: It does. And I was paying attention. So the answer is yes, even if it's perennial, it does not mean it's navigable?

MR. HJALMARSON: That's right.

MR. HOOD: This map depicts contours; is that right?

MR. HJALMARSON: It depicts groundwater contours.

MR. HOOD: Those are groundwater contours, not

stream contours?

MR. HJALMARSON: Those are groundwater contours, but at the apex, I believe, it's at the stream channel, because the stream channel is perennial, and it corresponds to the groundwater level.

MR. HOOD: And you're -- again, you're tieing your statement that this is perennial back to this USGS HA-664?

MR. HJALMARSON: Yes.

MR. HOOD: There had been some mention in briefing previously, and then as a result what Mr. Patel addresses in his declaration, some discussion about San Pedro Lake. I didn't see that in your PowerPoint. I haven't heard anything about that from you today. And so --

MR. HJALMARSON: Well, I don't -- I don't know where that came from, but I think it's -- well, it's referring to the cienega that has a large pond near the mouth of Aravaipa Creek, I believe.

MR. HOOD: Yeah. You didn't take that into account in your analysis?

MR. HJALMARSON: No. It's just a cienega.

MR. HOOD: Let's look to page 13, please.

Okay. This says (indiscernible) says photo taken July 2008 by Charleston (indiscernible) by Marie

Godwin (phonetic), user permission. And this is one of the photographs we looked at earlier. This is, again, on page 13. And it says here taken in July 2008. Is what we're seeing here indicative of the way the stream would look during other parts of the year?

MR. HJALMARSON: Well, I think you could look at the flow-duration curve and say that for maybe 10 percent of the time during the tip of the year, it might look very close to that. The flow-duration curve shows conditions changing, because the discharge, say, versus time, it shows it changing throughout the year. And the appearance of the river would change accordingly.

MR. HOOD: May I approach again?

Mr. Hjalmarson, what I'm handing you is a USGS San Pedro River at Charleston Daily Discharge Graph for 2008. And in taking a look at this graph, would that indicate to you, sir, that this was probably during a time when there was a higher-than-typical discharge, likely in response to monsoonal events?

MR. HJALMARSON: There is definitely direct runoff in the river at that time, before the graph was taken, yes. You can tell from the turbid nature of -- of the flow. You know, it's -- it's chocolate, chocolate brown.

MR. HOOD: And Mr. Chairman, I have copies of

that draft, for the record, to circulate. Do you want me to interrupt each time I have a new document? Or should I handle that on a break? It's --

CHAIRMAN NOBLE: We do not want you to interrupt each time you have a document.

MR. HOOD: Do not interrupt?

CHAIRMAN NOBLE: Correct.

MR. HOOD: Okay. That sounds great. Thank you.

Let's go to page 18, if we could, sir.

MR. HJALMARSON: Are you through with this document?

MR. HOOD: Yes.

You talked a little bit earlier today about Cananea. And at the end of the day, though, I actually grasped this from your PowerPoint, but you didn't use -- you didn't factor that into your calculations. You --

MR. HJALMARSON: No. I said that more than once. I'm using it, I used it to show that there was a probable effect there.

(Conclusion of Tape 1; commencement of Tape 2.)

MR. HJALMARSON: I -- but I did not incorporate it into the quantitative analysis.

MR. HOOD: Would you agree that most of the water impacts from the Cananea mining operations would

affect the Rio Sonora side of the watershed, as opposed to the San Pedro? I'm not saying -- not saying zero impacts, but more on the Rio Salado side -- I'm sorry -- the Rio Sonora side.

MR. HJALMARSON: I'm aware that what -- the Cananea Mine has had wells on both sides of the watershed. I understand that in the early days, around, you know, 1899 or, say, 1901, '02, in there, they had more wells in the Rio Sonora than they had in the San Pedro, based on what I've read. Nothing that I've read, though, is real clear about what was going on there, and -- but in recent times, they've developed more wells in the San Pedro.

And I'm going to answer that slide -- I'm going to answer your question. I'm going to my slide -- I'm going to use this and go to mine. Oops.

Okay. Here we go. There's the Upper San Pedro watershed. This is a report by Goode and Maddock from the University of Arizona. There's a lot of wells going there from Mexico.

Now, look at the table. The Mexican wells on the right-hand side, and look what I've underlined in red.

And sir, how many wells would you -- do you see in Mexico on that slide? 20, 30? And they're all the mine's wells.

MR. HOOD: May I approach (indiscernible) with

a document?

CHAIRMAN NOBLE: Please.

MR. HOOD: Mr. Hjalmarson, Mark handed you this. He calls it The Conservation of the San Pedro River. This is a document that the Center submitted into evidence this year.

And can you just read the highlighted sentence for me, please.

MR. HJALMARSON: Most of the water (indiscernible) and water impact to the mining occurred in the Rio Sonora side of the watershed, although some were in the San Pedro.

Now, I'm going to finish answering that question. The figures I showed you for the use -- for the estimated use of that mine for those early years does not include the water consumption for the population of 25,000 people.

MR. HOOD: And where is that located? Where is that population?

MR. HJALMARSON: Well, the population is in that document that -- where I gave you the figures. It's referenced -- it's the same document. There were 25,000 people -- it's actually in several documents, but it may be referring to the same source.

MR. HOOD: Is the population on the Rio Sonora

side?

MR. HJALMARSON: The population in the --

MR. HOOD: (Indiscernible.)

MR. HJALMARSON: -- in the community of Cananea itself, in that -- in those days was about 25,000, during the heyday of the mine, before the 19 miners were killed by the Arizona -- the Arizona Rangers.

MR. HOOD: Was the population on the Rio Sonora side, as opposed to the San Pedro side?

MR. HJALMARSON: I think it was on both, as far as I know.

I think I've answered your question. There were wells on both sides.

And I will add something that might help everybody in this room. One of the reasons I did not include the numbers that I (indiscernible) is because of just what you're alluding to. I don't know how much was on -- how much was used in each watershed. That's the (indiscernible), so I do not know that. But it's -- I'll guarantee you, it's on both.

Let me respond further on that. I showed you water use versus time for the three mines: the Tombstone, the Copper Queen, and the Cananea. That came out of another report, other than this. That was out of Toole's (phonetic) report, a USGS report. The subject of that

report is the San Pedro River. The groundwater -- there's a groundwater model of the Upper San Pedro River. I showed you very high water-use amounts.

Why would they show those diagrams on a study for the San Pedro if they thought that water was in the Rio Sonora?

MR. HOOD: I think what my question was, Was the population on the Rio Sonora side?

MR. HJALMARSON: I know. But I'm -- I'm finishing -- no, I'm finishing the whole thing.

MR. HOOD: Okay.

MR. HJALMARSON: I was asking myself the same question. And I've talked to Don Pool about it, and he thinks it is in the San Pedro.

MR. HOOD: Could we move forward to PowerPoint page 150, please? 150.

MR. HJALMARSON: 150?

MR. HOOD: Yes.

MR. HJALMARSON: Oh, yeah, way up here.

MR. HOOD: While he's getting there, I may be about halfway done, so I'm happy to keep going through, as long as you want me to. If you want to break at any time, I can do that at any time. So just let me know.

CHAIRMAN NOBLE: Well, I'm good until about 4 o'clock this afternoon.

MR. HOOD: Okay, cool.

MALE SPEAKER: (Indiscernible.)

CHAIRMAN NOBLE: We're going to have to make a decision on what we're going to do on lunch, and we're going to have to figure out if there's any way to finish this today, at a reasonable time during the afternoon, or if we're going to be here until the wee hours of the morning or what we want to do timewise.

I don't know what the other presenters are and how much time we have to allocate for them, but we certainly want to hear all of those who wish to make presentations. And if the presentation is made, we want to afford those who are here to -- the opportunity to question on any presentations.

Having said that, are there those who are going to make, let's say, presentations that are going to last more than half an hour?

MALE SPEAKER: Yes. Mr. Patel's presentation will certainly be --

CHAIRMAN NOBLE: How long?

MALE SPEAKER: Two to three hours would be my guess, on direct.

CHAIRMAN NOBLE: Another presentation?

MALE SPEAKER: Yes, sir. I guess 45 minutes, plus cross-examination.

CHAIRMAN NOBLE: Mr. McGinnis?

MR. McGINNIS: Yes. We also have some (indiscernible) Mr. Karlson's (phonetic), hour -- we would take an hour.

CHAIRMAN NOBLE: Well, we might as well have lunch. We'll break for lunch now. Let's give ourselves an hour because I don't see any McDonald's next door. So we'll reconvene here at 1:15.

(Off the record.)

CHAIRMAN NOBLE: Come to order and make the announcement that during the break we discussed with the various parties and their representatives how to proceed with the rest of the day. We're going to continue with Win, finish any questions that we have for him.

And we expect that at that point we will recess the hearing until a further notified date, at which everyone will be notified, and, of course, because of that, the record will remain open through the hearing in 20 days, be reset -- a continued hearing and 20 days beyond.

Any questions or comments about that?

Win, you're on for the rest of the afternoon, then.

And Mr. Hood, you may begin again.

MR. HOOD: Good afternoon.

MR. HJALMARSON: Good afternoon.

MR. HOOD: Where I think we -- I think what I was about to get into with you, Mr. Hjalmarson, related to the Preparation of Average Annual Runoff Map of the United States by Krug and others. This is one of the reports you relied upon; is that correct?

MR. HJALMARSON: That's right.

MR. HOOD: Okay. And if we look at, let's see -- should we look at -- if we could go to page 150 of your PowerPoint. And I will refer to -- you know, for brevity's sake, I will refer to that USGS report as the Krug report; is that acceptable?

MR. HJALMARSON: Beg your pardon?

MR. HOOD: Does that work for you?

MR. HJALMARSON: What?

MR. HOOD: The Krug report?

MR. HJALMARSON: You'll call it a what?

MR. HOOD: The Krug report.

MR. HJALMARSON: Yeah.

MR. HOOD: (Indiscernible) first (indiscernible) listed; is that okay?

MR. HJALMARSON: Oh, you -- okay, I thought -- I thought you said (indiscernible), excuse me.

MR. HOOD: No, sorry, Krug.

MR. HJALMARSON: Okay.

MR. HOOD: K-R-U-G. Is that okay?

MR. HJALMARSON: Yes, sir.

MR. HOOD: Okay.

CHAIRMAN NOBLE: And Mr. Hood, leaning closer to that microphone doesn't improve your sound amplification in the least.

MR. HOOD: So I can relax a little bit. Thank you. Thank you. Now I'll get a little more relaxed. I appreciate that.

FEMALE SPEAKER: (Indiscernible.)

CHAIRMAN NOBLE: Yes. And we'll be fine. They're walking in the door.

FEMALE SPEAKER: Oh, okay.

MR. HOOD: Should we hold on for just two minutes until they get (indiscernible)?

(Indiscernible - simultaneous speech.)

CHAIRMAN NOBLE: Oh, they must not have had enough time for lunch, because they brought it back.

MALE SPEAKER: That's fine. (Indiscernible.)

CHAIRMAN NOBLE: Mr. Henness and Mr. Horton, we have begun.

(Indiscernible - simultaneous speech.)

CHAIRMAN NOBLE: Okay, Mr. Hood.

MR. HOOD: 150. So we're talking -- just to recap, we're just introducing now the Krug report, is what

we will call it. It's titled: Preparation of Average Annual Runoff Map of the United States, 1951 to '80, and it's a USGS report.

And this -- this is a report, Mr. Hjalmarson, that's utilized on -- as you prepared your flow-duration and depth-duration curves; is that correct?

MR. HJALMARSON: It was one of the factors used to define those, yes.

MR. HOOD: Okay. And what you did is you identified three locations that you would measure: the join, the mouth, and the border; is that right?

MR. HJALMARSON: I used the Krug report for the join and the border -- oh, excuse me -- the join and the mouth.

MR. HOOD: Where did you get -- so where did you get your border?

MR. HJALMARSON: The border was non -- not navigable. It's not really -- it's not really a pertinent location on this -- in this issue. I used the Charleston (indiscernible).

MR. HOOD: Well, we --

MR. HJALMARSON: And I showed you the diagram on how I came up with the total runoff at the Charleston (indiscernible).

MR. HOOD: You do list -- let me see if I can

find it quickly. You did have a slide where you included a cfs for --

MR. HJALMARSON: (Indiscernible.)

MR. HOOD: -- the border as well, correct?

MR. HJALMARSON: Oh, do you want to ask me how I got that number?

MR. HOOD: Sure.

MR. HJALMARSON: Okay. I'll answer that.

I did the total flow computation for the sites, and I made an estimate of the base flow that has been removed. And it was rather easy to do at that site. It is basically -- because it goes down to zero so often now, I added a -- a fourth cfs, which has -- was used by several modelers, including ADWR and the USGS, the Pool -- the Pool model, and so forth. So I simply computed from the total record of the runoff and added 4 cfs, a constant amount for the whole year.

MR. HOOD: Let's go to -- I think Slide 92 would be helpful for this discussion, if you could go back to that.

MALE SPEAKER: (Indiscernible) 92 a little bit.

MR. HOOD: 92, there you go. And so Mexico, that's also referred to as the border in other places in your PowerPoint; is that right?

MR. HJALMARSON: That's right.

MR. HOOD: And the upper is, at times, referred to as the join?

MR. HJALMARSON: Yeah. The runoff from the upper would be at the join.

MR. HOOD: And the lower would be the mouth?

MR. HJALMARSON: That's right.

MR. HOOD: Okay. So you were talking about how you computed the average annual runoff for the cfs for the border, which on page 92 is identified as Mexico.

And where -- I understand -- I think I understand that you added 4 cfs. What was your starting figure, which I guess would be 29 cfs?

MR. HJALMARSON: I -- okay. Let me say it again. I take the -- I computed the flow for the Palominas gauge, the total runoff for the Palominas gauge.

MR. HOOD: Is that from the Krug? Did you take that from Krug?

MR. HJALMARSON: No. No. I didn't use Krug there. I -- and I covered this in the report. If you remember, I made an area adjustment factor for the flow at the Palominas gauge. I corrected it, a small amount, to convert it to Mexico, the border. Okay. I don't know which slide that -- I don't remember right now which slide that is, but I showed the conversion, and the total came out 29. Then I added the 4 cfs base, which is gone, so --

to make it predevelopment. It's an estimate, but it's a pretty darn good way to do it.

MR. HOOD: Where did you get the 4 cfs?

MR. HJALMARSON: I just said that. From -- there's several USGS models that have that. I actually --

MR. HOOD: Can you identify them for us?

MR. HJALMARSON: The Pool model, the ADWR handbook or whatever it is, Number 10, by -- I forget the author's name; it begins with a C. There is two models there.

I can do it myself by using the base flow numbers that I showed -- when I showed the effect of -- of the mines there, pre World War II and post World War II. If I used the pre World War II numbers that are shown there and make an evapotranspiration -- ET adjustment there, it comes out 4. So there's several ways to come to determine the 4.

MR. HOOD: Okay. It sounds like you've covered this, and I haven't maybe quite caught it yet, but just what rounds did you use as your starting flow number that you then adjusted?

MR. HJALMARSON: USGS free-flow records that are on the -- on the Internet.

MR. HOOD: For what years?

MR. HJALMARSON: All.

MR. HOOD: All years. Okay.

MR. HJALMARSON: Now, wait a minute. Hold up. Stop.

I also said, very clearly, there's about ten years missing. And you go to the Boundary and Water Commission, and you'll find all the records there that are available. The USGS says there's no records, when, in fact, they operate -- they get the gauge together with the Boundary and Water Commission, and the Boundary and Water Commission operated it on paper during that period that the USGS says is missing. But, in fact, it's not missing.

And the USGS did the measurements and the record computation during that period, but they didn't publish it. When I discussed this (indiscernible) this was going -- this -- I was aware of things like that. That was my job.

MR. HOOD: Staying on page 92, so your average annual runoff in cfs for the lower, which is -- which is also the mouth, that is based on Krug; is that true?

MR. HJALMARSON: Krug, yes. Yes, with the adjustment that I spent five or six nights on.

MR. HOOD: And the same for the upper, which is the join, that average annual runoff in cfs you calculated using the Krug report?

MR. HJALMARSON: Yeah. The fourth number, the

92, requires no adjustment. The second number involved adding the runoff from the upper to the lower, and making an adjustment for the amount of transpiration of the water that crossed over the lower -- or through the lower. Out of 4,500 cfs was subtracted from the sum of the two runoffs from Krug.

MR. HOOD: So if we turn to page 97, if you would, sir, you plotted -- and I notice the Salt River in that figure. So you have -- you have starting high to the low, and left -- right to left, you have the mouth, you have the join, you have Charleston. As I understand the way -- now, this is to depict annual -- average annual runoff versus drainage area. What you're trying to do here is arrive at an estimated figure for the Charleston gauge; is that right?

MR. HJALMARSON: Yes. I'm creating a -- or estimating a -- a total runoff figure that would be comparable to the two Krug numbers.

MR. HOOD: And so you used the mouth runoff that we just described and discussed from page 92 and the join runoff figure from -- also from page 92, and then there was an extrapolation made on this graph to give you the Charleston point?

MR. HJALMARSON: Yeah, I didn't show the Mexico number there. It's slightly below the dashed line, but I

did -- it would have to come down to the origin there, where runoff -- where the ability to generate is zero, then the runoff has to be zero. So I have two points up above, and I just -- and I -- and this would be a smooth -- a curve. So I just smoothed it in, and I showed it in dashes, and just slightly below that dashed line, which is the Mexico number that is there. But I didn't bother with it. Mentally I just threw it out, because I realized at this point that the upper part wasn't navigable.

MR. HOOD: Let's take it step by step. Just to clarify, what I was getting at with my question is that the Charleston point that's on this graph, that is the function of the graph extrapolating from the join and the mouth data, true?

MR. HJALMARSON: No. That's computed independently, and it's covered. You take -- you compute the total runoff for Charleston and add the 10 cfs base that I showed here, and you get that. So runoff for the total record of Charleston is 52, and you add the 10, and there you are.

MR. HOOD: The point -- I'm not sure we're communicating. The Charleston point that's on here, that's not based on data for Charleston; that's based on the average runoff that you calculated for the join and

the mouth, and then put your graph to arrive at the Charleston point; is that correct?

MR. HJALMARSON: The average runoff for the join and the mouth -- no. Forget the Charleston for the moment.

Just look at the two points and the origin and draw (indiscernible) through that. And I looked at that. And then the Charleston was 52, and I saw it was 10 below. Then I realized from groundwater modeling -- well, let's put it this way: The 290 number from Hydrologic Atlas 664 is 10 at that point, but it's gone because it goes dry. So that -- I knew that 10 was missing, and lo and behold, when I looked at this (indiscernible), the difference is 10. I added the 10, just like I did at the border, and that's what you have. And if we prove remarkably it came out that darn close.

MR. HOOD: Going back to page 92, we have a 92 average annual runoff in cfs for the upper; we have a 113 average annual runoff in cfs for the lower. Those points you plotted on the graph are on page 97, correct?

MR. HJALMARSON: Yeah, they're plotted there.

MR. HOOD: Okay. You did not plot (indiscernible) Charleston as a function of the graph; isn't that right?

MR. HJALMARSON: I did not plot it when I

estimated that group?

MR. HOOD: Correct.

MR. HJALMARSON: That's right. That's what I just said.

MR. HOOD: I just want to make sure that Charleston is that -- this graph is providing that Charleston number. That's not data you input?

MR. HJALMARSON: I drew the graph. The Charleston number was 52. It was 10 below the graph, 10 cfs below the graph. The Hydrologic Atlas 664 showed 10 cfs under predevelopment conditions, that now goes to zero. 10 is missing. I added it to 52, it's 62, and that's on the graph.

MR. HOOD: Okay. And where did the 52.1 come from?

MR. HJALMARSON: The US Geological Survey record at Charleston.

MR. HOOD: In -- from which report?

MR. HJALMARSON: It's on the Internet. It's basic data. Add it up. Go in there and ask the average -- what the average is there.

MR. HOOD: You're here for me today. So I -- I have to ask you where you got from the data, sir.

(Indiscernible - simultaneous speech.)

MR. HJALMARSON: I got -- I just told you, I

got it off the -- it's -- this is really elementary stuff you're asking.

MR. HOOD: Okay. But I'm entitled to understand how you used these numbers.

MR. HJALMARSON: Okay. Well, I -- I've said it three times now.

MR. HOOD: Okay. So these -- okay.

MALE SPEAKER: Is there a web site or --

MR. HJALMARSON: Pardon?

MALE SPEAKER: Is there a web site or someplace specific that somebody could go to to go look at that?

MR. HJALMARSON: Anybody -- just go to the USGS and Arizona District, and it says, Surface water records, and they want the station number, and put in the station number and ask them for the average annual discharge.

MALE SPEAKER: Okay.

MR. HJALMARSON: If it's just up the (indiscernible) just -- I think my granddaughter can do it.

MALE SPEAKER: Because she's got a Ph.D. in it.

MR. HJALMARSON: Yeah, she's better than I am.

MALE SPEAKER: She's smart like that.

MR. HOOD: Mr. Hjalmarson, if you had included the 33 ccfs -- cfs for the border, which is also identified as Mexico, that Charleston point would have --

would not have fit on this graph; is that right?

MR. HJALMARSON: It did -- the curve would have been just slightly different, but that point plots pretty close down there.

MR. HOOD: Did you bother to run a graph using the 33 cfs to see what figure for annual runoff you would get for Charleston?

MR. HJALMARSON: I think I had a computer plot of that, but like I say, once I realized --

MR. HOOD: It's not in here, is it?

MR. HJALMARSON: No, it's not in there. No, I -- you never put all the work you put in on something like this.

MR. HOOD: Um-hmm.

MR. HJALMARSON: I -- I use Minitab. It's a real high-end scientific program for all sorts of statistical analysis and the graphs, and it does everything.

MR. HOOD: Do you remember how much lower the annual -- the average annual runoff at Charleston was in cfs when you used that Mexico depth?

MR. HJALMARSON: It doesn't matter.

MR. HOOD: That's not my question, sir.

MR. HJALMARSON: I don't care. I'm -- I'm not going to answer that because you're not listening to me.

I independently computed the border. I independently computed Charleston. Had I seen this graph or not, I knew that Charleston now went to no flow. I knew that the base flow that was in HA-664 was 10, and I knew that is missing. I would have added to that and then found a new number and then drawn the graph. So you're going -- you're using circular logic here, and I don't think you understand what -- what this (indiscernible). Now, I've explained it several times, and that's about as good as I can do.

MR. HOOD: Okay. I just want to make sure you understand my question. And if you're not going to answer me, say it again, and we'll have it on the record.

My question to you is -- because you said -- you did a graph that included the Mexico data. And I want to know if you recall -- if you don't, you don't -- but do you recall how much lower the average annual runoff for Charleston was when you used that data, instead of omitting it from the graph?

MR. HJALMARSON: I never used it to determine Charleston.

MR. HOOD: You told me earlier you ran a graph with the Mexico data and that you did not include it in your report.

MR. HJALMARSON: I -- I --

MR. HOOD: And I'm asking you if you remember --

MR. HJALMARSON: I never -- I never did -- did it to estimate Charleston. I realized in this process, where I was doing several different kinds of computations, that it was not navigable above there, and I just discarded it and focused on Charleston.

MR. HOOD: Not navigable because the depths between the border and the point at which you say navigation began, the depths were too low, correct?

MR. HJALMARSON: Yeah. It was less than one. I didn't even go for the other criteria of a half, which I could have, because the (indiscernible) report has that. But that -- I was holding this at a higher level. And so, yes, it was below water.

MR. HOOD: So the data that you omitted related to a portion of the river where the depth was so low and the average annual runoff corresponding to that depth was commensurately low, and you don't know how that would have impacted the graph and how that depth (indiscernible) Charleston (indiscernible)?

MR. HJALMARSON: What I'm telling you is that it doesn't mean anything.

MR. HOOD: That's not my question.

MR. HJALMARSON: I don't care. That's my

answer.

CHAIRMAN NOBLE: Win, you're going to have to kind of do the best you can to answer the questions.

MR. HJALMARSON: I -- it's irrelevant.

CHAIRMAN NOBLE: That's not your decision.

MR. HJALMARSON: I did not make an estimate of the Charleston. I didn't even consider it for my graph.

Does that answer it?

MR. HOOD: At the point where you have your Charleston documented on this graph, where you did include the 33 cfs, how did that alter the curve at that point where Charleston is? How much lower would it have been?

MR. HJALMARSON: I didn't even compare it. I can eyeball it right from here, you know, about 700 and -- and -- it's awful close.

If I included that to -- let me answer it real quick -- I want to finish this. If I had included those two points, Charleston and the Mexican border, and I was going to draw a curve, I'd probably let both points influence it, or possibly I would have drawn the curve right through -- right through there, you know, and make a little dog leg in it. But generally -- curves like this generally are pretty smooth, so that was kind of the basis for this.

But, you know, well, that -- if I had multiple

points here, I would have run a statistical (indiscernible) for him, using -- this would be a quadratic equation, and I'd use a plot program and -- and let the computer run it through.

MR. HOOD: May I approach?

CHAIRMAN NOBLE: Yes.

MR. HOOD: This is a graph that Mr. Patel prepared, noting your omission of the Mexico data. And you'll see that when the graph is calculated, the average annual runoff where the Charleston gauge lies is 55 cfs, instead of 62. Do you see that? According to this graph.

MR. HJALMARSON: I see the 55, yeah.

MR. HOOD: Okay.

MR. HJALMARSON: Where did it go?

MR. HOOD: But as I understand your testimony, you didn't do this? You didn't draw -- you didn't draw a similar graph using the Mexico data?

MR. HJALMARSON: Look. What I'm looking at is --

MR. HOOD: That's all I'm asking is if you did this or not.

MR. HJALMARSON: I didn't do it, because it's nuts. You're plot -- you're plotting two different kinds of data on the same graph. You're plotting a Charleston that is not a -- it's not predevelopment. It's not a

predevelopment number, and you're plotting the other two points which are. It's nuts.

MR. HOOD: Your Mexico number, 33 cfs, is not a predevelopment number?

MR. HJALMARSON: It's not what?

MR. HOOD: Is not a -- are you saying, by your last answer, that your 33 cfs figure for annual -- average annual runoff for Mexico, that that is not predevelopment, adjusted?

MR. HJALMARSON: It would be a -- yes, that would be a predevelopment -- that would be a predevelopment, yes. It's important to keep in mind that both that number and the Charleston are estimates, but it's a pretty sound estimate.

MR. HOOD: You have a statement on page 107. You can pull it up, if that's easier.

MALE SPEAKER: 107, okay.

MR. HJALMARSON: That one?

MR. HOOD: No. 107.

MR. HJALMARSON: Is that -- is --

MR. HOOD: What I have for 107, it begins: The Leopold Goldman Association (phonetic).

MR. HJALMARSON: Oh, okay. Let's see. I'd like to talk about (indiscernible).

MR. HOOD: No. Actually, I wouldn't.

MR. HJALMARSON: Okay. I didn't complete that (indiscernible).

MR. HOOD: 107, not 137. Okay.

(Indiscernible.)

There's a statement there, it's about halfway down that says (indiscernible) marshy cienegas reportedly were along the river from Mexico to the mouth at the Gila River, and you have a citation there to (indiscernible) and Elmore, and I just wanted -- I want to ask, Is it your opinion that the San Pedro River, from Mexico to its confluence with the U.S. in predevelopment conditions, was, in fact, a marshy cienega throughout its reach?

MR. HJALMARSON: No. There was a series of springs, which are cienegas. And in this climate they tend to be marshes. They can also have ponds and so forth. There is not a continuous, let's say, ring line. It was spotty all the way down.

And by the way, since you brought that up, they were -- they've been documented by the Arizona Geological Survey, and I think others, for -- there's this dark soil up on the top of the crust on these vertical banks that are out there now, and they go all the way from Mexico all the way down to these spots. That's carbon -- carbonized material that's developed from an oxygen-starved environment from saturated soil, i.e., cienegas. And if

you age date that stuff and it shows that it was there for a long time before the head cutting started. In other words, this was a very stable river for a long period of time before about 1850.

And in my appendix that's described. You want to see that?

MR. HOOD: No.

May I approach?

CHAIRMAN NOBLE: Yes.

MR. HOOD: I've handed you a map. It's the Hendrickson and Minckley (indiscernible) map, and the map on the far right side, this was actually part of a report that's previously in the record. I believe it's Exhibit 4 to the existing record, developed ten years ago or more, and it's actually --

MR. HJALMARSON: (Indiscernible.)

MR. HOOD: It's a (indiscernible).

MR. HJALMARSON: It's what?

MR. HOOD: It was an exhibit entered by the center in DO-3 or whatever --

MR. HJALMARSON: Center of who?

MR. HOOD: Your -- your client.

MR. HJALMARSON: Oh, oh, my client entered it. Okay.

MR. HOOD: And this just illustrates sort of

what you've talked about. You'll see the cienega, river, and marsh designation in the legend.

MR. HJALMARSON: Yeah.

MR. HOOD: And it does show that the cienega, river, and marsh conditions in -- are continuous, right, which is consistent with what you just said?

MR. HJALMARSON: Okay. But now -- okay. Okay. I see what it's like, yeah.

MR. HOOD: Okay. And it -- isn't it true that this map also shows that we do not have a perennial flow throughout some of those portions north of where the main cienega portions end, that those are in static (indiscernible)?

MR. HJALMARSON: It does appear that. It's -- the copy -- I kind of question the copy, but it does seem -- seem to show that. My eyes are getting tired.

MR. HOOD: Let's -- and that's all we need with that map. Let's go to -- let's go to your width equations. I believe we want to go to page 117.

MR. HJALMARSON: 107?

MR. HOOD: 117.

MR. HJALMARSON: 117, okay.

MR. HOOD: Okay. And is it true that this is the -- you discuss that this is -- this equation was developed by (indiscernible)?

MR. HJALMARSON: No. Well, not -- not, per se. What you do is you work with the material at hand to set them up, and -- and Ostergram, Wade Ostergram, who is our -- a friend studied -- studied this stuff most of his career. He's an internationally known expert on it. And he developed the methodology, and I just applied the methodology. So what I used --

MR. HOOD: And by the way -- sorry.

MR. HJALMARSON: I used methods that he developed, yes.

MR. HOOD: Right. And by "methodology," you're referring specifically to his equation?

MR. HJALMARSON: I'm referring to what goes into this equation. Using his methodology, you'll get this equation.

MR. HOOD: Did you get the equation from Ostergram, or is it a methodology that you created --

MR. HJALMARSON: I used that reference and then applied that material to it. And you'll come up with (indiscernible) coefficient.

MR. HOOD: So Q is discharge, W is width, and so basically Q discharge to the .57 times 3.01 will give you width, that's basically the way you -- the way it works?

MR. HJALMARSON: That's right.

MR. HOOD: Okay. And you applied that equation for -- for the join and the mouth; is that right?

MR. HJALMARSON: Yes. I used that for the -- well, no. Look, I applied it at Charleston. Did you want -- they both end (indiscernible) and the mid point. I applied it for all three points.

MR. HOOD: I just want to make sure we're clear on what those points are. Is that Charleston, the join, and the mouth?

MR. HJALMARSON: That's what I said.

MR. HOOD: Did you -- I didn't see it in here, I may have missed it -- did anywhere in your PowerPoint or your appendices, did you run some equations using real San Pedro data to see if this equation was applicable, whether it works?

MR. HJALMARSON: Okay. This is for predevelopment. Do you -- do you understand? It's predevelopment. I chose the only measured widths done by the federal land surveyors in 1878, I think if that's the date, real close. The federal land surveyors did it. They had 64 boundaries on cross sections. They were doing township -- township and range survey, and they were surveying both the square mile areas. And where those lines, should the line cross the river, they measured the width, which most -- in most cases would be skewed to the

true width of the river. I showed that diagram.

And so I compared the width computed in this equation with those measured widths. I showed the equation that relates to predevelopment, but I didn't do an adjustment. But you can eyeball it -- if you know anything about trigonometry, you the -- that you can eyeball that and see that, hey, that's not -- that's not bad (indiscernible). But I also said that I don't know how good those survey widths were because effects of humans started to (indiscernible) in 1850, and this was 28 years -- or yeah, 28 years later. So I don't know the impact that that had on this. So I -- and I clearly qualified that. So this is the best I can do in applying the scientific method.

MR. HOOD: The widths that were measured at the section lines, those were channel widths, correct?

MR. HJALMARSON: Correct.

MR. HOOD: And your W here is for stream width, not channel width?

MR. HJALMARSON: Yes. Let's go to that relation. I'm -- I'm -- I don't want to -- I don't want to, you know -- let's see, where the heck was it? Oh, okay. That's coming up right here.

MR. HOOD: It was page (indiscernible).

MR. HJALMARSON: Well, I've got it coming up.

Well, here, let's explain it right here. Up at the top is -- is WS (indiscernible) it says W (indiscernible).

MALE SPEAKER: Can you expand that?

MR. HOOD: Make it bigger so we can see it.

MR. HJALMARSON: Oh, I'm sorry.

MR. HOOD: That's fine.

MR. HJALMARSON: I got too many things to do here.

CHAIRMAN NOBLE: Thanks.

MR. HJALMARSON: Well, he's starting to tire me out by going back and forth to all of this stuff.

MALE SPEAKER: (Indiscernible) ask that.

MR. HJALMARSON: Okay. Let me -- I've had trigonometry -- it might have been in high school. It's better to ask if those (indiscernible) than failure. Failure is the angle of incidence of the river to the section line, okay? So you can see, WS is what they surveyed, and what I compute is W. My computation is typically going to be more, unless the river happens to cross the section line perpendicular to the section line, and then they'll be the same, okay? So all I'm doing is -- is showing one of -- the final steps of the scientific method, the steps you do before you actually start applying whatever you created using the method -- equations or whatever.

In other words, I hypothesized that the San Pedro River behaved like a typical alluvial channel river. I applied that hypotheses using Ostergram's method, and then I compared it to the best measurements of channel width that I knew of. And that's what you're looking at here, and that's the final step of the (indiscernible) method (indiscernible) you continue applying is what's whatever you created, and that's what I did.

MR. HOOD: And then equation 2 is the depth equation, and just very briefly, that depth equation --

MR. HJALMARSON: What page -- what page?

MR. HOOD: If you go to 123 it's as good as any other exhibit.

MR. HJALMARSON: 113?

MR. HOOD: 123.

MR. HJALMARSON: Oh, 123. Yeah.

MR. HOOD: And I'm asking you the question, just for the record. It's not because I misunderstood your testimony before or your report's not clear. I just want -- I just want to say this, the depth equation here is a function of the Q and W figures that you arrived at previously, which we've already talked about, right? You're getting those figures and you're using them in your depth equation?

MR. HJALMARSON: Yeah. The way the hydraulic geometry or the gene theory -- this all comes from British engineers who designed canals, right? They developed the Eugene theory and then they -- this evolved from it, and then it started to be applied to rivers. And then the geomorphologists came along, and they called it grading -- grading condition. And they came in from both directions, and lo and behold, they got the same thing. So that's all I'm doing. And so they found that (indiscernible) depth and velocity are related to discharge, like I'm showing here, but in a unique way.

MR. HOOD: The Q and the W figures that you arrived at previously, we discussed how you did that. You use those as functions of your depth equations, true?

MR. HJALMARSON: You estimate -- yes, you estimate width first and then the other two estimates follow, yes. And there's several ways to do that, and they all come out very, very, very close.

MR. HOOD: And the depth that you get is for the channel invert, which is the deepest part of the channel, correct?

MR. HJALMARSON: Yes.

MR. HOOD: And this equation assumes a parabolic channel, correct?

MR. HJALMARSON: It's very -- it's very close

to a parabola, and this equation I'm using here is one that Bill Bertham (phonetic) derived. He's an ex-USGS guy and worked a lot with this type of stuff. And he determined that this was very close to a parabola, yes. I gave the reference to his report. It's basically (indiscernible) equations with an adjustment for the hydraulic radius, is all it is.

MR. HOOD: Let's go to page 111. Okay. Here's a channel cross section, and I don't remember, did you draw this in (indiscernible) full report?

MR. HJALMARSON: No. I think I might have borrowed that out of a USGS (indiscernible) where they -- I think it came out of some circular in the USGS that I removed, something that's been in my files for 50 years.

MR. HOOD: When you talked about certain channel contacts as being very close to a parabola, would this be indicative of that?

MR. HJALMARSON: Not really, no.

MR. HOOD: This is not very parabolic? It's irregular, you have very different depths throughout its course?

MR. HJALMARSON: Not really. What this demonstrates is how the width and the average depth are determined. You could -- you could use -- yeah, this shows how it's determined, and then it shows how the

maximum depth is related to (indiscernible). All it is a demonstration of -- of what average depth means.

MR. HOOD: Let's go to 157, please.

MR. HJALMARSON: 127?

MR. HOOD: 157.

MR. HJALMARSON: Oh, 157, okay.

MR. HOOD: Okay. And you referenced this during your presentation, Mr. Hjalmarson, and you said this was not of San Pedro. Do you know where this photo was taken?

MR. HJALMARSON: No. I -- I said these are cartoons, and I said that in the upcoming slides that show the river are not the San Pedro. I made a point to make that real clear. This is just to demonstrate what (indiscernible) might be like, and the little cartoon with the beaver in the road, that's -- that shows that, hey, there could be 500 or more of these dams along the river. That's the way beavers make dams.

MR. HOOD: No. I understood for your presentation -- I just had to (indiscernible). I was just curious if you knew where it was taken. I --

MR. HJALMARSON: No, I -- I don't. I'm careful not to remove anything copyrighted, but I -- I really don't remember. I think -- there's a whole lot of national parks that are stuck out there. And, you know,

they charge fees for people to come in and use these little creeks with beaver dams on them to build their canoes and so forth. So when you charge a fee, you've kind of got a promotional activity.

MR. HOOD: If we go to 162, 162. Can we go to 162? That's it. This is the slide we were talking about in 2008. There was a good monsoon that took out all of the dams. Coincidentally, that's the same year, the same monsoon that relates to the picture we talked about before with the person canoeing in July of 2008, correct?

MR. HJALMARSON: It could be, yeah. I -- pardon?

MR. HOOD: Make it larger.

MR. HJALMARSON: Oh, I'm sorry.

CHAIRMAN NOBLE: Thank you.

MR. HOOD: I think I'm down to my last question that may require a little bit of back and forth between us. But I just have one question, there might be applause --

MR. HJALMARSON: Well --

MR. HOOD: -- (indiscernible) that I just talk to you, I understand.

(Indiscernible - simultaneous speech.)

MR. HJALMARSON: I'm starting to enjoy this. Please don't stop.

MR. HOOD: I do have about ten more pages, but I think everybody's (indiscernible). (Indiscernible) I just have one quick question, and I think it's a simple question. I hope (indiscernible). Why did you -- we have -- we have hydrological cataloging unit 15050202, and then below that we have 203. In the average per unit, why didn't you use that .18 for the mouth, instead of going to the calculations that you did?

MR. HJALMARSON: That's runoff in inches.

MR. HOOD: That's what, I'm sorry?

MR. HJALMARSON: The .18, what's up at the top there? What -- what is the unit called? What does it say, log, and then it says inches. I used cfs and acre feet.

MR. HOOD: Well, why did you convert?

(Indiscernible - simultaneous speech.)

MR. HJALMARSON: I did.

MR. HOOD: But you used this figure.

MR. HJALMARSON: Using your gauge area, multiplying (indiscernible) if it's converted to feet, divided by 640, and you've got acre feet, 21.

MR. HOOD: I'm just asking you if you used that figure, the .18 as a starting point?

MR. HJALMARSON: Sure.

MR. HOOD: You did?

MR. HJALMARSON: Yeah. Well, wait a minute. You've got to be careful here, because the way some of these -- there might -- there might -- I did -- and my deal was on one of the other -- either this one or the -- the base load, there's -- it included part of (indiscernible) and beyond (indiscernible), and I -- I had to make -- there was an adjustment made there. So that if that wasn't there, then, yes, I used this.

MR. HOOD: Mr. Hjalmarson, thank you for your time and your patience. That's all I have. And thank you, Commissioners.

MALE SPEAKER: I actually have one question for you, if that's okay. And this is for counsel, not for the witness.

MR. HJALMARSON: Oh, thank you.

CHAIRMAN NOBLE: We want to have questions for Mr. Hood.

MALE SPEAKER: But a simple question here, this exhibit of Hendrickson and McKinley --

MR. HOOD: Minckley.

MALE SPEAKER: -- or Minckley, I'm sorry. I know we're not following the rules of evidence, specifically. But just a little bit more foundation on it. So I'm just curious about where this came from and -- and I know (indiscernible) if there's anything

(indiscernible).

MR. HOOD: You know, it -- this does tie into some of the other mapping that's been done on the San Pedro. And I was planning to get into that in more detail where Mr. Patel.

MALE SPEAKER: Okay.

MR. HOOD: And so it -- that'll be my request is if we can handle that there. But this is in our -- this is in the record. It was used in the last round of hearings, and so it's not really breaking new ground.

MALE SPEAKER: (Indiscernible.)

MALE SPEAKER: Oh, sure, yeah, and any of the documents that you've -- that you've used today, as long as we can get those today or -- it would be great to get them today, if we could.

MR. HOOD: Here's my plan. I've got copies of everything that I've used, and I'll turn those in. And I wanted -- I intended to bring electronic copies as well, because I wasn't sure exactly what I'd end up using, and I didn't want you to have a bunch of documents I ended up not using, so I will get you that very early next week.

CHAIRMAN NOBLE: Just so you know, and again, the record is open.

MR. HOOD: Okay. I'm glad that it's open. Thank you very much. I appreciate it.

CHAIRMAN NOBLE: Mr. McGinnis?

MR. HJALMARSON: Here's your stuff. Mr. Hood, right here.

CHAIRMAN NOBLE: Good afternoon, Mr. McGinnis.

MR. McGINNIS: Good afternoon.

(Indiscernible - simultaneous speech.)

MALE SPEAKER: We know that you've memorized and submitted to memory all of Mr. Hood's questions, and that you will not be asking repetitive questions.

MR. McGINNIS: I think that's a pretty safe bet. (Indiscernible), especially (indiscernible) navigability -- the guy in the canoe in the navigability test.

MR. HJALMARSON: (Indiscernible.)

MR. McGINNIS: All right. Good afternoon, Mr. Hjalmarson.

MR. HJALMARSON: Good afternoon, (indiscernible).

MR. McGINNIS: You and I have been through this current process a couple times before, right?

MR. HJALMARSON: Yes.

MR. McGINNIS: Once -- once on the same side, at least, and once on the other side, right?

MR. HJALMARSON: Yes.

MR. McGINNIS: Okay.

MR. HJALMARSON: I liked you both times.

MR. McGINNIS: Good. Well, hopefully you'll still feel the same way in a couple hours.

MALE SPEAKER: My hearing's a little bad. Did you say you liked him both times?

MR. HJALMARSON: Yeah, he's a good guy.

MR. McGINNIS: Sir, I only mention that because I am certain that some of you probably in the next five minutes -- I'm going to start referring to you as Win, instead of Mr. Hjalmarson.

MR. HJALMARSON: That --

MR. McGINNIS: I want to make sure that's -- you know, that's not familiarity, and not from contempt.

MR. HJALMARSON: That's brilliant.

MR. McGINNIS: Okay. You've talked a little bit this morning about how you came to be here to testify today.

MR. HJALMARSON: Yes.

MR. McGINNIS: Can you tell me some -- tell me some more about that, how that's -- the initial conversation with Mr. Fuller, I guess; is that right?

MR. HJALMARSON: That's my general memory. I became aware that there wasn't going to be a representative -- a hydrologist here or an engineer arguing for the river. And I had fair idea that it might

be navigable. However, when I started this process, I didn't know. But I do communicate -- I communicate with several people all -- all the time, including, you know, you guys or SRP guys. And that's kind of the way my memory goes.

But I do seem to remember learning that Mr. Fuller wasn't going to do this, and I told him I will help -- I will tell you where some information was, that kind of stuff. Being a USGS guy, I know where all the data are. So I offered to do that if he needed it, you know, if he needed assistance.

The next thing I know, I'm getting drawn into this thing. We discussed it at our club, and our president calls Joy, and she says, Hey, why don't you call Joy? And the next thing I knew I was working for her.

MR. McGINNIS: So I guess what I was trying to get at is what caused you to come here on behalf of Ms. Herr-Cardillo and her clients, as opposed to just showing up as Win Hjalmarson, concerned citizen about the San Pedro?

MR. HJALMARSON: I'm thrown up here as an interested citizen, who is capable of analyzing this and just as, let's say, a public person. So, like, Arizona Center for Law in the Public Interest, I'm here kind of in the public interest.

MALE SPEAKER: I'm sorry. I didn't understand your last remark. Would you repeat it? I couldn't hear you.

MR. HJALMARSON: I'm here as kind of a public person. In other words, as in Arizona Center for Law in the Public Interest, I'm here as a public person, representative, saying in the public interest. The (indiscernible) the RCA has an interest in Arizona rivers.

MR. McGINNIS: So you're testifying as Win Hjalmarson, or you're testifying on behalf of Arizona Center for Law in the Public Interest, or you're testifying on behalf of the clients at Arizona Center for Law in the Public Interest?

MR. HJALMARSON: Well, yeah, I'm aware of the -- yeah, who they're working for. But I'm -- I feel like I'm working for Joy and the Arizona Center for Law in the Public Interest. I've never met a defender of wildlife person in regard to this case, and I'm not a member of any environmental group or whatever.

MR. McGINNIS: I'd like to do kind of what Mr. Hood did with you and go through your slides. Hopefully I'll talk about different ones than he talked about, and won't be back over the same.

MR. HJALMARSON: Wait a minute, talk about what?

MR. McGINNIS: Hopefully I'll talk -- I want to go back and talk about some of your slides in your PowerPoint.

MR. HJALMARSON: Okay.

MR. McGINNIS: The way Mr. Hood did with you for the last hour or two.

MR. HJALMARSON: Yeah.

MR. McGINNIS: Hopefully I'll talk about different slides than the ones he talked about, and we won't go back to the same ones, but I might.

MR. HJALMARSON: Good.

MR. McGINNIS: Okay?

MR. HJALMARSON: But --

MR. McGINNIS: Sorry.

MR. HJALMARSON: Go ahead.

MR. McGINNIS: Let's start with Slide -- Slide Number 5. I refer to Mr. -- to Dr. -- I'm sorry, it's not my number 5. Is that your number 5 (indiscernible)? Here we go.

Can you all see it? Can you see the slide, or have you got it memorized by now?

MALE SPEAKER: It needs to be full size.

MR. McGINNIS: Okay. In this slide you refer to Stanley Schumm; is that correct?

MR. HJALMARSON: Yeah.

MR. McGINNIS: Okay. And you're familiar with Dr. Schumm, who was a geomorphologist?

MR. HJALMARSON: I know -- I know Dr. -- we were friends of Dr. Schumm. He goes by Stan, but his friends call him Charlie. I called him Charlie.

MR. McGINNIS: Okay. And you're aware that he's no longer arrive, right?

MR. HJALMARSON: Oh, yeah, I'm aware of that.

MR. McGINNIS: And you didn't work with Dr. Schumm on this report for this river, did you?

MR. HJALMARSON: No. In fact, I never saw the report that he did working for you.

MR. McGINNIS: Okay. As a matter of fact, you did -- you did testify before this Commission once before on the Gila River, right?

MR. HJALMARSON: Yes.

MR. McGINNIS: And in that situation you testified that the Gila River was navigable on behalf of Maricopa or the Flood Control District; is that correct?

MR. HJALMARSON: That's correct.

MR. McGINNIS: And Dr. Schumm had wrote this book upon which you now rely, and testified that that river was non-navigable.

MR. HJALMARSON: Dr. Schumm was using a different set of rules. The State has changed the rules.

MR. McGINNIS: Okay. And my question was, Dr. Schumm testified in the same proceeding you testified in, that the Gila River was navigable, he testified that it was not navigable; isn't that correct? It's --

MR. HJALMARSON: Yes. Okay. I see your point.

MR. McGINNIS: So the two of you disagreed on the Gila River, at least, right?

MR. HJALMARSON: I used these rules that are being used now.

MR. McGINNIS: Okay.

MR. HJALMARSON: I worked for an attorney who knew we would be here some day.

MR. McGINNIS: Dr. Schumm testified that the Gila River was non-navigable, and you testified that the Gila River was navigable, correct?

MR. HJALMARSON: I -- I -- that's correct, but I was using different rules, and you'd have to compare the reports to see why we testified differently.

MR. McGINNIS: Okay. Did you use the same type of analysis in doing this work on the San Pedro River that you used on the work you did on the Gila River for Mr. Helm (phonetic) and his firm with the county?

MR. HJALMARSON: Yes. I didn't start out thinking that, but I figured that -- that if the historic accounts weren't truly of predevelopment conditions, then

this was definitely the best way to go, that there was a good solid set of historic accounts that were not affected by diversions and -- and the cattle and all of this kind of stuff, I would have leaned strongly in that area, and it would have been a lot less work. But because nothing existed, this is the way to do it, in my opinion.

MR. McGINNIS: But you -- I'm sorry. I didn't mean to cut you off.

You would agree with me that there are some historical accounts from the San Pedro from, say, the 1850s, right?

MR. HJALMARSON: The post 1850s, yes, there are -- there's a couple of -- yes, there's several accounts, yeah.

MR. McGINNIS: But you think that's not far back enough; is that the problem?

MR. HJALMARSON: That's exactly right. Yeah. It goes like -- it kind of goes like this: I'm not absolutely sure they weren't diverting up there. For example, we submitted a supplement of the report I did on a flood (indiscernible) Benson, that I -- that's -- I published in a white paper publication. It was a tributary to the San Pedro, and it showed unbelievable amounts of sediment in one area and nothing in another area for a storm way up in the mountains. It showed

channels completely filling full-blown (indiscernible) culverts and everything. No -- no water was going underneath the bridges or anything, on the highway and so forth. And that is an example of the kind of disequilibrium that has been occurring here because of what happened.

And this is in a general area, for example, where the Mexicans were coming over from Tucson Presidio, under armed guard -- the (indiscernible) was so good along the San Pedro, they would risk their lives coming over to farm and then haul their produce back to Tucson. And so it was right in this general area. So they would be boating in that area, in 1830.

MR. McGINNIS: So how far back do you think you'd have to go in the San Pedro to get back to its ordinary and natural condition?

MR. HJALMARSON: Well, I covered that at the beginning here. You definitely go back before 1850. And it starts -- things start to trail off there. The Mexicans had a lot of cattle when they won their independence from Spain. So around 1820, '21, it looks like the cattle increased, from what I've read.

MR. McGINNIS: Did -- so were there cattle there before 1820?

MR. HJALMARSON: Yes, there were. The Spanish

had them too, and you know, the Spanish came in and built a whole lot of ranches, and they built ranches with the (indiscernible) on them. And so that's taking water from the river.

MR. McGINNIS: Well, how far -- how far back did the Spanish cattle go (indiscernible)?

MR. HJALMARSON: I think I said 1697, possibly.

MR. McGINNIS: Is there any empirical data from 1697 about anything?

MR. HJALMARSON: I have no -- I don't have a clue and -- well, I don't -- I don't know.

MR. McGINNIS: So there's no way for you to go pull a record from something that came to the US Geological Survey and find out anything about the San Pedro River from 18 -- 1697 or -- is that correct?

MR. HJALMARSON: Well, the geological survey started in 1888.

MR. McGINNIS: So there's no government records that you know of about the San Pedro River before 1697, right?

MR. HJALMARSON: No. That's right.

MR. McGINNIS: Okay. So every -- if you say 1697 is the date we have to use to go back to ordinary and natural conditions, there's no empirical way to do that?

MR. HJALMARSON: No, no. I haven't gone --

what I've said is the method I've used doesn't really matter whether -- whether -- you know, what it is, providing that the (indiscernible) of humans wasn't very great. And it -- from all accounts, what you have to do is rely on -- let's say I just got through talking about cienegas and the carbonaceous material up there, and blah, blah, blah, and that shows a very stable condition up to a certain point, and people have dated that.

MR. McGINNIS: So is time and human impacts irrelevant for purposes of your analysis?

MR. HJALMARSON: No. I'm just describing time -- time to you. I just -- I just said that. I said they dated it. That's a time, Mark.

MR. McGINNIS: Okay.

MR. HJALMARSON: And -- and so -- there is a time established there for a period, and if you read --

MR. McGINNIS: So let's assume -- I'm sorry, go ahead (indiscernible).

MR. HJALMARSON: Well, yeah. Let's go back to this. These are the simple guidelines that they took the trouble to write for us because they knew we would be into this -- what we're talking about.

MR. McGINNIS: Okay.

MR. HJALMARSON: And they said 1850 for sure there were effects by humans.

MR. McGINNIS: Okay. But you said it's 1697, the date (indiscernible).

MR. HJALMARSON: I said (indiscernible) back there, because there's -- the history here is kind of wild and crazy. It's a lot different than most of -- well, the Santa Cruz and the (indiscernible) whether it was early settlement. (Indiscernible) the settlers didn't come in. And in those days they couldn't come in because the Apaches would kill them, you know? So there's hardly any history in the (indiscernible).

And so in this particular areas, because it's so close to Mexico and Spain controlled it, they -- they came up in it and raised cattle and all that kind of stuff, way back.

MR. McGINNIS: So there's no way to empirically go back far enough on the San Pedro to get some empirical data about the San Pedro in its ordinary and natural condition, right?

MR. HJALMARSON: We can only see it through a geomorphologist's eyes. What the people at Arizona Geological Survey have done, the author of this paper, there's -- there's a handful of experts out there that that could paint a pretty good picture for you. I'm not one of them, but I communicate along with them.

MR. McGINNIS: And you haven't cited of those

people in this report that you got the information from?

MR. HJALMARSON: Sure I have. They're all over the -- yeah, here's one, Mark --

(Indiscernible - simultaneous speech.)

MR. HJALMARSON: This is one right here.

MR. McGINNIS: Again, I'm asking about -- I'm asking about empirical data from before 1697. Is there any of that in this document that -- (indiscernible) with?

MR. HJALMARSON: No, none.

MR. McGINNIS: Look over to the next -- your next slide, Slide 6, if you could. And I know you talked about this a little bit, so I'll try to be brief.

At the bottom of that, you see where it says -- this is Slide 6 of your PowerPoint presentation -- however, much of the State report doesn't really lend itself to the present analysis. Do you see that?

MR. HJALMARSON: Yes.

MR. McGINNIS: I know you're talking about the 1997 and 2004 versions of the report prepared by CH2M Hill for the State Land Department, which was presented to the Commission, right?

MR. HJALMARSON: That's the state report, yes.

MR. McGINNIS: Okay. And that report, you would agree with me, though, has quite a bit of factual information that would be helpful to the Commission still,

right?

MR. HJALMARSON: Yes. And I said that.

MR. McGINNIS: Okay.

MR. HJALMARSON: So yes.

MR. McGINNIS: So when you say much of the state report doesn't really lend itself to the present analysis, you don't mean it's worthless?

MR. HJALMARSON: No. I said much of it -- much of it doesn't pertain to the new law.

MR. McGINNIS: But much of it does?

MR. HJALMARSON: Yes.

MR. McGINNIS: Okay.

MR. HJALMARSON: Yes, absolutely. In fact, Mark, I referred to it in this report.

MR. McGINNIS: Well, I thought you had, and that's why that statement is surprising a little bit. Okay.

If you could flip over to Slide 7, about two-thirds of the way down there, there's a sentence that starts, "The available information in the State report." Do you see that, maybe halfway down?

MR. HJALMARSON: Yes, yes.

MR. McGINNIS: And in view of that statement it says, Much of the change probably resulted from human activity going back 300 years or more, even to 1697.

MR. HJALMARSON: Yes. That's -- that's a possibility.

MR. McGINNIS: That's what we were just talking about, right?

MR. HJALMARSON: Yes, that's right. Look at -- look at the (indiscernible).

MR. McGINNIS: You would agree with me, though, wouldn't you, that a substantial portion of the change in the San Pedro occurred in the late 1800s?

MR. HJALMARSON: Yes. And I (indiscernible) pulled this up and I said, I believe what they say here. 1850 is when it really got significant.

MR. McGINNIS: Okay. But a portion of this Arroyo cutting and incision that you talk about in your report that happened in the late 1800s, was likely caused by factors other than human activity, wasn't it?

MR. HJALMARSON: Some of it was. And what the -- what they had said here was, hey, we don't -- we suggest you guys really not get into a battle about this. Here's what -- here's what we suggest -- and these are the experts, the scientists.

MR. McGINNIS: Okay. But if we're trying to figure out if the San Pedro River's navigability in its ordinary and natural condition, don't you think the Commission has to figure that out -- has to figure out

whether these changes you're talking about were human caused or whether they were naturally occurring?

MR. HJALMARSON: Once you start having human causes that start to become significant, then you're no longer in predevelopment. So it's a moot -- it's a moot point. The logic would -- fails -- fails to hit me.

MR. McGINNIS: But if the cause was a big earthquake, for example, and not necessarily human causes --

MR. HJALMARSON: Yeah, the earthquake --

MR. McGINNIS: Let me finish my question, and I'll let you finish your answer.

MR. HJALMARSON: Okay.

MR. McGINNIS: If the cause of changes in the river was caused -- was a big earthquake, instead of something else --

MR. HJALMARSON: Right.

MR. McGINNIS: -- that was human caused, that would likely be the natural condition, wouldn't it?

MR. HJALMARSON: Part of the problem with an earthquake could be if there was human activity and it affected it there, it's kind of, you know, the chicken and the egg. Which was -- which was human caused and which wasn't?

MR. McGINNIS: There was a big earthquake --

MR. HJALMARSON: But the earthquake would be a natural -- no. Now, wait a minute. Earthquakes can be caused by dewatering.

MR. McGINNIS: Okay. Assuming this is a naturally caused -- earthquakes do occur by -- earthquakes do occur for reasons other than human causation, don't they?

MR. HJALMARSON: They can occur -- most of them occur naturally. But they occur by dewatering too.

MR. McGINNIS: You're familiar there was a big earthquake in the San Pedro in the 1880s 1890s, right?

MR. HJALMARSON: I certainly am. I showed it on my chart, one of my first slides.

MR. McGINNIS: Do you know the cause of that earthquake?

MR. HJALMARSON: Nature.

MR. McGINNIS: So that would be a natural condition that had effect on the river itself, right?

MR. HJALMARSON: It had -- yes, it had a higher degree of a small effect.

MR. McGINNIS: Okay. You would agree with me though that -- wouldn't you, that there are some scientists who believe that the earthquake was maybe the substantial causation -- part of the factor of the incise -- incision of the San Pedro River. Can you agree

with that, there's some people that think that?

MR. HJALMARSON: I'm not really aware, but I've heard that there is some kind of debate, but I -- I listen to people I consider reliable, and they -- they don't talk like that.

MR. McGINNIS: Okay. Flip over to Slide 9. We're going to actually skip one --

MR. HJALMARSON: Okay.

MR. McGINNIS: -- which should make these guys happy. Slide 9, the first part there, you say, even in 1697, the San Pedro Valley was crisscrossed by irrigation ditches and had irrigated fields in which cotton, squash, watermelon, beans, and corn were growing. Do you see that?

MR. HJALMARSON: Yeah. That's where I used the state report.

MR. McGINNIS: Right. You cited the Fuller -- the CH -- what was in the CH2M Hill report, right?

MR. HJALMARSON: Yeah.

MR. McGINNIS: Okay.

MR. HJALMARSON: That's Fuller, yeah.

MR. McGINNIS: You don't have any information, as you sit here today, do you, as to the number of acres that were irrigated in the San Pedro Valley in 1697?

MR. HJALMARSON: No, I don't.

MR. McGINNIS: You don't have any information as to the number of ditches that were in the San Pedro Valley in 1697?

MR. HJALMARSON: No.

MR. McGINNIS: Okay. You don't have any information, as a matter of fact, do you, of the number of acres that were irrigated in the San Pedro Valley in the 1600s at all?

MR. HJALMARSON: I didn't go to the trouble to -- to check that out because I didn't feel it was necessary. I knew everything I needed to know to continue with my analysis.

MR. McGINNIS: But we talked earlier, but you think that you have to go back before all of this irrigation in 1697 to get back to the ordinary and natural condition, right?

MR. HJALMARSON: No, no. That's not what I said at all. I said this -- with this method, you really don't need to know precisely when it happened.

MR. McGINNIS: Okay.

MR. HJALMARSON: I said that real clearly when I introduced this method.

MR. McGINNIS: You believe that the human impact went back to 1697?

MR. HJALMARSON: I doubt it, no. I doubt it.

But I am saying the point here is, is there's been human activity in that basin since 1697, and there is the reference in the state report that says so.

MR. McGINNIS: Okay. So you -- we just -- either I asked the wrong question, but you gave the answer right, and I didn't understand it.

Do you or do you not believe that there was human activity going on in the San Pedro River Valley in 1697 that impacted the river?

MR. HJALMARSON: Not significantly, no.

MR. McGINNIS: Okay. So you don't know how many acres that were irrigated in the San Pedro River Valley in the 1700s, for example?

MR. HJALMARSON: No.

MR. McGINNIS: Okay. 1800s, early 1800s?

MR. HJALMARSON: The actual amount of irrigated acreage --

MR. McGINNIS: Before 1850, let's say.

MR. HJALMARSON: Before 1850? I do know -- I think there might be an estimate of acreage for the Mexican farmers I was telling you about that required an armed guard to come in (indiscernible) area there. They -- they were growing produce and taking it by wagon back to the Tucson presidio. So -- and that's, you know, a commercial operation there.

The earliest impact, Mark, let me cut through this just a little bit -- maybe I can help you out. I know you're trying to trip me up here, but --

MR. McGINNIS: Just trying to get to the truth, sir.

MR. HJALMARSON: The early -- the earliest impact, here, Mark -- okay. I know you're trying to get the truth.

The earliest impact is cattle, that we're aware of. We know there was a lot of cattle out there. I showed you a photograph of a herd that's unbelievable. Of course, that's in the early 1900s, but there's accounts of the same number of cattle there back when the Mexicans are doing it in 1820.

MR. McGINNIS: Okay. If you're going to cut to the chase, I'm going to try to too, okay?

MR. HJALMARSON: Okay.

MR. McGINNIS: It seems to me, from what you said this morning, that you're trying to discount some of the historical evidence from the 1850s by saying, oh, no, there was already impacts in the San Pedro back all the way to 1697.

MR. HJALMARSON: No.

MR. McGINNIS: So -- let me finish, and I'll get to you.

MR. HJALMARSON: Okay.

MR. McGINNIS: So that 1850 wasn't ordinary and natural. Is that correct? Is that what you're -- is that what you're saying?

MR. HJALMARSON: What I'm saying is we know there was a significant impact in 1850 based on, say, this report and those other -- information I got myself. At 1850, we know that accounts of whatever the conditions were were probably affected by human activity. Prior to that, I'm saying that we don't really know, but we know that people have been in there a long time.

MR. McGINNIS: But --

MR. HJALMARSON: Then I said, my method doesn't need -- you don't need to know.

MR. McGINNIS: Okay. But you don't seem to have much information about the impact on the river that might have happened from 1850 going back to 1697, and that's what I was trying to get at. Would you agree with me that you don't know much about what happened before 1850? And maybe nobody does.

MR. HJALMARSON: I have Pattie's account of his two visits when he was trapping beavers. That sheds a lot of information about what was going on. It was perennial, a lot of flow down there and a lot of beavers. That tells you something about it. Then you're looking -- Mark,

there's two kinds of historic accounts. There's one that's left in the soil and the -- it's -- there's one left in -- in only the dirt that scientists can interpret, and that -- that's an historic account. They can date it. And I've explained that in regard to the cienegas. And they -- they can say if you go back there to a certain point, and by God, it's stable. It was stable for a long time, because look at what happened here. It took years and years to develop that dark soil.

MR. McGINNIS: Dark soil --

MR. HJALMARSON: And it's right up -- and it's right up at the top, all the way down the river, then stops.

MR. McGINNIS: Dark soil could also be associated with a marshy bog that ran all the way down the river -- what's now the river, right?

MR. HJALMARSON: It's associated with an oxygen-starved environment that's covered with water and that's -- very important, I believe it is.

MR. McGINNIS: Right, but --

MR. HJALMARSON: And it has to be there a lot time.

MR. McGINNIS: (Indiscernible) you started to cover with water in there for a long time, doesn't necessarily mean you can carry on commerce down it, with a

boat, does it?

MR. HJALMARSON: No. That doesn't have anything to do with it.

MR. McGINNIS: Right, that's what I thought.

MR. HJALMARSON: It -- it's stability.

MR. McGINNIS: Okay. The other half of this slide says it's important to -- so it's important to consider all historical accounts as a group and understand the hydrologic setting when considering historic accounts. You still agree with what you wrote there, don't you?

MR. HJALMARSON: Agree with who?

MR. McGINNIS: With that second paragraph, that second paragraph there. That's your writing, right?

MR. HJALMARSON: Yeah. There's some assorted -- yes, yes, I agree with that. I still believe that, yeah.

MR. McGINNIS: So you had to look -- you have to look at all the historical accounts when you come to an opinion like this, right?

MR. HJALMARSON: Not all of them, no.

MR. McGINNIS: (Indiscernible) all, right?

MR. HJALMARSON: Well, yeah, you have to consider it, yeah.

MR. McGINNIS: That's what I asked.

MR. HJALMARSON: You have to consider the

situation, yes.

MR. McGINNIS: Okay.

MR. HJALMARSON: But there's reason to -- pre or post about 1850 accounts where the implication is this says something, you know? When, in fact, you have to be careful about what you're -- you know, what could be going on upstream, when you make such a statement.

MR. McGINNIS: Sure. Okay. You have to also understand the hydrologic studies; that's right? Is that right?

MR. HJALMARSON: That's right.

MR. McGINNIS: Okay.

MR. HJALMARSON: Well, I should have -- there's a -- there is an error. I should have said hydrologic/geometric. You have to look at both.

MR. McGINNIS: I didn't catch your error, because I'm not sure I completely understand the difference, even after 20 years of doing this stuff, but I getcha. I do know there is a difference, I'm just not sure I completely understand.

Did you, in rendering the opinion you gave today, consider all the historic accounts of the San Pedro River Valley?

MR. HJALMARSON: I did a lot of research. I'm sure I didn't find all of them.

MR. McGINNIS: What did you do to familiarize yourself with all historical accounts of the river?

MR. HJALMARSON: Well, I looked at the State Land -- well, the state report. I've been aware of it for several years. The first place I went was USGS. I talked to Mr. Cook, who did one of the groundwater modelings with Mr. Maddock. I talked to him twice. And I talked to Don Pool probably 50 times.

MR. McGINNIS: Who is that?

MR. HJALMARSON: Don Pool is the USGS guy who has done several of the models here.

MR. McGINNIS: Um-hmm.

MR. HJALMARSON: A few years ago, when I did the Gila, I talked to Phoebe (phonetic) several times.

MR. McGINNIS: Were those -- were those -- all the people you just listed, were they giving you historical documents or hydrologic and geomorphic documents?

MR. HJALMARSON: Up where?

MR. McGINNIS: All the people you just listed to me seem like they're hydrologists. And my question was, what did you do to familiarize yourself with all historical accounts on the San Pedro?

MR. HJALMARSON: I don't -- I'm sure I didn't, if not all of them, but I saw some that were very

questionable, and that's the basis of some of these comments I've made in here.

MR. McGINNIS: Okay. Do you have any training or certification as a historian?

MR. HJALMARSON: Historian?

MR. McGINNIS: Yes.

MR. HJALMARSON: No. Not a professional historian, no.

MR. McGINNIS: Any coursework in history beyond, like, high school? (Indiscernible.)

MR. HJALMARSON: In college, I had -- I might have some history and humanities, but --

MR. McGINNIS: Okay. But no graduate work or -- in history or anything?

MR. HJALMARSON: No, none.

MR. McGINNIS: What did you do in your -- in preparing this report to ensure that you fully understood the hydrologic setting in the San Pedro?

MR. HJALMARSON: Hydrologic sediments?

MR. McGINNIS: Hydrologic setting. We're still on Slide 9.

MR. HJALMARSON: Oh, the setting, oh, okay.

MR. McGINNIS: It reads better than I talk, so you might want to look at that.

MR. HJALMARSON: Okay. The hydrologic setting,

what I mean there is, is that the -- when the diversion started and when the cattle came in, and -- and what happens -- you have to understand morphology and hydrology to really understand the impact of that. And so when you look at things, you can make a judgment, say, or an educated judgment about what that really means.

MR. McGINNIS: Okay. My question was, What did you do in this particular case to familiarize yourself with that?

MR. HJALMARSON: I -- well, I know the river. I've been all over the river. It's been a while. It's been a few years, but I've been all over that freaking river many times. I -- I was (indiscernible) chief there for many years, it was my job to look over all the gauging on the river -- river and so forth. You know, and I was just -- so as far as a specialist, I was on it many times.

MR. McGINNIS: (Indiscernible) if you would flip over to Slide 12 for me. The last sentence there says, The goal is for an active analysis of the San Pedro River's natural condition that recognizes that fine precision is unlikely.

MR. HJALMARSON: Right.

MR. McGINNIS: Do you still agree with the fact that there's no fine precision in your report here?

MR. HJALMARSON: There -- let's see. That's a

good question, because it's subjective.

MR. McGINNIS: Well, you wrote it. I'm just asking what you just looked -- what that's --

MR. HJALMARSON: I had a course in gas turbines and jet propulsion in high school -- in college. And everything in hydrology is implying (indiscernible) precision involving in 20,000 rpm rotor blades. So just looking at what I know -- understand about the field of hydrology and morphology, when you postdate backward, you're not going to get that much precision. There's unknowings in everything. So that's -- that's basically what I mean. Now, by accuracy, that means unbiased, (indiscernible), using standard methods that you can support.

MR. McGINNIS: So you did it the right way, but you might be wrong, is that what that means?

MR. HJALMARSON: No.

MR. McGINNIS: Not you particularly, but doesn't accurate mean --

MR. HJALMARSON: No. Precision doesn't imply wrong.

MR. McGINNIS: Okay.

MR. HJALMARSON: (Indiscernible) if it's inaccurate, it's wrong. It might be precise (indiscernible), but it's wrong.

MR. McGINNIS: Okay.

MR. HJALMARSON: It's like a grandfather (indiscernible) a couple hours ago.

MR. McGINNIS: You would agree that there's some estimation involved in any kind of work that you -- in this kind of report, right?

MR. HJALMARSON: Estimation involved?

MR. McGINNIS: Well --

MR. HJALMARSON: You make choices using your -- you make judgments based on your experience, yes.

MR. McGINNIS: There's some extrapolation from other data.

MR. HJALMARSON: There's some of that. However, if you note, I didn't -- I didn't, myself, try to estimate the impact of the Cananea Mine on the river, because that was beyond what I considered my duty. My duty was is to look -- examine existing information, not do original analysis like that myself.

MR. McGINNIS: Okay. Let's look over to Slide 18. And the fact that we're only up to 18 slides already shouldn't be indicative of how long it's going to take to get back to (indiscernible).

MALE SPEAKER: Hopefully.

MR. McGINNIS: Although if he'd just say yes, it would go a lot faster.

This is Slide 18. It talks about some of the difficulties that were involved in doing the kind of work you did here, right?

MR. HJALMARSON: Yeah. This is -- this is a toughy. It's a very tough one to analyze. Any alluvial channel where you've had a lot of impacts generally would be very difficult to analyze because of the geometry, the morphology just goes to pieces.

MR. McGINNIS: And all of those difficulties would affect the confidence level in your ultimate opinion in this situation, right?

MR. HJALMARSON: Yes, it does.

MR. McGINNIS: Okay. Does the stream (indiscernible) is one of those that would affect the confidence level in your opinion?

MR. HJALMARSON: The confidence -- the confidence?

MR. McGINNIS: The confidence level that you have in the opinion you've rendered to this Commission.

MR. HJALMARSON: It affects the precision, yes, definitely.

MR. McGINNIS: Now, again, we just talked about precision versus accuracy, so I want to make sure. Does it affect whether it's right or wrong?

MR. HJALMARSON: Not really. It depends on how

you interpret it. So you have to understand the field, you have to be an expert in the field to know -- to know -- to say what to use and what to -- "if you don't understand it, then don't use it" kind of attitude, you know, so you don't really make a mistake. However, call in the experts, which is what I do. I'm very -- I know my limitations. You'd be surprised how many people I call, so, you know.

MR. McGINNIS: But all of those things that are listed in the first sentence there affect the confidence level that you can have in the opinion you give to the Commission, right?

MR. HJALMARSON: See, this has an effect on the precision, yes, definitely.

MR. McGINNIS: This sentence ended about two-thirds of the way through -- excuse me -- the second sentence says, The stream channel incision, prior to 1900, and subsequent widening of the stream channel through the 1950s. Do you see that?

MR. HJALMARSON: Yeah.

MR. McGINNIS: So this situation -- this is the situation on the San Pedro where you have kind of a wide, marshy, boggy channel.

MR. HJALMARSON: No.

MR. McGINNIS: At some point -- okay.

(Indiscernible - simultaneous speech.)

MR. HJALMARSON: Not quite.

MR. McGINNIS: Was it before 1880?

MR. HJALMARSON: Well, it --

MR. McGINNIS: 1850, sorry.

MR. HJALMARSON: You have marshy boggy areas on the side of this channel, and it wasn't necessarily wide back then.

MR. McGINNIS: Okay.

MR. HJALMARSON: It became wide.

MR. McGINNIS: Did it become more narrow in the late 1800s? Is that part of the incision?

MR. HJALMARSON: Pieces of it became narrow, but the overall channel was widening as everything was caving in and washing away.

MR. McGINNIS: Okay. So after -- say, between 1900 and 1950 the channel got wider?

MR. HJALMARSON: Yes. That's part of the widening theory. But like I say, everything started in 1850. But there was definitely a widening period during that particular period, yes.

MR. McGINNIS: Was there also a narrowing period at one point?

MR. HJALMARSON: I'm not aware of a narrowing, unless you want to call channel incision a narrowing. But

that's -- see, that's what I'm talking about. If you know geomorphology, I doubt if you could call it like that.

MR. McGINNIS: Okay. When we talk about incision, that's basically where the channel goes down below the surrounding widening; is that right?

MR. HJALMARSON: Yeah. But the level of the channel itself starts to drop, and there's various ways it can happen. It can happen during general (indiscernible) during a flood. Apparently there was a -- head cutting's been used to (indiscernible) promulgates a specific method, which means -- an increase in area of slope, and it moves upstream. That's head cutting. I'm not sure if that's really happened here, but a few people have used that. And I've got it in a few places locally. Doesn't seem like it's happened to the whole river.

MR. McGINNIS: Flip over to Slide 27, for me, could you?

MR. HJALMARSON: 27?

MR. McGINNIS: Yes. And -- yeah. Just go to 28. Is that -- it's one of the cattle pictures. You just -- oh, just missed it. Head back now.

MR. HJALMARSON: Okay. I'm getting tired.

MR. McGINNIS: Yeah, I'm sure.

MR. HJALMARSON: Okay. Wow.

MR. McGINNIS: Let's go to 28. I think that's

27.

MR. HJALMARSON: Yeah, that's 27.

MR. McGINNIS: Can we go to 28?

MR. HJALMARSON: I like that one.

MR. McGINNIS: Okay. Well, let's -- let's go -- let's start there.

MR. HJALMARSON: That's a bunch of cows.

MR. McGINNIS: That's a bunch of cows. This is after the 1880s incision had begun, right?

MR. HJALMARSON: That's right.

MR. McGINNIS: (Indiscernible) 1800 (indiscernible).

MR. HJALMARSON: The cattle -- there was two --

MR. McGINNIS: (Indiscernible), yes.

(Indiscernible - simultaneous speech.)

MALE SPEAKER: I just want it bigger so the Commissioners can see it.

MR. HJALMARSON: Oh, I'm sorry. Yeah.

MR. McGINNIS: I know it seems like it's just you and me, but the rest of them are all still here.

MR. HJALMARSON: I'm trying to talk to them, though.

MR. McGINNIS: I know.

MR. HJALMARSON: They're more important than you are.

MR. McGINNIS: This is after the 1880s incision, right, had begun?

MR. HJALMARSON: Yeah.

MR. McGINNIS: Okay. Let's go up to the next one, because I think it shows a better chart.

MR. HJALMARSON: Yeah, it does.

MR. McGINNIS: This one just looks like a big island of cattle, these. Here we go. This one shows that -- you've got (indiscernible) on the far and back. That's what we're talking about an incision, right?

MR. HJALMARSON: Yeah. All of this stuff, and you can see, it looks pretty fresh in here. There's, you know, pieces of material still there. It hasn't rolled it away yet. It looks like they herded the cattle down this little incised tributary. It looks like they're coming out right in -- right in there.

MR. McGINNIS: And in this particular picture, the depth of the water is not very deep, right?

MR. HJALMARSON: No. I took a look at that. Yeah, it's hard to judge it. It looks like it's 30-foot wide and at the most about a foot deep in places. Keep -- yeah.

MR. McGINNIS: Yeah. That one cow looks like it's up to its ankles there. See the one kind of lolling out by itself?

MR. HJALMARSON: Yeah, but I -- look at all -- I kind of just for fun looked at that, and it's -- (indiscernible) you can't really tell.

MR. McGINNIS: Okay. You can't tell from this -- from just looking at the picture, that this is less than a foot deep?

MR. HJALMARSON: Well, some of it looks like it's -- like it's a foot deep.

MR. McGINNIS: Okay. Can you describe for us, generally, what this area would have looked like before 1850, 1880, and these incisions?

MR. HJALMARSON: Well, from what I've read and from what people have talked to me -- or told me -- primarily people like (indiscernible) with the Arizona Geological Survey and so forth, that it's a lot like this channel I simulated, and you might have the flat line coming in, and then it would be slightly (indiscernible) with the (indiscernible) line and this would be the stream alluvium, but it wouldn't be -- you know, it would be kind of general slopes and so forth, and then in there you'd have this little (indiscernible) channel.

MR. McGINNIS: You'd have some bogs and marshes around here, right ?

MR. HJALMARSON: You'd have marshes on it, and according (indiscernible) to the Mormon expedition, you

had grass so high that you can't -- you don't know the river's there until you're right upon it.

MR. McGINNIS: Okay.

MR. HJALMARSON: And they got -- you know, they got charged, I think, 17 times by (indiscernible) bulls. Killed some of their mules, and so they couldn't see these -- these bulls that were coming after them until they got real close.

MR. McGINNIS: Let's flip over to Slide 75. This will get me into the Mexican (indiscernible), Slide 75.

MR. HJALMARSON: Yeah. I'm getting there.

MALE SPEAKER: What is that?

MR. McGINNIS: You haven't done any study, have you, of the amount of water that was withdrawn in Mexico in the late 1800s from the San Pedro? I know you talked to Mr. Hood a lot about it, but you don't have any empirical data about the actual withdrawals, do you?

MR. HJALMARSON: The actual?

MR. McGINNIS: The actual withdrawals of water from the San Pedro in Mexico in say 1808 or earlier? Do you have any data?

MR. HJALMARSON: I have -- in 1889, I have a figure of the number of times it (indiscernible) produced at the Cananea Mine, and I know it takes about 26 to 29

gallons of water to produce -- to produce one pound of copper.

MR. McGINNIS: In that Slide 74 -- let's go back and talk about that, actually, one slide back. So you've got Mexican copper production data in pounds from the turn of the 19th century --

MR. HJALMARSON: That's right.

MR. McGINNIS: -- 1900. And you've used a 2010 Arizona State -- State of Arizona Department of Mines publication that said the average use of copper -- the average use of water to produce a pound of copper is 28 gallons; is that right?

MR. HJALMARSON: That's right.

MR. McGINNIS: And did this 2010 publication talk about the average amount of water used to produce a pound of copper in 1900, specifically?

MR. HJALMARSON: No. I'm not sure if Joy's going to allow me to introduce this. This is a geological survey report --

MR. McGINNIS: I just asked you a question, so we don't have to get into that.

MR. HJALMARSON: Well, I'm going to answer this.

MR. McGINNIS: Okay.

MR. HJALMARSON: I'm answering it now.

MR. McGINNIS: Okay. You -- what you have there is a document I just asked you about the 2010 copper thing?

MR. HJALMARSON: No. I'm not sure if I -- here's -- here's what I have holding in my hand.

MR. McGINNIS: Okay. Well, my question --

MR. HJALMARSON: I'm answering your question very good here.

MR. McGINNIS: My question was --

MR. HJALMARSON: (Indiscernible.)

MR. McGINNIS: My question was --

MR. HJALMARSON: Sir, give me just a second.

MR. McGINNIS: My question -- well, let me ask the question again. If you can answer it, I won't bother you, okay? How is that? Okay. Well, I'll bother you about some different things, but --

MR. HJALMARSON: Okay. Go ahead. Let's do it again.

MR. McGINNIS: All right. Did the 2010 report that you used from the State of Arizona Department of Mines --

MR. HJALMARSON: Right.

MR. McGINNIS: -- have any specific number for the amount of water that was used to generate a pound of copper in 1900?

MR. HJALMARSON: No, but I have a publication that shows it was within one gallon of what it was in the early days after -- at the Copper Creek --

MR. McGINNIS: So between --

MR. HJALMARSON: -- at the Copper Queen Mine.

MR. McGINNIS: The answer to my question is, no?

MR. HJALMARSON: The answer is no. But -- but here I have a document that says that it's the same.

MR. McGINNIS: Okay. There'll be redirect examination, and they'll let you -- they'll let you do that, I promise. Well, I think they'll let you do that. Maybe not today.

CHAIRMAN NOBLE: There's a shuttle out there, but I'm not seeing any heads nodding.

MR. McGINNIS: Yes. The answer is (indiscernible) cited in your report, right?

MR. HJALMARSON: Yeah, the minute -- I'm going to add to this. I have a document in my hand produced by the USGS, and it says, Water requirements of the copper industry, and it covers the San Pedro mines way back -- or the Copper Queen Mine, and mines all over the west. And I used that, and I said -- and I checked it with this, and it's within one gallon -- one's 26 and one's 27 gallons per pound. In fact, it -- we're using more than we used

to use.

MR. McGINNIS: You know, if we were in court, I'd just strike your -- move to strike your answer, but since we're before the Commission, they listen, so that's fine.

Let's put the -- go to Slide 119. This is just a follow-up on some things we --

MALE SPEAKER: (Indiscernible.)

MR. McGINNIS: -- talked about earlier. First sentence there, you have to blow it up for me. There are no known document observations of predevelopment, natural river morphology.

MR. HJALMARSON: That's right. I have -- I couldn't find anything.

MR. McGINNIS: Okay.

MR. HJALMARSON: (Indiscernible) to show it was predevelopment.

MR. McGINNIS: Flip up -- flip up to Slide 122.

MR. HJALMARSON: Oh, let's see.

MR. McGINNIS: And I think I asked you about this already. You used a smooth parabolic channel for this analysis, right?

MR. HJALMARSON: I used that, yeah, to determine these characteristics, and then I (indiscernible) at how they can vary on them, so they had

to remove it.

MR. McGINNIS: The smooth parabolic channel is basically like the bottom of a basin, right?

MR. HJALMARSON: Yeah.

MR. McGINNIS: Is that what it looks like?

MR. HJALMARSON: Yeah, and it's kind of -- it's what a straight channel wants to be. That's the way they're formed.

MR. McGINNIS: It looks like a canal?

MR. HJALMARSON: No. Canals are typically of much finer material.

MR. McGINNIS: But the shape of it --

MR. HJALMARSON: Yes, yes, yes, it would, Mark, it would form, but it would be a different -- slightly different parabola, because it's finer -- it's (indiscernible).

MR. McGINNIS: The shape of the San Pedro today, at least, is not -- doesn't look like a canal, does it?

MR. HJALMARSON: Today it's full of sand.

MR. McGINNIS: Okay. The shape of the San Pedro back in 1697 probably didn't really look like a canal, did it?

MR. HJALMARSON: No, but it would have a parabolic shape. I didn't say that it would look like a

canal. I said they both have the same shape. But they'd be different because one's (indiscernible), one's a sandy (indiscernible) in that area.

MR. McGINNIS: But it wasn't a smooth parabolic, sort of round channel, all the way from the Mexican border to the -- to the confluence with the Gila, right?

MR. HJALMARSON: (Indiscernible) no.

(Indiscernible - simultaneous speech.)

MR. HJALMARSON: It would not -- they would not be the same exact, you know, the same geometry, and also there's a variation of geometry about this representative graph.

MR. McGINNIS: Right. And there were undulations on the bottom of the river, you know that, right?

MR. HJALMARSON: (Indiscernible) there were that kind of thing.

MR. McGINNIS: The sandbars?

MR. HJALMARSON: The sandbars moved through. You'll get tributary streams coming in. You'll get sediment deposited, and a localized (indiscernible) effect, and all that kind of thing.

MR. McGINNIS: There were rocks in there?

MR. HJALMARSON: Rocks, yes, you can get them

coming; coarser material, yes.

MR. McGINNIS: Okay. There were -- trees probably fall over in the river?

MR. HJALMARSON: Sure.

MR. McGINNIS: You could assume that.

MR. HJALMARSON: Yeah.

MR. McGINNIS: So wouldn't you agree with me that if you have -- if you compare a smooth -- assume a smooth parabolic channel, versus a real channel, like the San Pedro was at any given time, it'll take more water to float a boat in the real channel than it would in a smooth hypothetical channel? I'm glad I --

MR. HJALMARSON: The smooth parabolic hypothetical channel is determined from real channels.

MR. McGINNIS: Okay. That's not my question.

MR. HJALMARSON: Well, that's what -- that answers it in reverse.

MR. McGINNIS: Okay.

MR. HJALMARSON: The smooth parabolic channel is a real good estimate of a real channel, so a real channel --

MR. McGINNIS: Right.

MR. HJALMARSON: -- if you know the sediment characteristics, like I talked about.

MR. McGINNIS: But we just listed five or six

or seven different differences between your hypothetical smooth parabolic channel and a real life channel, right?

MR. HJALMARSON: There's -- there's nothing perfect in alluvial channels. I tried to (indiscernible) my talk by showing Schumm's report, and it said variable and complexity, those two words. And I said, those mean a lot about these particular channels.

MR. McGINNIS: This is obviously taking longer than I thought it would. I'm getting ready to start (indiscernible). I don't know if you want to give him a break or you want to keep going or -- I'm fine. It's just a matter of --

MALE SPEAKER: So you may be beginning a new area?

MR. McGINNIS: Yes, sir. Yes, sir. But it's hopefully shorter than the one I just did, but it depends on how long his answers are, to be honest.

CHAIRMAN NOBLE: We'll take a ten-minute break.

(Off the record.)

MR. McGINNIS: A copy of the September 1997 version of the Arizona Stream Navigability Study for the San Pedro River, Gila River Confluence to the Mexican Border, prepared by CH2M Hill. Do you see that?

MR. HJALMARSON: Yeah.

MR. McGINNIS: Yeah. Is that a report that you

reviewed prior to today, as part of your work?

MR. HJALMARSON: That I reviewed prior?

MR. McGINNIS: Is this a report that you reviewed as part of your work on the San Pedro?

MR. HJALMARSON: I think I had a different date on it.

MR. McGINNIS: Okay. There's a 2004 version, I think, too, maybe.

MR. HJALMARSON: I think that's what I used, yes.

MR. McGINNIS: From the 2004 version that you read, as you sit there today, (indiscernible) today, is there anything that you specifically recall disagreeing with as to the historical accounts in that report?

MR. HJALMARSON: That I disagree with?

MR. McGINNIS: Yes.

MR. HJALMARSON: You know, Mark, I don't remember the specifics. Point me to a page.

MR. McGINNIS: Okay. Well, let's look at the '97 version then. Take a look at page -- roman numerals -- or small roman numeral iii on that paper.

MR. HJALMARSON: 13?

MR. McGINNIS: No, just three little i's.

MR. HJALMARSON: Oh, three little i's, okay.

MR. McGINNIS: And I'm going to read it for you

to make it go a little faster, but if you'll listen along and make sure --

MR. HJALMARSON: Thank you.

MR. McGINNIS: -- I read correctly, they'll -- because I know you're getting tired, and I don't want to tax you anymore.

The last full paragraph on that page, third sentence says, let's talk about some studies for the San Pedro. It says, These studies indicate that prior to about 1890 the San Pedro River was a -- was an irregularly flowing stream, marshy in places, free flowing in other places, entrenched or subsurfaced in still other places. Moreover, the flow of the stream varied throughout the year. Did I read that right?

MR. HJALMARSON: Yes.

MR. McGINNIS: As you sit here today, do you have any basis to disagree with that statement done by the State Land Department's consultants?

MR. HJALMARSON: The river flowing -- no, it seems like there's nothing that jumps out at me real bad, no.

MR. McGINNIS: Is that part of the hydrologic study that you considered in coming to your opinion that you delivered to the Commission today?

MR. HJALMARSON: I -- I'm having trouble

hearing you.

MR. McGINNIS: Okay. Sorry. I guess I'm sometimes loud.

We talked earlier and you talked about a slide in your report that said it was important to understand the hydrologic setting. Is this type of information part of the hydrologic setting that you considered?

MR. HJALMARSON: That would be a setting, but this is post -- post human influence, of course.

MR. McGINNIS: Okay. Well, this is prior to 1880 -- 1890, sorry.

MR. HJALMARSON: No. It's 18, and it -- well, yeah, but that would be after 1850.

MR. McGINNIS: Okay. Flip over to the next page, 5-B, last full paragraph, second sentence. Do you see me now? Historical accounts of early explorers of Arizona who traveled the San Pedro River did so on foot or by horseback and wagon. In some cases these travelers built boats upon reaching the Gila River after walking or riding along the San Pedro River. Do you see that?

MR. HJALMARSON: Yeah.

MR. McGINNIS: Do you have any reason to disagree with that statement?

MR. HJALMARSON: I would -- I would agree.

MR. McGINNIS: Did you consider that historical

fact in rendering your opinion that the San Pedro River was navigable?

MR. HJALMARSON: I don't think it has any bearing on it.

MR. McGINNIS: Okay. So you're -- is that because you believe that the historical accounts of early explorers of Arizona aren't early enough to get to ordinary and natural? Do you understand what I'm asking?

MR. HJALMARSON: No. I'm -- I think it -- because of the same velocity of the river and so forth, if you were on a horse, you can go faster down the San Pedro than you can in a boat.

MR. McGINNIS: Okay. So the fact that somebody rode along the river in a horse instead of taking a boat means nothing to you?

MR. HJALMARSON: I don't -- I don't get the connection. No, it doesn't mean anything to me.

MR. McGINNIS: Look over into the body of this report, then, page 2-9, last paragraph there --

MR. HJALMARSON: Wait a minute. Wait a minute.

MR. McGINNIS: Sorry, sorry. The last paragraph says, No evidence of prehistoric boating on the Salt River or river conditions that would support navigation was identified during the archaeological investigation and literature search. Do you see that?

MR. HJALMARSON: Yeah.

MR. McGINNIS: You don't have any reason to disagree with that, do you?

MALE SPEAKER: Well, (indiscernible) you could use the Salt River (indiscernible). I think you meant San Pedro.

MR. McGINNIS: I'm sorry, it's -- you -- I said -- I read it wrong. It said much -- instead of Salt River, it's San Pedro River. Do you want me to read it again?

MR. HJALMARSON: Yeah, read it again.

MR. McGINNIS: Okay. No evidence of prehistoric boating on the San Pedro River or river conditions that would support navigation was identified during the archaeological investigation and literature search. Do you have any reason to disagree with that statement?

MR. HJALMARSON: I'm not an archaeologist, and I -- if that's what that showed, fine.

MR. McGINNIS: Did you consider that historic and prehistoric fact in rendering your opinion that the San Pedro River was non-navigable?

MR. HJALMARSON: Not it -- I would have to -- I would look at it from a standpoint of an archaeologist, who I -- what I do is talk to archaeologists. I don't

know much -- much about it. But that's -- that's the only point I've been trying to make here today is, is you have to understand geology to do morphology to interpret some of this stuff. So you'd have to be an archaeologist to know what this means. But this might be one little piece of evidence, and if you came in from other sources or other backgrounds, you might -- it might (indiscernible) you might therefore conclude that (indiscernible).

MR. McGINNIS: But you didn't consider that one little piece of evidence in rendering your opinion today, is that your testimony?

MR. HJALMARSON: No. Actually, what I -- what I talked about is, today, the piece of evidence we have is Pattie, the beaver trapper, and that man built a canoe at the mouth of the San Pedro River. And he talked about going across the river, setting beaver traps, and collecting his beavers. And it does not say which river.

MR. McGINNIS: So that really isn't helpful at all, is it?

MR. HJALMARSON: Huh?

MR. McGINNIS: That really isn't helpful at all, is it?

MR. HJALMARSON: Well, it -- you know, there's a possibility that there was a canoe on it, that's for commercial purposes.

MR. McGINNIS: And that -- that's something that you, as a scientist, would consider to be supportive of your opinion?

MR. HJALMARSON: No. I'm just saying that's what it was, and I'm saying, you know, wow, it's kind of like, well, okay, it's something to think about, but I'm not -- you know, I'm not using it (indiscernible).

MR. McGINNIS: So here you have a report prepared by the expert from the State Land Department, submitted to this Commission -- (indiscernible) now, CH2M Hill -- is this report that you have in your hand that talks about basically as a conclusion, it was based on a big chunk of work they did, and you don't give that any credence at all in your opinion? Is that what you're saying?

MR. HJALMARSON: No. We've already gone over this state report. There's parts of this that don't apply to the present problem because the rules changed, but I agreed with you, there's a lot of information in here that is valuable.

MR. McGINNIS: Is -- is this one of --

MR. HJALMARSON: What -- what this -- well, go ahead.

MR. McGINNIS: Is this one of the parts that matter or one of the parts that doesn't matter, under the

new -- in your -- in your analysis?

MR. HJALMARSON: What -- what this does -- what -- the value of this report is that it describes the change.

MR. McGINNIS: Okay.

MR. HJALMARSON: But then it uses a different period to apply it to.

MR. McGINNIS: Okay. I think maybe we're all getting tired, because doesn't -- this -- this statement that we're talking about on 2-9 talks about new evidence of prehistoric boating on San Pedro River or river conditions identified -- the river conditions that would support navigation during archaeological investigation. How does that have anything to do with a change in the river?

MR. HJALMARSON: Using archaeologic techniques, it doesn't show it. Okay. Fine. So what?

MR. McGINNIS: Okay. So is this something you considered or not? That's all my question is.

MR. HJALMARSON: I -- it would probably in my data bank, yes.

MR. McGINNIS: Okay. And the -- the fact that Pattie -- there was some story somewhere that would get -- I get to see the document on, maybe took a canoe across the one -- some river somewhere, is also something you

considered to support your opinion as a scientist or engineer?

MR. HJALMARSON: Yeah. Because it's document he built eight more canoes that I haven't talked about, and he flowed all the way to the -- where there's a title (indiscernible) California.

MR. McGINNIS: Okay. Have you seen the document -- a document that says that?

MR. HJALMARSON: We have submitted it to the Commission.

MR. McGINNIS: Okay. Do you recall which document it is?

MR. HJALMARSON: I don't know. You'd have to ask -- it's 122 pages --

MR. McGINNIS: Okay.

MR. HJALMARSON: -- and it's the account.

MR. McGINNIS: Okay. You're talking about Pattie's diary, again?

MR. HJALMARSON: That's what we're talking about.

MR. McGINNIS: Gotcha. You would agree that prior to 1890 the San Pedro River was variable along its course, wouldn't you?

MR. HJALMARSON: Well, yeah, it's -- what compliment are we talking about that's being variable?

What characteristic?

MR. McGINNIS: Flow, depth --

MR. HJALMARSON: Sure, it varies.

MR. McGINNIS: -- impediments, all of those things vary.

MR. HJALMARSON: They vary a little bit, yeah.

MR. McGINNIS: Okay. The San Pedro River, prior to 1890, also was variable on a seasonal basis, wouldn't you agree with that? All of those same kind of factors we just talked about.

MR. HJALMARSON: Well, yeah, yeah. Like variable flow and the different amounts of flow in the summer and the winter, yes.

MR. McGINNIS: Would you agree that there are historical counts as far back as 1857 that talked about the Gila River going underground -- I mean, excuse me. I'm getting -- everybody's all confused. The San Pedro River going underground?

MR. HJALMARSON: Yeah. It's not only me that's getting tired around here.

MR. McGINNIS: I agree. It's been a long -- a long day.

MR. HJALMARSON: I read the entire diary of Mr. Park. I read his entire log. I agree with his observation --

MR. McGINNIS: Okay.

MR. HJALMARSON: -- that the San Pedro River disappeared into the ground. But don't take that out of context. Look at everything he said. He said there was a 15-foot high vertical cut bank where there was water at that time. He described a narrow channel. He described the depth and the width. That 15-foot vertical cut bank is not a natural phenomena.

MR. McGINNIS: Okay. I wasn't actually talking about Mr. Park. So let me -- let me show you what I'm talking about.

MR. HJALMARSON: Yeah, you --

MR. McGINNIS: Because I'm not showing the (indiscernible).

MR. HJALMARSON: You were talking --

MR. McGINNIS: Let's look at 3-17 on the report that you have in front of you. I'm not trying to --

MR. HJALMARSON: 3-17?

MR. McGINNIS: I'm going to take baby steps here for as long as we go, because we'll -- we're both going to get ourselves in trouble by not keeping track.

MR. HJALMARSON: 3-17?

MR. McGINNIS: 3-17.

MR. HJALMARSON: Okay.

MR. McGINNIS: Okay. This is toward the bottom

here.

(Conclusion of Tape 2; commencement of Tape 3.)

MR. McGINNIS: An 1857 account by James H. Tevis. Do you see that quote at the bottom? That's the one I was asking you about.

MR. HJALMARSON: Oh, I'm sorry. Okay. Well, okay.

MR. McGINNIS: I mean, it basically says -- and again, I'll read it so you don't have to. About -- it's going to start about the third line down. It says, About every five miles is a beaver dam. This is great country for them, and we have went to the river and water, and it was running fine. And a half mile below the bed of the river would be as dry as the (indiscernible) --

MR. HJALMARSON: Yeah, (indiscernible).

MR. McGINNIS: -- sinks and rises again. And we went down as far as the Aravaipa, and eight miles below that the San Pedro empties into the Gila.

So this is an 1857 account.

MR. HJALMARSON: Yeah.

MR. McGINNIS: It's talking about the river basically going dry -- going dry and then going to water -- going underground.

MR. HJALMARSON: Okay. I haven't read accounts that this gentleman makes. I don't know how reliable he

is. There's some real funny stuff out there. But I wouldn't dispute this, and it doesn't matter, because this is post 1850, and I'm using that as a cutoff on all of this.

MR. McGINNIS: You would agree that an underground river is not navigable, correct?

MR. HJALMARSON: Yeah.

MR. McGINNIS: Even with some submarines, I think.

MR. HJALMARSON: Yes.

MR. McGINNIS: Okay. You would agree also that there are several historical accounts after 1857 of places where the river goes under -- the San Pedro River goes underground, right?

MR. HJALMARSON: There is, oh, I've run across maybe three. This was a new one on me. I didn't -- I hadn't -- I hadn't seen this one. So maybe this is about the fourth one I've heard, because -- and like I say, well -- okay. Go -- never mind.

MR. McGINNIS: (Indiscernible.) Are you done with the answer? Yes? Are you done with the answer?

MR. HJALMARSON: Yes, I'm aware of -- yes, I'm done with the answer.

MR. McGINNIS: Are you done with your answer? Okay. Okay.

MR. HJALMARSON: Yes. I'm sorry, Mark.

MR. McGINNIS: You talked -- you talked earlier in your testimony about Dr. Schumm's book, River Variability and Complexity.

MR. HJALMARSON: Yeah.

MR. McGINNIS: You would agree with me, wouldn't you, that the San Pedro River is and always has been variable and complex?

MR. HJALMARSON: Rivers of that nature are -- tend to be that way, yes. If you disturb them, things get real complex.

MR. McGINNIS: You talked earlier in your direct testimony that there were 144 diversions for agriculture in the Arizona Department of Water Resources records.

MR. HJALMARSON: Yeah. They have -- yeah, I have that in my appendix, if you want to go to it. That's --

MR. McGINNIS: Is that -- sorry, that's -- that's currently?

MR. HJALMARSON: No. That's -- they had -- I sent -- and I explained that, I remember exactly what I said. I said, they have records that people have, let's say, obtained permission to build these diversions, and they weren't sure how many had actually been built. But

most of them had been built, but some of them may have never been built, but they had the permission to -- you know, to do it, but they had, you know, approval through the state. So over a period of time there's been 144 or almost 144 diversions on that river. That suggests there's one heck of a lot of water.

MR. McGINNIS: You talked earlier -- I think in your direct testimony you said that although Mr. Pattie talked about beavers, he never talked about beaver dams, right? Do you recall saying that this morning?

MR. HJALMARSON: Mr. Hamm?

MR. McGINNIS: Pattie?

MR. HJALMARSON: Oh, Pattie.

MR. McGINNIS: I'm sorry. I'm being -- sorry. Mr. Pattie you said talked about beavers in his account, but never talked about beaver dams.

MR. HJALMARSON: Yeah. I don't recall -- he did not -- it's interesting. Of course, he wasn't -- he was after beavers. He was trying to get rich.

MR. McGINNIS: Which is part of why he talked about beavers, though, right?

MR. HJALMARSON: Yeah . You know, but he never mentioned a dam.

MR. McGINNIS: He doesn't --

MR. HJALMARSON: Of course, beavers build

lodges in two places and -- anyway, I thought it was a little odd.

MR. McGINNIS: He wasn't -- he wasn't going in a canoe down the river, as far as you know, was he? So he wouldn't have encountered dams in -- in water -- in a watercraft?

MR. HJALMARSON: Mr. Pattie went miles up the San Pedro. Some people even think he may have gone, you know, way -- way up. But we know -- I testified that we know he went to the mouth of the Aravaipa, because he -- he described the cienega there with the pool.

MR. McGINNIS: But he was walking (indiscernible), right? As far as you know.

MR. HJALMARSON: He -- here's what happened -- well, he got attacked -- let's see --

MR. McGINNIS: Well, wait, let's just try to stay on course here.

MR. HJALMARSON: (Indiscernible.)

MR. McGINNIS: He was not on a boat as far as you know, going up the San Pedro?

MR. HJALMARSON: That's right. But you said horse. And see, they took -- they had to kill the horse and eat it.

MR. McGINNIS: Okay. You talked some with Mr. Hood about braiding the curve on the San Pedro River,

did it corrupt the San Pedro (indiscernible) flood, braiding occurred after a flood. Do you recall talking about that?

MR. HJALMARSON: When -- oh, boy, I'm having --

MR. McGINNIS: Okay. My understanding was that when you testified with Mr. Hood sometime today --

MR. HJALMARSON: Okay.

MR. McGINNIS: -- you were talking about impacts of a flood on the San Pedro.

MR. HJALMARSON: Yes.

MR. McGINNIS: And how there could be some braiding for some period of time.

MR. HJALMARSON: That can tear -- a big flood can tear the heck out of a big -- of a river like the San Pedro. It takes a while to heal.

MR. McGINNIS: And at one point you had the graph up there with sort of a diagonal line that talked about a braided versus meandering. Do you remember that?

MR. HJALMARSON: Yeah. Do you want to see it?

MR. McGINNIS: No. Not necessarily. You said you want to go home sometime, but that's --

MR. HJALMARSON: I -- I didn't answer your question quite properly, so if you want to revisit, I can --

MR. McGINNIS: Let me finish mine, and then

we'll talk about it, okay?

MR. HJALMARSON: Okay.

MR. McGINNIS: You said the braiding made the river less navigable, is that right, less likely to be navigable?

MR. HJALMARSON: Generally speaking, you bet.

MR. McGINNIS: At one point with (indiscernible) you said it might take up to a couple years for the braiding to recover after a flood.

MR. HJALMARSON: I said a major. You know, I'm talking -- I mentioned two big floods. And yeah, I just -- those things can tear them up, and it takes a while for everything to get back.

MR. McGINNIS: So if I'm the big guy in the canoe that you talked about earlier, and I'm relying on the San Pedro River for commercial transportation, say, okay? Assume that for the purpose of this question.

MR. HJALMARSON: Yeah.

MR. McGINNIS: And it's braided for two years and I can't navigate, isn't that going to cause me a problem?

MR. HJALMARSON: You're talking navigation, and not navigability, Mark, and I'm not going to answer that. You're into a totally different realm. You're talking a specific use of boats, and that's not navigability.

MR. McGINNIS: But isn't navigability, navigability, in fact, isn't that part of what shows up in every case and every statute that's in all of these things throughout 70 years?

MR. HJALMARSON: That's not the way I'm using it. I fight with myself all the time. Don't think navigation. It has the potential to be navigated, that's navigability.

CHAIRMAN NOBLE: Excuse me, Mr. McGinnis, would you rephrase the question? I have no idea what the question was.

MR. McGINNIS: My question is, if it takes two years for the braiding to recover, and somebody is using that river for navigation, assuming it is navigable, subject to navigation, whatever word you want to use, and there's a two-year interruption, even by your own testimony in that status, it happens periodically, isn't that a problem for a person that's using it?

MR. HJALMARSON: Okay. This is kind of off the record in a sense, in that now I'm not talking about navigability, I'm talking about navigation. And yeah, I can imagine certain types of navigation.

Now, let me go back to this, you talked about this two-year messing up the river because of a major flood. I'm referring to getting it to where this river

comes back to where it was, where it's not -- you know, a meandering stream and so forth and so forth. And it -- there might be reaches where things are tough, and they're not -- there'll be reaches where a nice simple (indiscernible) meandering river, and there might be reaches that are still braided and very difficult.

Now, I can further answer your question, instead of 80 percent of the year for navigation, because it's been torn up and so forth, it might be -- it might be 70 percent. Is it --

MR. McGINNIS: But it might be zero, right?

MR. HJALMARSON: Well, yeah. But now we're still talking about navigation, so yeah, it could be, so, you know --

MR. McGINNIS: I have no further questions. I know you didn't think you'd ever hear that, did you?

CHAIRMAN NOBLE: Is there anyone out there who has questions of Mr. Hjalmarson?

MR. HJALMARSON: Thank you, Mark.

FEMALE SPEAKER: (Indiscernible.)

CHAIRMAN NOBLE: We would hope that.

MALE SPEAKER: (Indiscernible.)

CHAIRMAN NOBLE: You do as well?

MALE SPEAKER: That's correct.

CHAIRMAN NOBLE: About how long?

MALE SPEAKER: (Indiscernible.)

CHAIRMAN NOBLE: How long do you expect yours is going to take?

MALE SPEAKER: I may have about 20 minutes. I -- I work pretty fast.

MALE SPEAKER: That's what I thought.

MR. HJALMARSON: I'll -- I'll try to -- if I can do it, I'll say yes or no.

MALE SPEAKER: (Indiscernible.)

MR. MURPHY: Mr. Hjalmarson, could I ask you to go back to Slide 4 --

CHAIRMAN NOBLE: Could you state your name on the record?

MR. MURPHY: It's Tom Murphy, and I represent Gila River in this case.

CHAIRMAN NOBLE: Thank you, Tom.

MR. HJALMARSON: Back where?

MR. MURPHY: Number 4.

MR. HJALMARSON: Oh, you guys are all starting from the beginning here. All right. Oh, heck, I can't even see the damn thing. Okay.

MR. MURPHY: All right. The first question is that -- that --

CHAIRMAN NOBLE: Win, could you blow that up?

MR. HJALMARSON: I'm sorry.

MR. MURPHY: Your statement of the navigability standard isn't quite accurate, is it?

MR. HJALMARSON: Isn't quite?

MR. MURPHY: Sure. You say, Navigability or non-navigability of the San Pedro River, in its ordinary and natural condition, prior to the state of Arizona's admission to the United States on February 14th, 1912. The actual standard is the ordinary and natural condition at the date of the state's admission, February 14th, 1912, right? Or do you not see a difference?

MR. HJALMARSON: This -- well, that's -- that's -- let me answer it this way: The attorney I'm working for provided that slide to me.

MR. MURPHY: Oh, okay. And you arrived at the information provided to you by the attorney, as part of --

MR. HJALMARSON: By the person I'm working for.

MR. MURPHY: Okay.

CHAIRMAN NOBLE: So now we're going to cross-examine Joy?

(Indiscernible - simultaneous speech.)

MR. MURPHY: (Indiscernible) move forward to Number 6. And the first sentence, it says, This analysis of navigability used as the present 2013 federal standard, as interpreted by the Arizona Court of Appeals. (Indiscernible) if I'm not mistaken, the Arizona Court of

Appeals last spoke on this issue in 2010, but the most recent federal case was 2012?

MR. HJALMARSON: Well, the present is now. I wrote it in 2013.

MR. MURPHY: Oh, okay.

MR. HJALMARSON: That's what it means.

MR. MURPHY: What -- what did you do to resolve any conflict between the federal standard and the standard as expressed by the Arizona Court of Appeals?

MR. HJALMARSON: What did I do?

MR. MURPHY: Yeah.

MR. HJALMARSON: To resolve?

MR. MURPHY: Yeah. If there are conflicts between the federal standard and what the Arizona Court of Appeals said, how did you resolve those? Or did you not see any conflict?

MR. HJALMARSON: When I -- that came up when I was talking about my work on the Gila. At that time we ignored the state standard because my attorney said, I know where we're going to where we are right today. Okay.

MR. MURPHY: Okay.

MR. HJALMARSON: He's a smart man.

MR. MURPHY: If you go down to Slide Number 7, and then I -- this question may have already been asked in another form, but would human activity going back at least

300 years or more --

CHAIRMAN NOBLE: Could you blow it up?

MR. HJALMARSON: Yes.

MR. MURPHY: How much of the human activity over the past 300 years involved use of river for commerce or trade?

MR. HJALMARSON: Use of what?

MR. MURPHY: Use of the river for commerce or trade?

MR. HJALMARSON: I'm not aware of any.

MR. MURPHY: Okay. And if you'd go to Slide Number 10. Now, Mr. Hood was asking you a little bit about this. There are these little circles on that map that -- would -- those little circles would be -- does the pie charts represent?

MR. HJALMARSON: Those are the water -- groundwater budgets for each of the basins, and they had 74 of them in this study.

MR. MURPHY: And if you look, there's three of those that go up along the San Pedro, right?

MR. HJALMARSON: That's right.

MR. MURPHY: Now, the key for this, if we go with the pie charts, one of the things in the chart is the -- I want to say the -- so I don't get it wrong --

MR. HJALMARSON: It's the basin

(indiscernible).

MR. MURPHY: And by the way, this chart purports to be predevelopment conditions, right?

MR. HJALMARSON: That's the title of it, yes.

MR. MURPHY: So would the little pie chart on the corner, the white page represents the spring base flow, right?

MR. HJALMARSON: That's right.

MR. MURPHY: Now, if I look at the little pie chart closest to the Mexican border, there's -- about a third of one-half of the pie chart is the light pink, right?

MR. HJALMARSON: That's right.

MR. MURPHY: If I go to the other two up above, there's none, right?

MR. HJALMARSON: Yeah.

MR. MURPHY: And so based upon the turning of this, other than at the border, there's no spring base flow at all anywhere else along the San Pedro; is that correct?

MR. HJALMARSON: Okay. This -- this base flow, represented by those pie charts, is the Q90. It's the 90 percent number I'm using. If you remember the numbers I used, I -- at the upper end, I used 10. That's what the pie chart shows. At the end of the next line, I used 7,

and at the mouth I used 4. So you have a good observation. There is no increase in base flow. There's a loss at that -- down at that level.

So what it really says is when the flow is really low, the evapotranspiration losses along that river cause a decrease in flow at that level. When you work with the average base flow, it's completely different. I can show you the average base flow.

MR. MURPHY: So just so I understand this then, you're -- what you're saying is that the charts they represent are base flow at a certain minimum level?

MR. HJALMARSON: Yeah. That -- that -- it's a budget at Q90, and I've discussed this with the author, with Jeff Regan. Yes, that's what he does.

Can I add one little enlightening thing about this?

MR. MURPHY: Sure.

MR. HJALMARSON: Okay. When you look at the 74 bases that these guys studied, and they created these pie charts, then things like the base flow transfer from one basin to another, they looked at the whole figure, and they had four points where they knew -- where the Q90 flow was, and so they made sure that mathematically everything added up at the top. So there might be some areas where they're guessing pretty good, but they adjust it so in the

big picture it all matches. So you might look at this and think, hey, it's a pie chart, and it's a guess. Now, there's -- it's a lot better guess than you might -- than the pie chart might suggest.

MR. MURPHY: Could you go down to 21? Could you talk a little bit about the mining operations along the San Pedro? Is there any evidence that you're aware of, or historical accounts, I should say, of any use of the San Pedro for shipping or --

MR. HJALMARSON: No.

MR. MURPHY: -- transportation or --

MR. HJALMARSON: No.

MR. MURPHY: And go down to 23. And this is just -- it's something that was confusing. The last portion of your box says, A study by Thomas and Pool 2006 found that the variation in the stream flow was caused by fluctuations in precipitation. That's the remaining variation of (indiscernible) stream flows caused by factors other than precipitation. Is the -- the comment about Thomas and Pool just sort of misworded or -- I mean, what factors -- did Thomas and Pool find a variation that was caused exclusively by fluctuations in precipitation?

MR. HJALMARSON: No. That's saying just the opposite. It's saying that based on the more recent information, in other words maybe taking this up

(indiscernible), you know, into this man-caused climate change, worldwide, et cetera, et cetera, there -- you know, up to almost the present or 2006, when they did the report, the reason the duration suggests that there is a decrease in (indiscernible).

Now, other studies that go back a few years that could it appear of record of where it was at I'm using, and I told you that 1950 to 1980 is where there's runoff estimates came from, I mean, analysis of (indiscernible). Back then, the -- there was no trend, and I showed the slide that showed that. So there is a recent trend, but there's a lot of other stuff going on here, and the reason it's not still down here is they're not sure -- they're not sure what's going on.

Now, I was Thomas' supervisor for about five years, and we did statistical analyses up the kazoo. He knows what he's doing. And I trust -- I trust this. But it's -- it's being influenced by recent stuff.

MR. MURPHY: Would you go down to Number 30, next?

Would it be fair to say that one of the problems with the historical accounts -- 30.

MR. HJALMARSON: Oh, 30. I'm sorry.

MR. MURPHY: That's all right.

MR. HJALMARSON: Wow. I'm wearing hearing aids

and any noise -- any murmurs going on are giving me trouble, so --

MR. MURPHY: Oh, next one down.

MR. HJALMARSON: Yeah, here we go.

MR. MURPHY: And could you blow that up?

Would it be -- would it be fair to say that one of the issues with any of the historical accounts would be exaggeration?

MR. HJALMARSON: Accounts of evaporation?

MR. MURPHY: No, historical accounts of activities along the river. For example, Cook says that there was a salmon trout that grew up to 3 feet long.

MR. HJALMARSON: No. Well, I -- I didn't write that quite right. It's a quote from Tillman.

MR. MURPHY: Oh, okay.

MR. HJALMARSON: And I've read Cook's account. He says 8 -- 16 or 18 inches, but there are other accounts of 3 foot. And so I didn't write that clearly. It might could -- let's see. Yeah, I don't -- I think my transfer of that from Tillman to here, I got it jumbled a little bit.

MR. MURPHY: Okay.

MR. HJALMARSON: But there are accounts of three feet.

MR. MURPHY: Now, could you go to the next

slide, which is 31?

Now, when Cook was going along the trail, and this was in -- was this the late 1800s?

MR. HJALMARSON: Mid.

MR. MURPHY: Mid 1800s, so when he was coming up along the San Pedro, instead of staying along the river up to the -- the mouth of the river, he actually left the -- the water supply and went over land toward --

MR. HJALMARSON: He went to the presidio.

MR. MURPHY: Okay.

MR. HJALMARSON: One of his jobs was to get rid of the Mexican army. They were there. When they saw him, they ran to Mexico.

MR. MURPHY: All right. Where's the location of the presidio?

MR. HJALMARSON: Huh? Tucson was called the presidio, the Mexican fort.

MR. MURPHY: Oh, okay. Well, this dotted line says that he left the San Pedro -- oh, okay.

MR. HJALMARSON: Yeah. He left at mid -- well, Tres Alamos or near Benson, right in that area. It came to the divide -- the pass there, Remington Pass.

MR. MURPHY: Okay. Any indication that -- that Pattie, when he was trapping beavers along the river in the 1800s, utilized the river for transportation of this

product?

MR. HJALMARSON: Well, like I talked about on the San Pedro, there's something that -- there's a hint that something -- something might have been going on. But I didn't say that on the Gila he transported all of his hides down, he went into the gulf, into the tidal effect of the gulf (indiscernible).

MR. MURPHY: I'm sorry, I didn't hear you.

MR. HJALMARSON: He went in -- all the way down the Colorado into the -- where there's a tidal effect in the gulf at the mouth.

MR. MURPHY: I mean, it -- when I look at other accounts of navigability in other parts of the United States, one of the things that, you know, appears not infrequently is use of rivers, you know, by trappers for transportation of their product or their parties.

MR. HJALMARSON: Right.

MR. MURPHY: And what I wanted to know is if there is any indication that Pattie did this along the San Pedro?

MR. HJALMARSON: Well, like I say, we're not sure where that canoe he was using went. Now, you have to put yourself in the situation at the time. There were hostile Apaches all over the place, and if you put yourself in a little boat in that river, you'd be -- you'd

be very vulnerable. So you've got to think Apaches. I know a lot about the Verde, and I know why there's very few historical accounts, because it was (indiscernible) to get up there in 1850.

MR. MURPHY: And you're not going to put a boat in a river that's shallow, braided, and unreliable, either, are you?

MR. HJALMARSON: Yeah, right.

MR. MURPHY: In terms of your calculations, I mean, there was some discussion earlier about precision and you utilized some formulas to arrive at particular calculations, correct?

MR. HJALMARSON: Say --

MR. MURPHY: When you did these calculations, did you compute a standard of error?

MR. HJALMARSON: No.

MR. MURPHY: Why not?

MR. HJALMARSON: Well, let me think. No, I -- no, it didn't require that level of -- of precision. Like, the 64 measure of -- during the federal surveys, those 64 measurements of width. I considered that they're not -- I wasn't able to acquire all of the measurements. If I was working with a bigger group, then I could have done an analysis. If you're going by the Gila analysis, there's a -- quite a sophisticated analysis in there of

those measurements. And it matched this method unbelievably well.

MR. MURPHY: Is it fair to say, as a general matter, you are utilizing a scientific method to arrive at results that you should compute some sort of an error to determine what the range of the results are?

MR. HJALMARSON: No. I calculate them in general format. We're after accuracy and to realize that precision isn't going to be all that high. We're post (indiscernible).

MR. MURPHY: And so if there's no standard of error, then there's really not anyway for somebody else to take your data and replicate your findings?

MR. HJALMARSON: They can replicate them. I've laid it out here. It's not that complicated. I -- I -- you're talking to a guy that -- you're talking to a -- I've done more -- more statistical analysis than anybody in this room, I guarantee you. I -- I've done (indiscernible) frequency studies for the western United States, involving 2,000 (indiscernible) stations, and thousands and thousands of years of (indiscernible), et cetera, et cetera.

MR. MURPHY: And basic principle statistical methods is when you use a method, you always calculate the standard deviation or standard error, right?

MR. HJALMARSON: Yeah.

MR. MURPHY: I mean, if we look at the line -- when you put a line on the chart like you have in this, I mean -- there -- there would be -- if you do statistical calculations, there's going to be a plus or a minus with regard to where your data falls.

MR. HJALMARSON: Which -- all right. Give me a page number.

MR. MURPHY: Well, what about the flow duration curves that you did? What's the standard of error for those?

MR. HJALMARSON: They're not fit. You want me to show you how a flow duration curve is -- is derived, or do you want me to just try to describe it to you briefly? Here's -- a flow duration curve is daily discharge. And you have a hydrograph -- say around here, you have a hydrograph where you have low flow until you get into the monsoon season, and then you start getting high flows. And then let's talk about, say, the highest daily discharge, and you take that daily discharge and move it over on the left-hand side of that chart. That's zero. That's zero probability. And then you take your next one and move it over, and the next highest and move it over. And you keep doing that so you have an arrangement in descending order of every daily discharge down to the

lowest day. That's a flow duration curve.

MR. MURPHY: Let me ask you to go down to number 89.

MR. HJALMARSON: 89, boy.

MR. MURPHY: Where'd the 4,500 figure come from?

MR. HJALMARSON: Where's what?

MR. MURPHY: The 4,500 acre-feet figure at the bottom, where did that come from?

MR. HJALMARSON: That's -- that's what this whole discussion is about. That's -- I think of it as a computational estimate. It's accounting for the loss of the runoff from the upper area, as that runoff moves over or through the river and the lower river. So the losses for the runoff of each area is already accounted for.

Now, you have this -- but now you have to account for the loss as the -- as the water upstream moves across it. So it's an addition to the river that's already wet, it's already, you know, and so forth. So it's not very much. And I would argue for -- you know, how accurate that trigger is. It could be three, it could be seven. But it's -- it's an accounting. And if you look at the final result and the flow duration curves I'm using for this analysis, I could be way off on this figure, and it doesn't change the results of this analysis

at all.

MR. MURPHY: All right. Could you go to 119? Could you blow that up?

And I think Mr. McGinnis might have gone over this with you. You say there are no known documented observations of the predevelopment natural river morphology with depth sinuosity, et cetera, for the San Pedro, right?

MR. HJALMARSON: Yeah. Mark asked me that question. Yeah, I don't know -- I don't know any.

MR. MURPHY: And would it be fair to say that a lot of what you're undertaking here are your best guesses about what it was like predevelopment, based on currently available information?

MR. HJALMARSON: Based on current --

MR. MURPHY: Currently available information.

MR. HJALMARSON: Say it again.

MR. MURPHY: (Indiscernible) that what you're doing here is giving your best guesses about what the predevelopment conditions are, based upon currently available information?

MR. HJALMARSON: Yeah. I don't like to call them guesses. They're -- they're -- it's using, I think, the best of available methodology to do this. And like I'm saying again, I'm not -- the precision may not be

there, but what I'm doing is pretty accurate.

MR. MURPHY: Could you go down to 123?

MR. HJALMARSON: 123?

MR. MURPHY: Yeah. And again, you've used this equation, and I'm -- you know, I'm not an engineer or a statistician -- you've used this equation to arrive at information or, you know, conclusions about the San Pedro. When you utilized this equation, was there any computation of the standard of error or standard deviation?

MR. HJALMARSON: No. It's not necessary for this. No, it's not a statistical fit. This is an empirical equation, and it's presented here because it's used to -- I already computed the width -- width equals some coefficient to Q to an X (indiscernible). And now I'm computing the depth and velocity.

MR. MURPHY: And if you --

MR. HJALMARSON: So this is an equation that Mr. Bertham put together, and I'm just showing -- I'm not showing the computation, I'm just showing the -- the values of the different elements in here, so people would have an idea of what I'm doing, but I'm not showing the computation, per se. I've plugged this into Minitab and out pops the (indiscernible). I don't -- I don't do -- I don't -- can do this myself. I just write the program and it's -- and let the computer plot it out and --

MR. MURPHY: Did the sinuosity of 1.5, that's the breaking point between -- generally between a meandering and a braided channel?

MR. HJALMARSON: No. No. It's -- it's a good value -- good added value, and it's also based on respecting old -- old maps of the river. And it's about 1.5 average for the whole thing.

MR. MURPHY: Let me jump down to 138. When you did your evaluation of the Gila River, you utilized three methods for your navigability analysis, right? There was the USGS method --

MR. HJALMARSON: I -- you're talking about the Gila or the San Pedro?

MR. MURPHY: I'm talking about the Gila. When you did the Gila -- well, I'm talking about the Gila right now. When you did your analysis of the Gila River, you used three methods. One was -- two of them were recreational, and the third was a USGS method, right?

MR. HJALMARSON: Yeah. That -- that -- that's quite a sophisticated method. But yes, I used that method, yes.

MR. MURPHY: And then in this case you just used the two recreational methods, right?

MR. HJALMARSON: Yeah. The third method we (indiscernible) was because this -- this wouldn't fit in

that category, that method I used that would apply to the Ohio River and Mississippi River and (indiscernible) and others.

MR. MURPHY: When -- how is it that you chose these standards for determining navigability?

MR. HJALMARSON: How -- what -- say it again, please.

MR. MURPHY: Well, for example, the method from Cortell, which is the recreation and in-stream flow, why did you -- how did you decide to choose that?

MR. HJALMARSON: To choose these two?

MR. MURPHY: Yeah.

MR. HJALMARSON: The fish and wildlife method and the parks and rec method or whatever?

MR. MURPHY: Yeah.

MR. HJALMARSON: They were the -- I think one of those has been used in prior navigability studies elsewhere. My attorney I was working for supplied those two. I -- I'm the one that gave the geological survey method. I studied that in school and -- well, when I was in school, I had studied it.

MR. MURPHY: Now, let me ask you about the method from Cortell and Associates, 1977. That method involved the analysis you did. It also involved making actual site visits to validate the computations, right?

MR. HJALMARSON: On the Gila or --

MR. MURPHY: No. I am talking about what Mr. Cortell did in 1977, when he developed this method. That method involved doing the computations and actually going out to the rivers to see if the conditions matched the computations, right?

MR. HJALMARSON: Mr. -- what's the name? Just say his name.

MR. MURPHY: Cortell, '77.

MR. HJALMARSON: K-O --

MR. MURPHY: C-O-R-T-E-L-L.

MR. HJALMARSON: C-O-R-T-E-L-L. Show me the -- show me the document.

MR. MURPHY: It's -- actually, it's your document.

MR. HJALMARSON: Okay. Where -- where is it?

MR. MURPHY: Do you have it with you?

MR. HJALMARSON: Huh?

MR. MURPHY: Do you have it with you?

MR. HJALMARSON: No, I don't have it here. Do you have a reference to it or -- what slide?

MR. MURPHY: 139.

MR. HJALMARSON: 139?

MR. MURPHY: Yeah. There it is.

MR. HJALMARSON: Oh, okay. Yeah, okay. I

gotcha.

MR. MURPHY: Yeah. Well, this method involves two things, right? It involves the computation, and then it involves going out to the river and determining whether the actual conditions match the computations.

MR. HJALMARSON: No.

MR. MURPHY: No? You sure about that?

MR. HJALMARSON: Yeah, because I couldn't go back before 1850.

MR. MURPHY: But I'm not asking about what you could do in this case. I'm asking about this method. This method says do the computations and then go out to the river and look and see if they match. That's what the method is, right?

MR. HJALMARSON: I don't know how they -- this is the Bureau of (indiscernible) Recreation. Now, how a federal agency would do this, I don't know. I don't know how -- how they devised it, but it appears in a federal document, and I was looking for federal methods.

MR. MURPHY: Okay. So if there was a part of the methodology developed by Cortell, which involved not only the computational aspect, but going to the river to look and see if this -- if the data matched the river, then you did not use the entire method, you just used a portion of the method, right?

MR. HJALMARSON: No. What you're saying doesn't make any sense to me.

MR. MURPHY: It doesn't make any sense to go out and see the actual conditions to validate the data that you generate?

MR. HJALMARSON: They -- they've defined the method using whatever -- whatever means they have. And I'm just simply following the manual, word for word, and applying it to the conditions that I have.

MR. MURPHY: Okay. If you go down to 141, which is Hiram's method in 1978, the fish and wildlife.

MR. HJALMARSON: Yeah.

MR. MURPHY: Now, Hiram developed (indiscernible) method, but he developed two methods of assessing spring flow, right?

MR. HJALMARSON: He developed two?

MR. MURPHY: Yeah. There was a cross-section technique, but then there was a second technique that most researchers believe is the preferred technique, right?

MR. HJALMARSON: Yeah. I think primarily he -- he's -- it's a cross-section based method that you can take into the --

MR. MURPHY: There was a -- there was a -- what was the second method in Hiram's -- Hiram's court?

MR. HJALMARSON: Well, it's basically the same

method, it's displaying data differently.

MR. MURPHY: Are you sure?

MR. HJALMARSON: Yeah, I -- that's -- that's basically it. It's -- here's the one that I -- here's the one I show in my final, right here. It combines the velocity and the depth, and there it is, it's in the acceptable range. And as I explained, I didn't go down to the marginal.

MR. MURPHY: So you used the cross-section method from Hiram, not the incremental method, right?

MR. HJALMARSON: They're all based on cross-section data.

MR. MURPHY: Just a couple of final questions. Has your work in this matter been peer reviewed at all?

MR. HJALMARSON: Has it what, now?

MR. MURPHY: Has it been peer reviewed?

MR. HJALMARSON: On this one, the San Pedro, no.

MR. MURPHY: Because it --

MR. HJALMARSON: I have discussed some of this with -- with people. There's -- the Gila I did was peer reviewed by -- by two, a Ph.D. and a -- and an engineer -- and another engineer. I discussed what I was doing here with several experts, as I went through it.

MR. MURPHY: Okay. That's not the same as peer

reviewed, though, right?

MR. HJALMARSON: I know that. But I -- but I made sure what I was doing was -- was -- met experts in the particular areas, met their field, and they were -- and they agreed to it.

MR. MURPHY: Can you -- can you tell the Commission here of any other research study using the methodology that you've used in this case.

MR. HJALMARSON: Any other research?

MR. MURPHY: Yeah.

MR. HJALMARSON: No. I think I'm the only one -- the only one that's done this. I haven't found many people that have the ability to cover the whole range of what goes on here. I'm kind of alone. There -- there are a couple guys that could do this, though, but they haven't -- they haven't -- it -- it hasn't got their interest. This -- this combines several different aspects of river engineering.

MR. MURPHY: And just so I understand what you told Mr. McGinnis, when he asked you about when was predevelopment, I think the date that you came up with was 1850?

MR. HJALMARSON: And after 1850, I'm using this report as a guide. We know -- we know that man had an effect. So anything you use (indiscernible) you've got to

be careful, because you may think it's predevelopment, and it's not, so --

MR. MURPHY: Did you --

MR. HJALMARSON: And I've said, I really don't know where -- where significant effects of man occurred. And this method does not require that. That's the beauty of this thing.

MR. MURPHY: What would your conclusion be if, after you looked at the data, there was -- there were time periods prior to 1850 where there were sufficient flows for navigability, but there were also time periods prior to 1850 when there were not? How does the Commission decide which one to choose? Do you choose the closest to statehood? Do you just average everything out? I mean, what do you do?

MR. HJALMARSON: Well, I go back to what I just said. It -- if you move the period back where you know the effects of man were, say, in 1840, it still wouldn't affect this analysis. If you went back to -- to Pattie's observations, I have his observations kind of in the back of my mind when I was doing some of this stuff, it still wouldn't affect the numerical computations.

MR. MURPHY: Would you agree that some of the issues you discuss in your report, for example, the entrenchment or the development of the arroyos along the

river, have been and remain the subjects of scientific debate?

MR. HJALMARSON: That they're open to debate for --

MR. MURPHY: That they -- that when those events occurred and when they began are the subjects of scientific debate?

MR. HJALMARSON: Well, yeah. And that's why I held this up. We have experts that recognized that we, as right here today and every meeting we're going to have, there's going to be debates over this. And so they solved the problem for us with the San Pedro. The experts made the decision for us, in my opinion, 1850. I'm not going to argue with that, because some of these people are pretty smart. So --

MR. MURPHY: Oh, the -- that's okay. I think that's all the questions I have, Mr. Chairman.

CHAIRMAN NOBLE: Thank you, Mr. Murphy.

And regarding one of your early questions and Mr. Hjalmarson's answer, we will not let Joy bear the burden. We will just tell you it's perhaps in the manner in which this morning and day has gone, but in the future, the agenda notice appearing from the Commission will not say "in its ordinary and natural condition prior to the State of Arizona's admission." It will say, "at the State

of Arizona's admission." So we will correct that.

We're going to continue this hearing to a date in the future in Phoenix. We won't close the hearing. We'll direct Mr. Mehnert to check with the principals and make sure that we get a date that is as broadly acceptable as possible. We will continue with Mr. Hjalmarson at that hearing.

Mr. Sparks, we appreciate that.

And so are there any questions that we have before we adjourn for the day?

MALE SPEAKER: Yes. Mr. Chairman, one quick question. Win -- Win, in regards to the USGS definition of the San Pedro (indiscernible) a perennial river, did they consider that the (indiscernible) subflow as perennial?

MR. HJALMARSON: No. They did their decision before that, and -- well, I've read the subflow decision. And if you want me to say something about it, I'll give you my opinion.

MALE SPEAKER: Yeah, just --

MR. HJALMARSON: (Indiscernible) major influence -- the subflow -- in the subflow decision, ADWR was influenced by a couple of -- well, two or three attorneys. And they had this -- these accounts that were made after 1850. And that showed that it was dry. So

that -- what I'm saying here today in -- in this document weren't taken into account when they decided to say, okay, we'll call up maybe a preliminary (indiscernible). I do not agree with their decision to do that.

MALE SPEAKER: But you do acknowledge that from the upper end (indiscernible) to the San Pedro?

MR. HJALMARSON: Was -- was not?

MALE SPEAKER: Was not navigable? Did I understand you to say that it -- the beginning of the -- the river down to a certain point, the river was not -- non-navigable?

MR. HJALMARSON: Using the available information that I've done this analysis with, the upper about 20 miles was not navigable.

MALE SPEAKER: How many miles?

MR. HJALMARSON: About 20.

MALE SPEAKER: 20 miles.

MR. HJALMARSON: From the Mexican border to Lewis Springs. Well, actually, Lewis Springs is slightly above where things may got confined and a lot of the water comes up, out of -- you know, a lot of the groundwater comes up. So it's actually about a mile or so beyond Lewis Springs is where.

MALE SPEAKER: So your position on the current navigability is based on from there to the

(indiscernible)?

MR. HJALMARSON: Yes, sir. And because I did it that way, I think you'd see we -- I (indiscernible) the river. Now, I've looked at it for two -- two pieces, following the Montana decision.

MALE SPEAKER: All right. Thank you, Mr. Chairman.

CHAIRMAN NOBLE: Mr. Googan (phonetic) and Mr. Staudenmaier, do you need projectors for either of your presentations?

MALE SPEAKER: It would sure help. (Indiscernible).

(Indiscernible - simultaneous speech.)

CHAIRMAN NOBLE: Okay. That works. We'll probably schedule the follow-up on this for two days, so that we don't need to feel rushed.

We're adjourned for the day.

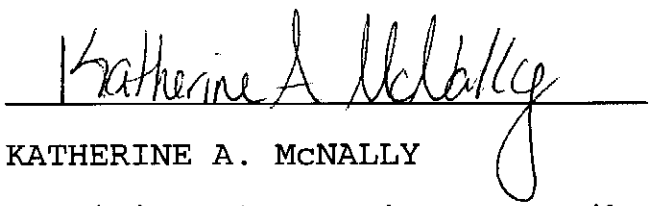
* * * * *

(Conclusion of electronically recorded proceedings.)

C E R T I F I C A T E

I, Katherine McNally, Certified Transcriptionist, do hereby certify that the foregoing pages 1 through 203 constitute a full, true, and accurate transcript, from electronic recording, of the proceedings had in the foregoing matter, all done to the best of my skill and ability.

SIGNED and dated this 8th day of August 2013.



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San Pedro River Hearing Transcript August 1, 2013, Phoenix, Arizona

BEFORE THE ARIZONA NAVIGABLE STREAM

ADJUDICATION COMMISSION

In Re Determination of Navigability of the San Pedro River	)	No. 03-004-NAV

REPORTER'S TRANSCRIPT OF PROCEEDINGS

Phoenix, Arizona
August 1, 2013
9:00 a.m.

Reported by: Deborah Cleary, RPR/CR
Certified Reporter
Certification No. 50663

(ORIGINAL)

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THE REPORTER'S TRANSCRIPT OF PROCEEDINGS was taken on August 1, 2013, commencing at 9:00 a.m. at the Arizona State Capitol Building, 1700 W. Washington Street, Third Floor Conference Room, Phoenix, Arizona, before Deborah Cleary, RPR, CR, a Certified Reporter in the State of Arizona.

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PROCEEDINGS

THE CHAIRMAN: We'll continue the hearing on the San Pedro River before the Arizona Navigable Streams Adjudication Commission.

Today, we have a court reporter with us, and the remainder of the proceedings will be taken by the court reporter. And it is my understanding that the court reporter is also transcribing the tapes from the previous hearing. Lawyers in the room are familiar with the process. If you need a transcript, if you want it, please take a card from the court reporter.

At this time, we would like to welcome Sister -- Sister. Senator Gail Griffin, and she has a presentation for us.

SENATOR GRIFFIN: Good morning. I have been a resident of Cochise county since 1968, so I'm not quite at the 1912 date. But I have many constituents that have family members of multi generations that have been in Cochise county since the late 1800s. So they have provided me with some information that I'd like to present to you.

THE COURT REPORTER: Could you speak up just a little.

THE CHAIRMAN: That microphone does not amplify your voice. That's the recording microphone.

SENATOR GRIFFIN: Oh, okay. Yes, I can speak up.

THE COURT REPORTER: Hold on just a second. Yes, you'll need to for me, please.

09:01:41 SENATOR GRIFFIN: Constituents in Bisbee and
09:01:43 Douglas area presented to me, which I will present to you,
09:01:50 information from the Cochise County Historical Society.
09:01:54 And it pertains to the railroads and how they were
09:02:00 established in Cochise county along the San Pedro River.
09:02:04 And in 1903, the layout of the rail route was
09:02:13 given, and in 1904, I believe it was completed. So
09:02:20 there's information on the railroads in southern Arizona
09:02:24 that goes through Cochise county and along the San Pedro
09:02:28 River.
09:02:29 The Benson canal was incorporated in 1908, and
09:02:35 there's information on that as well as a map showing 1909,
09:02:42 the Benson canal, along with the agreement, the assessment
09:02:49 that was in 1910. There was a diversion dam put in as
09:02:57 well. And a copy of the agreement, $10.00 for each share,
09:03:07 is in this report. Towns throughout the San Pedro Valley,
09:03:15 the Mormon battalion passed through the valley in December
09:03:19 1846, and they found the river to be shallow stream. The
09:03:23 new settlers found the channel in the river had deepened,
09:03:28 created serious problems for the farm irrigation. During
09:03:31 the flood season, the dam would wash out. And the men
09:03:34 would reconstruct the dam with their teams. So there's

information on the Benson canal.

And in the Palmarine area along the San Pedro River, in 1854, a survey crew saw their first glimpse of the San Pedro River. A view of the San Pedro Valley, a dry parched-looking plain. The stream is about 18 inches deep and 12 feet wide and flows with a rapid current. The banks are devoid of any timber or any sign indicating the course or even the existence of a stream to an observer who but short distance was removed. The stream itself was insignificant.

So there's a report on that. And I don't know if you have The Changing Mile. I'm not going to read the whole thing.

You're welcome.

MR. HORTON: You brought it.

SENATOR GRIFFIN: But I do want to talk about a couple things, and I will leave this with you.

During the sunny summer season, flash floods enter. The stream's impassable. At such times, the channel is filled bank to bank with raging running torrent that carves a new incisions in the flood plain and sharpens the edges of the old. So -- and when I talked to my constituents in the area, what they tell me is when it rains, we have water in the river. When it doesn't rain, we don't have so much.

I went to Mexico to see where the San Pedro started many years ago. And I asked the farmers in that area, "Tell me about the San Pedro and your water."

And their comment was: Well, we have water when it rains, and we don't have so much when it doesn't rain. So the same thing on this side of the border. And I've marked different things. And this portion of The Changing Mile is on the San Pedro River. It also shows the Charleston dam, a picture of the Charleston dam and -- and how it looks today.

And so on each page, there's a picture of 1891 and thereabouts up to -- and then on the other side is what it looks like today. So the story, the pictures really tell the story.

A few miles downstream from the preceding plate looking eastward towards Bronco Hill, one and one-half miles above the old town of Charleston, the dam which supplied water for the mills in Charleston for use of the proceeding ore from Tombstone mines, was destroyed in 1887 by a forerunner of the flood that three years later initiated channelling the San Pedro River.

So each one that I marked has information on the San Pedro River. So with that, I'm going to give you the book. And I received an e-mail from Mr. Shook that lives in Elgin, which is in Santa Cruz county, but not far from

the San Pedro River. And he tells, My grandfather, Raymond Shook, and my great grandfather Henry, Henry Pike, arrived in Benson in 1913. An integrate car pulled by the Southern Pacific Railroad, the car included dairy cattle, two bay horses, a springboard wagon and supplies. It was very cold and ice forming on the water barrels in the car.

They were eventually switched to a train headed to Fairbank and Charleston. At Fairbank, they switched to a doodlebug going to Elgin where they found the land office and were able to file for a homestead. I knew my grandfather well and often discussed his early days with him. He often spoke about how dry it was there compared to other places he had lived and how dry the San Pedro River was. He always joked about how it wasn't a river at all when he arrived. As a child, I always enjoyed going there with him after the rain so we could see water flowing. We picnicked there under the cottonwoods. Also when I was 14 years old, I read all the Charleston Pesos books about excavations and Indian sites along the San Pedro River. In his books, they never did read any findings of artifacts that may be associated with river-going culture. It seems it must have always had an intermittent area of water.

And so I'll submit his letter as well. And I'd be happy to answer any questions if you have any for me.

But I can -- weekly, I get calls from constituents. And I said, "Send your comments in."

THE CHAIRMAN: Thank you very much, Senator Griffin. Would it be all right if we kept the book long enough to copy that section --

SENATOR GRIFFIN: Absolutely.

THE CHAIRMAN: -- and then returned it to you?

SENATOR GRIFFIN: Absolutely. In fact, it's not my book. It's -- but I'll be happy to return it to the owner.

THE CHAIRMAN: Does the Commission have any questions for Senator Griffin? Does Fred have any questions? Does anyone else have any questions?

MR. HJALMARSON: I'd just like to make a comment. I also have The Changing Mile. I consider it a number one type reference as opposed to two, three, or four that you run across a lot. It's an excellent book.

SENATOR GRIFFIN: It is. I've ordered my own.

THE CHAIRMAN: Well, thank you again for coming.

SENATOR GRIFFIN: My pleasure.

THE CHAIRMAN: We appreciate you. Are there any other preliminary matters that we ought to take up before we return to Mr. Hjalmarson? My understanding is that Mr. Hjalmarson has some additional presentation that he would like to make prior to any additional questions. Is that

all right, Mr. Sparks, because I believe you're next?

MR. SPARKS: Yes, Mr. Chairman.

THE CHAIRMAN: And we can begin rearranging the tables so that you can face Mr. Hjalmarson at this time.

And, Mr. Hjalmarson, if you have additional items that you'd like to comment on before additional questioning, please start.

MS. HERR-CARDILLO: We were -- we were prepared to do it in the traditional order of redirect.

THE CHAIRMAN: Then we will do it in that way.

MS. HERR-CARDILLO: Okay. Sorry.

THE CHAIRMAN: We are accommodating.

MS. HERR-CARDILLO: Sorry for the confusion.

MR. HJALMARSON: Let me add to that a little bit. If I get a question that directly pertains to something that we plan to summarize or clear up, then I could -- I can show it now and then not show it later. So I could show part of it. I have about seven parts, seven separate items where I think there's a little confusion as a result of what transpired on the Benson range --

MS. HERR-CARDILLO: Bisbee.

MR. HJALMARSON: -- or Bisbee range. Excuse me.

THE CHAIRMAN: Here's how we'll do it. We'll go ahead with Mr. Sparks. Or you want to do the redirect now?

09:11:24 MR. SPARKS: I'm here, and I'll take my turn
09:11:25 whenever it is. And I don't have any problem if they go
09:11:30 now and then. You know, whatever the Chair and Commission
09:11:35 wishes to do.
09:11:36 THE CHAIRMAN: I'm thinking it's not just Mr.
09:11:39 Sparks.
09:11:40 MS. HERR-CARDILLO: Yeah.
09:11:41 THE CHAIRMAN: We have others that if we're going
to present additional information, let's do it now so --
MS. HERR-CARDILLO: Okay.
09:11:44 THE CHAIRMAN: -- they can gauge whether or not
09:11:44 they might want to have some additional questions --
MS. HERR-CARDILLO: Sure.
09:11:47 THE CHAIRMAN: -- from the additional comments of
09:11:49 Mr. Hjalmarson. Would that be all right?
09:11:51 MR. SPARKS: Yes, sir. Whatever you would like.
09:12:00 THE CHAIRMAN: And just so we're clear, with
09:12:02 additional comments coming from Mr. Hjalmarson, those who
09:12:02 previously discussed things with Mr. Hjalmarson will have
09:12:05 an opportunity to discuss points that he may raise today.
MS. HERR-CARDILLO: So you're never getting off
the stand. That was a joke. That was a joke.

WIN HJALMARSON,

called as a expert herein was examined and testified as follows:

REDIRECT EXAMINATION

BY MS. HERR-CARDILLO:

Q. I understand that you're concerned that there may be some confusion about your methodology and you wanted to -- you brought some slides with you to help hopefully clear up that confusion?

A. Yes. I was concerned about the hydraulic geometry. But first off, I want to emphasize that the reason that I focus on both the hydrology and the hydraulics and the geomorphology is because everything changed because of human activity. So that's why I'm going to all this trouble to recreate what the natural channel looked like.

And a good way to do that is with hydraulic geometry or machine theory, depending on which scientific endeavor you're involved in. So let's start with just a simple, discharge is equal to the area which is width times depth times velocity. Whoops, that's it. Now you can -- for alluvial channels like the San Pedro and also, for example, liked the Mississippi River, the same procedures follow in regard to the hydraulic geometry.

Engineers have determined that you can describe width as shown in the first equation. In other words, width as a function of discharge using a coefficient A and an exponent B. And you can get the same thing for depth and the same thing for velocity. This allows you to describe how width, depth, and velocity varies with change in discharge. And this is -- to try to avoid some confusion here, hydraulic geometry works for a particular cross-section on the channel. It also works for a down channel. What I'm talking about here today is a particular cross-section on a channel, so one particular location.

So what we have, Q is equal to area times velocity. And you can substitute what I showed in the previous slide and you can show that it -- the equation Q is equal to this AQ to the B exponent times the other and the other. And then using mathematics, you just combine that, and you end up with the equation Q is equal to the product of the coefficients with Q -- times Q to the sum of the exponents. Then what you end up with is some fundamental relations there.

In order for that equation to be proper, the sum of the exponents has to equal one. And the product of the coefficients also has to be at 1. And so when AK -- ACK is 1 and Q and BFM is one, then Q equals Q. So it's that

simple. So this is a background for hydraulic geometry. So this has been around for couple hundred years.

So back in the 1970s, the USGS conducted a lot of studies on hydraulic geometry. And the original work was what I just showed you. It was by Leopold and Maddock. And Maddock is a University of Arizona graduate, first Rhodes scholar from the University of Arizona way back when. Anyway, they produced this classic paper. And then it's been expanded upon and refined by many scientists.

One of them in particular is Wade Osterkamp, and he's also -- he lives in Tucson, and he's a retired USGS scientist. And he devised a method of using hydraulic geometry and sediment -- the sediment characteristics along the channel. And this is the characteristics of the sediment in which the channel was formed like the San Pedro.

That's the method I used. So it's used for many purposes. And a good example of it is this National Engineering Handbook that I am showing here on the slide. And I want to make a comment that it's unfortunate that this method is misused, and there's a few examples of it. I'll show you one.

There was a study up in the state of Washington conducted by two USGS employees, and they were trying to use information of stream gages to predict river depth and

top width and bottom width. And as you can tell from the reference there, it was for the navigability potential of rivers in the state of Washington.

So they were trying to take a shortcut on coming up with parameters of -- of primarily depth using existing information on the geologic information system network. So as a result of this, taking this shortcut method, they violated some basic rules in regard to the use of the hydraulic geometry method.

And here's three of them, and they readily admitted this in this report. In the summary of the report, they're very, very honest about it. They say, Hey, this didn't work because of such and such. And one problem was a lot of the gaging sites they used for discharge were affected by manmade structures.

And then they had a combination of base level and tributary streams. So they have different kinds of streams in their sample. And -- and they had a mixture of natural and human-affected streams. So if you know anything about hydraulic geometry, you would have known right from the start wasn't going to -- wasn't going to be very good. So okay.

Q. Okay. So and also there were a couple slides that you had included in your Bisbee presentation that you felt there was a lot of confusion about, and you'd like to

revisit those?

A. Yes. I believe the attorneys for the mine questioned us, and this is slide 97 from the Bisbee power plant. Mark asked me about where the main discharge came for the Charleston gage. And on every -- every day of record was used to determine that average of 52.1. So I took the average of 39,899 days of record and simply computed the average. So I hope that settles that.

And I presented this slide just to show that I was using a USGS method for the runoff, the total runoff. And then I was making an adjustment to the Charleston gage to create the same kind of number. And so I just plotted those points and eyeballed a curve through it.

Now there was a discussion about the shape of that curve. The shape of that curve is meaningless. And I showed it as a smooth curve just to show relative magnitudes. Now here's the result of a ground water model by Maddock and Goode. And this Maddock is the Maddock's son, and he's the head of hydrology department at the University of Arizona. Goode is a Ph.D. and he's in the consulting business over here in Tempe. And I talked to him twice about this particular result of their ground water modeling.

This is an extremely sophisticated model of the base flow of the San Pedro River at different times.

1940, '60, '80, 2000 and then an estimate of 2020. It starts up near the Cananea mine right at the headwaters. And you can see that it's not a smooth curve.

Oh, let me clarify one thing: This is for the base flow. The previous slide was for total runoff. Okay. So you have to have a little bit for, like the senator said, when it rains, you get a little more water in the river. But the point I'm making here is it's not a smooth curve. And like at the narrows, you get an increase of flow, and then a decrease in here because more -- more water would be flowing through the sediments and not on the surface and so forth. So you get a variation because of the river conditions itself. You also get a variation because the recharge for ground water is coming in all along the length of the river because there's mountains all the way along, and that's where most of the recharge is occurring.

And then you can see the effect of these diversions. The St. David ditch and the Pomerene canal. So to get an idea of what the total base flow, it's just displace this relation up the amount of that, that diversion. So just displace this part upward. And you'll see here on this discharge scale, you'll start getting quite a bit of base discharge when you do that. So that would be a rough estimate of what the natural base flow

would have been.

Now in the appendix of my original report, there's also a display of a USGS study, a display of base flow along the entire river. And it's my Freethey. And to clear up another thing about Freethey, Freethey produced two ground water models for the San Pedro. Most people are aware of the first one, but there's a second one out there. So just -- I just want to drop that off as a piece of information.

Okay. Let's go back to the smooth curve. This is the smooth curve that I showed in Bisbee that seemed to cause so much trouble. So I thought I'd clear -- clear -- clear some things up here. So these green points are the USGS open file report that showed the total runoff. And then the Charleston gage that I had estimated is the blue point here. And then at the -- at Palominas, I also have a point here that people were raising questions about. So it's shown here.

But here's something that's very interesting. There's a U.S. Bureau of Reclamation report out that estimated the natural runoff of the San Pedro River. They did it at Mammoth, at Charleston, and at Palominas. So I didn't show that it on the original slide. I thought it would be showing too much data.

So here is all the information I had when I did

this. And I concluded that this number that I used agreed with these two numbers that I was using. And that's the whole purpose of that whole thing. Now if I wanted to show more water, let's say I was trying to promote, you know, water navigation, I could have easily used this number and referenced the U.S. Bureau of Reclamation report. And I could have used this one here. If I had done that, it probably would have been navigable clear to the Mexican border. Okay? I didn't because I'm using a method consistent with what I used for the lower Gila. I'm using the same method, as close as possible.

Okay.

Q. So if I understand from your testimony, if I understand correctly, which is a big if, but you are of the opinion that in doing -- running your model and looking at all the data that the impact from the mines was generally underestimated?

A. Yes.

Q. Can you explain that to the Commission why you believe that.

A. Okay. The Copper Queen and the Cananea mines are very old mines and predate 1940 big time. They both started roughly at the turn of the century or a little before actually. And the ground water modeling that's been done by almost everybody, USGS and what I just showed

you by Maddock and Goode, they start at 1940. They kind of consider that as a natural point to start. And the reason is the ground water levels had not changed much until that time. But our issue here today is not ground water levels. Our issue is the base flow in the river. So they can justify what they did, but it doesn't do us any good.

Now there was a quest -- Mark raised a question about how I came up with a water use per pound of copper. And I used a modern, a very recent set of information from the Arizona Bureau of Mines. Well, here's an old reference here, and it's almost identical to the number I used. So I just want to point out that -- that the water use per pound of copper produced hasn't changed much in 100 years, at least the long and the short of it.

So this is a reference that says that the water used for the Cananea mines was both from springs -- in the early years, was from springs. The springs, I assume, are both in the Sonora River basin and the San Pedro River basin. They are -- the water was -- came from both basins. So the early pumping or the use of ground water and the intersection of spring flow according to this reference can take -- it'd take quite a while to impact the river.

This shows where the Copper Queen copper

production started in 1884. The early water use was from the interception of spring flow. The first well was drilled in 1898. It was drilled about, I think, about one and a half miles west of Naco towards the river. And it was 120 -- or 118 feet deep, and it produced 200 gallons a minute. And that was enough to supply the mine, the hotel, and to produce ice. There's 35 wells now. Well, the mine, of course, is out of business, but the mine had a total of 35 wells, and 33 of them were in the San Pedro basin. And those wells, most of them were drilled in the early -- well, around -- well, before 1920 or so.

This information is in the ground water report by Don Poole that I previously had mentioned.

THE CHAIRMAN: Win, could you go back one slide.

THE WITNESS: Yes, sir. There?

THE CHAIRMAN: How do you number that slide or what do you call it? Does that slide -- does that slide have a number?

MS. HERR-CARDILLO: 15, it looks like.

THE WITNESS: 15.

THE CHAIRMAN: Is that slide number 15?

THE WITNESS: Yes.

THE CHAIRMAN: From the previous presentation?

THE WITNESS: No, sir. That's a good question. These were the new numbering system. This slide was not

shown previously.

THE CHAIRMAN: This is slide number 15 from today's presentation?

THE WITNESS: Yes, sir.

THE CHAIRMAN: Thank you.

THE WITNESS: Okay. This is a very interesting report. I haven't --

THE CHAIRMAN: Win, what slide number is this?

THE WITNESS: 17.

THE CHAIRMAN: This is slide number 17?

THE WITNESS: Yeah. My -- my -- here, let -- well, let's see. I've covered it up with the -- with the yellow.

THE CHAIRMAN: We're just trying to help the court reporter.

THE WITNESS: Okay. Okay. This is an interesting reference. I haven't seen it in any of the information presented thus far. In Fuller, you know, the land department stuff and all that, I haven't seen it. But it's a gem. It's a report by Mowry. He was a very interesting man. He used to be the boundary commissioner, as I -- as I said there. And he's a -- he was a West Point grad and a lieutenant in the military involved in some of the original mapping, the railroad surveys and all that.

But here's what he observed in 1864 up at the Cananea mine, that there's good springs and there's a permanent stream about a mile below the mines. And actually when I call it Cananea mine, there's about seven mines up there. And it's one smelter known as the Cananea smelter. So just I loosely refer to that as Cananea mine. So does everybody else.

Now --

THE CHAIRMAN: Slide number?

THE WITNESS: 18. And that's getting down here. See it?

THE CHAIRMAN: No.

THE WITNESS: This is from a -- the Mining and Scientific Press, 1930 publication. And it shows that -- it shows the copper production of the Cananea mines, but this is interesting. It shows the total production of the smelter. What's going on here is they're importing ore from the Miami mine in Arizona. They're railroading it in and smelting it there, in other words, using water.

Now I point out again, the water they're using is from wells and springs in both the Sonora River and the San Pedro. I do not know how much from each.

Here's a 1916 reference.

THE CHAIRMAN: And this is slide number?

THE WITNESS: 19. It shows the population of

Cananea as 16,000.

Here's slide 20. And this is from The Mines Handbook in 1922, and here's the copper produced from 1908 or what -- yeah. Let's see, 1908 to 1920, the total copper produced there, which is a bunch. And that represents quite a bit of water. That represents several cubic feet per second of water that could be the base flow of the San Pedro River.

Q. (By Ms. Herr-Cardillo) Okay. Moving on to slide 21, The Disappearing/Reappearing San Pedro. There's been a lot of discussion and some evidence submitted suggesting that this disappearance and reappearance of the San Pedro supports a finding of non-navigability. And could you explain to the Commission why you disagree.

A. Okay. This is slide 22. The purpose of this slide is to show that at the law school in New Mexico, there's a fellow there that thinks that we ought to consider human development growing since 1850. That agrees exactly with this report I held up a lot in Bisbee, the Arizona Geological Survey Report. So when you're talking about human effects, you'd better start talking -- go back to at least 1850.

So there's four accounts that I'm aware of where the San Pedro River was dry. The first one I'm aware of is by -- I think it was a Lieutenant Parke. And he was

doing a Pacific Railroad survey. And I have -- I didn't use Fuller's material on this. I used the original -- original document. So I have the original document submitted to Congress on that. I did not rely on Fuller's references.

THE CHAIRMAN: And, Win, we're talking about slide number 23?

THE WITNESS: Yes, sir.

THE CHAIRMAN: Thank you.

A. I also have the original document on the wagon road survey, right here. This is what -- this is what was submitted to Congress. Here's the -- all the references here are marked that relate to the San Pedro River.

And other documents, I also have the boundary survey documents, the originals. Not relying on references. And I'm going to show you why those are important.

So we have three accounts that remain in September of 1857. One of these was by a gentleman named Tevis, and his children wrote a book about his experiences. Walt Disney made a movie of the book, a three-part television series. But here's the book. This is the original reference. And Tevis exaggerates. He's a hyperbole expert, like a lot of old timers. They really make a good story.

So it makes the history that he has in here kind of iffy. For example, he talks about a six-mile tunnel at San Xavier mission, and you've seen it, you know, where the priests can escape from the Apaches and they can go down into this tunnel and go six miles wherever and be safe. Well, as far as I know, bedrock is three foot below the base of the mission. So it besides being kind of ridiculous, there's bedrock there, so I don't know how you'd get a tunnel. So but let's just -- I assume that, all right, that's an accurate account, but it's at the same place and the same month as two others, allegedly two others.

What did I do here? Oh, yeah, I missed my -- I made a point here.

Q. (By Ms. Herr-Cardillo) This is going back to 23.

THE CHAIRMAN: Okay.

A. Yeah, I'm back to 23. But when you read these documents, you'll see that an engineer Hutton produced a report and his supervisor Leach signed it at a different date. So as far as I can determine, Hutton saw the river dry. Leach, the supervisor, was back in Washington or whatever. That's a possibility. Where he just signed it at a different date so he gets credit for seeing a dry river. My point is there's four people that allegedly saw this, but it's really two times, two different occasions

it was that way.

THE CHAIRMAN: Will you keep the record straight.

MS. HERR-CARDILLO: Yes.

Q. (By Ms. Herr-Cardillo) Okay. Moving on to slide 24.

A. Okay.

Q. I'm just doing that so the court reporter knows what slide you're talking about.

A. Okay. So here's what I thought was interesting. Both Parke and Hutton referred to the river as turbid and that it disappeared and reappeared. And it reappeared clear and limpid. And I thought, How odd that two descriptions two years apart would use the same words.

And, second, what's the significance of turbid? When you see a turbidity in a natural river, what does that mean? It means something very important.

Q. So slide 25?

A. Slide 25. Mr. Hutton was an engineer on both the Pacific Railroad and the wagon road surveys. As far as I can determine, he wrote the reports and used the same description.

Now in regards to turbidity, natural streams rarely are turbid unless after major floods where there's been a big disturbance. And then for a while, you're going to get, you know, muddy water and so forth.

According to the EPA and a whole lot of other experts, turbidity, high turbidity rivers tend to be located in watersheds that have erodible soils, disturbed soils, and stream channels with significant agricultural farming activity. Well, that kind of describes the San Pedro to me after the humans got there.

So as far as I can determine, these guys were looking at a river that was disturbed. And we know all about the 60,000 cattle that were there the Spanish brought in so forth and so on. So I think we're looking at an unnatural -- an unnatural river.

Q. And just I'm sorry. I messed up. But turbidity was addressed in slide 26.

So moving on, the next few slides starting with slide 27 talk about the diversions that were along the San Pedro in the 1850s; correct?

A. Yes. In other words, I'm saying that you could have a watershed disturbed by, say, cattle and whatever, a lot of logging going on for different mining, small mining operations along the river way back. But anyway, there were diversions in the 1850s. The Indians were there through 1919.

Q. Slide 28?

A. Slide 28, it's been practiced since ancient times, according to a U.S. Congress document, right there.

Q. Slide 29?

A. Slide 29, some of these parcels have been irrigated continuously to the present time, and this is -- the present time in this is 1919 in this report.

Q. Slide 30?

A. Slide 30, you can read that for yourself. So this is just another statement about continuous irrigation.

Q. And slide 31?

A. Slide 31, until about 1860, the Indians maintained their rancheros -- rancheros -- rancherias or whatever you call it, along the San Pedro. And anyway, they were forced out and so forth. But up until about 1860, there were quite a few them there, and then they started -- there were fewer and fewer of them.

One reason you don't see accounts of these Indians is the military was rounding them up and putting them on the reservation over there near Safford. And they weren't going to show themselves to people coming by. They were hide -- they were pretty good at hiding, and that's what they were doing. So that's one -- one reason why I think they weren't documented in the Caucasian history, let's call it.

Q. Slide 32?

A. So we had about 75 Indians in there prior to

1868. So...

Q. And these slides and references to continuous irrigation, just to clarify, all came from the same 1919 property to Congress?

A. Yes, ma'am, same report. U.S. Congress and the pages that this references is given right there, 185 and 186.

Q. And is it generally -- go ahead.

A. I have that. I have a copy of that report here in my documents, if anybody wants to see it at a break or at lunch or whatever.

Q. Okay. So is it generally accepted among hydrologists and in the literature that the San Pedro was perennial historically?

A. Was what?

Q. Perennial historically.

A. Yes. I've shown -- I showed several at the Bisbee meeting, and I'd like to show some additional ones, additional references.

Q. This is -- I'm sorry. What's -- what number is this slide?

A. Let's see. I lost track. Okay. This'll be 34.

Q. Okay.

A. This is a reference. I'm showing this reference because they're saying that according to the federal

surveys, there was water -- it was perennial. There was water at every cross-section. I'm showing that because I didn't have access to the federal survey records. I wish I had because I've had a lot of surveying. I've had -- I learned how to survey using a chain and a transit, sighting Polaris at night and all that.

So when I read those federal surveys, I'm very comfortable reading them. I know what they were doing. So I didn't see it. But so here's a reference of somebody who has looked at them apparently. And the widths are 23 to 36 foot wide, some locations 56 foot wide. These are surveyed using federal standards.

Q. Slide 35.

A. Slide 35. There was stream flow at all of them, like I said. And this is from a different reference. This is Huckleberry of the Arizona geological surveys.

Q. Slide 36?

A. Slide 36. Well, I think you can see that -- see that for yourself. This is from the Arizona State Land Department information that we're -- we are -- we've all been -- also saying it was perennial.

Q. Slide 37?

A. Slide 37, this goes back to this interesting gentleman Mowry that I was telling you about. But nobody seems to know this report existed, but here it is. That's

what it looks like, 1864.

Q. And slide 38?

A. Slide 38, he said how he reached it. His description there matches a little bit like the description of the Mormon expedition. This is an interesting observation of the slides. This is the largest one I'm aware of where it shows the depth. The federal surveys don't show the depth. He observed this as 33 feet wide and two and a half feet deep.

Q. Slide 39?

A. Slide 39, this is from the railroad survey by Lieutenant Parke, page 219. Says there was water the entire length of the valley. And back then, I don't think he was all that focusing on the Mexican border, but I assume he was looking at the whole river, all the way through Sonora. I don't know, but it seems that way.

Q. And slide 40?

A. Slide 40, this is another reference to that by Emory during the original boundary survey. Says, "throughout the whole course, plenty of water for irrigation."

Q. And is this 41?

A. Yes. This is by the geologist of that survey, of Emory's survey, but it's a separate reference. And he said it was an uninterrupted stream of running water along

its whole course.

Q. So this next slide deals with the fire, the 1858 fire. And you wanted to talk about that.

A. Yes. I just wanted to point out that when the wagon road survey was being done, I guess they built too big a campfire and they burned the whole valley. This account indicates that it burned it from one end to the other for a hundred miles or whatever.

Anyway, a fire like this would seriously disrupt the sediment movement in the valley. You would expect more rain -- more runoff from rainfall because of the cleared ground cover and so forth. And this could remain, I'd say, unstable for years with high sediment yield and more runoff.

Q. I'm sorry. Is this slide 42?

A. Is that what it was?

Q. I believe it so. I believe so.

A. Okay. That's all I had on the fire.

Q. I'm sorry. I didn't mean to cut you off. But just my job here is to keep the record clear.

So finally, in your testimony at Bisbee, you emphasized that you've taken what you believe to be a very conservative approach in terms of trying to evaluate what this river would have looked like in its ordinary and natural condition.

09:55:23 1 Can you just review for the Commission why you
09:55:26 2 believe your approach is conservative, where you make
09:55:31 3 conservative choices.
09:55:33 4 A. Okay.
09:55:39 5 Q. So starting with slide 44.
09:55:42 6 A. Okay. Yeah, slide 43 was just the introduction
09:55:47 7 to this little section. Okay.
09:55:49 8 Slide 44, I've already covered why the
09:56:02 9 predevelopment hydrology was probably underestimated in
09:56:08 10 regard to the mines. And that's the first point I'm
09:56:12 11 trying to make here is that ground water model started in
09:56:15 12 1940, but a lot was going on before that in regard to the
09:56:20 13 base flow of the river itself.
09:56:25 14 I used the USGS study by Freethey and Ander -- or
09:56:38 15 by, yeah, Anderson and Freethey. And their results are
09:56:39 16 lower than almost -- actually not almost. They're lower
09:56:43 17 than all of the other ground water modeling form in the
09:56:48 18 upper San Pedro or in the entire San Pedro. Most of the
09:56:55 19 models -- (inaudible). There's two models that cover the
09:56:56 20 whole river. Their results show less base flow in the
09:57:03 21 river than the other studies. And I've used their study.
09:57:10 22 Q. Okay. Moving on to slide 45.
09:57:13 23 A. The discharge in the springs all along the river
09:57:19 24 and up on the mountain slopes and so forth was ignored.
09:57:30 25 And then the base flow, the base runoff at the Mexican

09:57:33 1 border doesn't account for the city of Cananea, 16,000
09:57:38 2 people back in 1916 or whenever it was. And this has been
09:57:46 3 ignored by, like I said before, by several ground water
09:57:51 4 models.
09:57:53 5 There's a USGS report that I covered in my
09:57:57 6 appendices that were in slides 23 and 24 of the appendices
09:58:03 7 of my first report that showed that the -- that
09:58:09 8 transpirational losses might have been 40 percent of the
09:58:15 9 post 1970 losses. But the earlier losses to ET might have
09:58:26 10 been considerably less. I ignored that.
09:58:33 11 I previously mentioned that there's ground water
09:58:42 12 stored in the stream alluvium. It kind of acts like a
09:58:46 13 separate aquifer from the basin fill aquifer. And the
09:58:51 14 effects of that storage and slow release of water back
09:58:55 15 into the river during dry periods, in other words, the
09:58:58 16 increase in base flow associated with that, was also
09:59:02 17 ignored.
09:59:07 18 And then a general uncertainty of predevelopment
09:59:13 19 conditions. And the slides where I mentioned that in my
09:59:20 20 original talk were given there.
09:59:23 21 Q. Moving on to slide 46.
09:59:25 22 A. Let's look at sinuosity. I used a sinuosity of
09:59:35 23 1.5. In the classic work by Leopold and Wolman, they
09:59:48 24 pointed out that 1.5 might be the lowest possible value.
25 A lot of recent work that further refined their original

work shows that the lower threshold sinuosity for -- this is for meandering self-forming rivers like the San Pedro. The lowest limit might be about 1.3.

Q. This is slide 47?

A. So let me go back to that. Let me finish the -- I -- I --

Q. So back to slide 46?

A. Yeah, I'm going back to that slide. There was a previous study -- I think it was presented to this Commission -- where a sinuosity of 2 was used. I chose to use the lower figure, and I stuck with Leopold. I used 1.5. This is conservative.

If I used a sinuosity of 2, I would get a lower slope of the river. When you get a lower slope, and you are, say, dealing with a specific discharge like 30 cubic feet per second, once you lower that slope, then what has to happen? The depth of the flow would increase and the widths will increase. The width of the flow would increase.

So if I was trying to stack the deck in favor of navigability and trying to create more depth, I would have used the bigger sinuosity. I didn't because I wanted to be on the low end of this. I wanted to be conservative. I'm going to explain why.

You have small ripples associated with meandering

streams. You'll have pools and riffles develop. They're very small. They're not big pools and riffles that you see on mountain streams where you have a lot of rock and so forth. They're -- but if you look at it very carefully, you'll see that. And a lot of diagrams you'll see in textbooks that are explaining this don't -- they're cartoons, and they're -- everything is amplified so you can see what they're talking about. But in reality they're generally very small.

Q. And this, just to be clear, you're now on slide 47; correct?

A. Okay. There's a few hard rock constrictions in the river. I think there's about three. And you can get a steepening of slope there and possibly a reduction in the depth of flow. So I stayed conservative on this because, you know, the navigability is looking at conditions all along the entire river. So these fluctuations in channel geometry and the small ones associated with slope and so forth will affect the navigability. So like I say, I'm stay -- I stayed conservative on the low end. Okay?

Q. Okay. Moving on to --

A. Let me just add one thing on that. If you look at existing surveys of, say, cross-sections along the river and so forth, you're looking at the effects of

humans on the river. So because of the severe disturbances and head cutting and so forth that's occurring along the river, you're going to see situations where the slope would be except -- quite a bit more than what I've used in this study.

You'll even see situations where the slope will reverse because I've showed an example in the supplemental material where this tributary in Benson completely -- it carried so much sediment it completely filled up the culvert at the railroad and the highway, completely filled the culverts and so forth. And that material will -- you know, went on down to the river, and it could have put a big deposit in there and actually formed a dam.

So when you look at present conditions or, let's say, non-natural conditions, you're looking at things like that that might have existed under natural conditions but on a much smaller magnitude and a much less -- much smaller frequency.

Q. And now moving on to slide 48.

A. Okay. This is slide 48. This is the -- slide 48, this is the last one I have. This kind of summarizes what I've been saying here is you have alternating gaining and losing reaches. And you have varying amounts of recharge, ground water recharge and so forth, coming in along the river, along the entire length of the valley.

There are possible multiple channels in a meandering river like the natural San Pedro. You can get reaches where you can have braided flow, for example. Now having braided flow does not mean it wasn't navigable. It means it was probably more difficult.

For example, the Mississippi River has a reach towards the upper end where there's miles of channel that under natural conditions was braided and so forth. So it does happen. And then just a general accounting of the recognized variable hydrologic and geomorphic conditions, such as small riffles and so forth, along natural rivers like the San Pedro. So -- so when I put my engineering seal on it, I'm going low end and I'm trying to be as safe as I can when I say it was navigable.

MS. HERR-CARDILLO: Thank you. That's all we have.

MR. HENNESS: When you say it was what?

THE WITNESS: What?

MR. HENNESS: What was the last word you just used?

THE WITNESS: Well, it was susceptible to navigability is what I just said. Thank you for -- I'm saying it was susceptible to navigability, the low level springs, 80 percent of a typical year.

MR. HENNESS: 80 percent of a typical year.

10:07:16 THE WITNESS: There's a couple of summer months
10:07:18 where all along the river because of the high
10:07:22 evapotranspiration, it wasn't -- it wasn't -- I didn't
10:07:30 consider it susceptible using a federal standard.
10:07:39 MS. HERR-CARDILLO: That's all I have.
10:07:40 THE CHAIRMAN: Any other Commissioners have any
10:07:43 questions for Win on this presentation?
10:07:50 Breedlove?
10:07:50 MR. BREEDLOVE: No, sir.
10:07:52 THE CHAIRMAN: Ms. Herr-Cardillo, we will offer
10:07:52 you an opportunity after Win is done.
10:07:57 MS. HERR-CARDILLO: Thank you.
10:07:58 THE CHAIRMAN: Mr. Sparks?
10:07:59 MR. SPARKS: Mr. Chairman, would it be possible
10:08:01 to take a very short break while we set up and --
10:08:03 THE CHAIRMAN: Certainly.
10:08:05 MR. SPARKS: Thank you.
12:48:48 (A recess ensued from 10:15 a.m. until
10:20 a.m.)
10:20:57 THE CHAIRMAN: Ready to begin. For the record,
10:20:58 we shall note the presence of all commissioners, Mr.
10:21:01 Breedlove and Mr. Hjalmarson.
10:21:01 Mr. Sparks, you may proceed.
10:21:09 MR. SPARKS: Win, I presume you're over there
10:21:11 someplace, but I can't see anything. I just saw the light

shining off your glasses. That's good. Are you there?

THE CHAIRMAN: Mr. Sparks, we'll get lights on.

MR. MEHNERT: He needs to get the microphone on.

THE WITNESS: I'm here. After riding in that freeway traffic though, I feel a little goofy.

THE CHAIRMAN: Win, could you move that microphone closer to you for purposes of the tape.

MR. SPARKS: Pardon me, Mr. Chairman. If we leave this light on, can the Commission still see the screen up there?

THE CHAIRMAN: Are you going to be referring to slides?

MR. SPARKS: Sometimes.

THE CHAIRMAN: Okay. We'll see what we can do to make the difference. We just wanted to make sure you could see the witness.

MR. SPARKS: I know he's up there now. I heard his voice. Win and I are old enough that we don't go towards the light just because somebody says go this way, you know.

CROSS-EXAMINATION

BY MR. SPARKS:

Q. Win, are you comfortable up there?

A. All things considered, I'm okay.

Q. I just -- I want to go back a little bit into your background, and sometimes I'm being pretty facetious. You probably know that. But as I recall, we were both over at ASU about 1962, weren't we?

A. Yes.

Q. And as I recall, you were one of the really brilliant guys over in the engineering department trying to make an academic institution out of what we were dedicated to making a party school. Do you remember that?

A. I remember they became -- the engineering department became nationally accredited when I was there, and it was a little different environment than it became or it was before and after.

Q. Guys like me were over in the chemistry building trying to make enough pureol to keep the professors oiled and to make a party school out of that place. Do you remember that?

A. Oh, I was either working or studying.

Q. Yeah, you didn't look up, huh?

A. I didn't look up.

Q. See, I was -- I was sure that you would be careful about admissions against interest even after this time.

A. I was married, and I had two babies. I was not a party animal.

Q. I can understand why. Well, just to get the record clear for bias that the commissioners might have, I graduated from both universities in Arizona so that I never lose the ASU/U of A game. And you taught at U of A after you left ASU, didn't you?

A. Yes.

Q. You taught some courses on gaging and stream measurement?

A. Not quite. I didn't quite hear that.

Q. You taught some courses on gage -- stream gaging and stream measurement?

A. I taught -- I was an adjunct professor at the University of Arizona for eight years. I took classes with Dr. Simon Enjay when he did his hydrology field camps. He did that twice a week for each semester, so I would come in and take over his classes. And I discussed subjects that he knew I was good at, but they were a variety of topics for the advanced surface water hydrology students. And he always had a question on the test on what I said.

Q. We're going to have a question on this test about what you said. That'll work out?

A. Okay.

Q. And in your report -- well, first of all, you used some terms. And it's not that the Commission doesn't

understand the terms, but the record may not understand the terms. So I need to clarify a few things.

You remember -- you referred to geomorphology. And what in your opinion is geomorphology?

A. Well, it's the -- it's the -- in simple terms, the shape of the earth, specifically for the subject at hand here. It's the morphology or the -- or let's say the geometry and so forth of the river channel area itself.

Q. Does it include the way the earth changes over time?

A. Yes.

Q. And the earth changes over time because of a number of natural environmental conditions like, for instance, precipitation or rainfall, snowfall; is that right?

A. Yes.

Q. And gravity has a significant effect on that?

A. Absolutely.

Q. Chemistry?

A. Gravity, chemistry, or coriolis effect.

THE COURT REPORTER: What?

Q. (By Mr. Sparks) I'm sorry? I didn't hear the last part.

A. Coriolis effect, the earth's rotation has an effect on it.

Q. Well, that's pretty esoteric, but we're not going to get into the 19-year cycle of the moon or anything like that here, but we might could talk about that later.

But when it comes to geoformolog -- geomorphology, basically in the earth's geological history, tall things tend to erode and become shorter things over a period of time like mountains become smaller mountains, lower mountains; is that correct?

A. That's generally correct, but some mountains are becoming bigger.

Q. I heard that rumor. And the Kilauea is an example of that. They're still making real estate over there, aren't they?

A. I guess so.

Q. Generally in the San Pedro Valley, the highest point in the valley are the mountains right on the border. They range up to 7,000 feet, don't they?

A. I believe so. I'm a little fuzzy on that. But, yeah, they're up in that area, yeah.

Q. And where the San Pedro crosses from south to north on the international border with Mexico, about what is the elevation of the stream bed?

A. Oh, wow. I'm a little fuzzy, 3,000, 4 -- 3 to 4, somewhere in there, I think. I'm a little fuzzy on that.

Q. And you were in charge of the gages on the San

Pedro and the Gila in your career at USGS, weren't you?

A. I was the sub (inaudible) for the Tucson office, and those gages were operated under my supervision. And also I -- for many years, I was a surface water specialist for Arizona.

Q. Do you recall the approximate elevation above sea level where the San Pedro meets the Gila?

A. What is it, a couple of thousand, something like that. I'm -- I'm -- I'm rusty on that. A little less than a couple thousand, I think.

Q. For purposes of this general conversation, would you think it would be reasonable to say that in the length of the San Pedro in the United States, it ranges from about 4,000 feet at the boundary to its confluence with the Gila at about 2,000 feet?

A. Well, like I say, I'm a little -- I'm -- that's very rough, yeah.

Q. That's pretty much the way I do stuff. I mean, it's pretty rough all around, I guess.

A. Okay.

Q. And the water that falls on the watershed including the higher elevations, it's seeking its own equilibrium, isn't it?

A. Can you -- can you explain that? What do you mean by --

Q. It's seeking a place where it's in equilibrium with gravity and the circumstances around it?

A. It is -- it's seeking -- it is seeking -- it tends to seek an equilibrium, but it may not be in full equilibrium.

Q. No, it's a seeking that I'm speaking to. So this, the water that falls on the watershed at the San Pedro in the system that it finds itself in is seeking equilibrium with the water in the Sea of Cortez where the Colorado meets the Sea of Cortez, isn't that right?

A. I guess, yeah, in a very general sense.

Q. And I want to refer to one of your slides. I believe it was -- it might be page 30 in your original report. I don't see a slide number on it, but it's where the -- you refer to the dark paleosols, paleo soils, dark soils, and it's page 30 of either the -- let's see. Maybe your appendix.

A. That's in the appendix? Yeah, let's see.

Q. Page 30. It's on page 30, if that's page 30. I don't know.

A. Let me go -- I'm having trouble finding myself here. Okay. Now I'm in that area. I need my granddaughter here to run this thing. I've got a lot of slides here I'm working my way through.

Okay. You're talking this section right here on

cienegas?

Q. Probably.

A. Okay. That one?

Q. There you go.

A. Is that the one? Okay.

Q. Yes. That dark up in the left corner, it says dark paleosols. See the arrow? I think you testified that that dark material was laid down during a period of very slow moving water; is that correct?

A. To get that kind of environment, it would be a very wet or cienega type environment.

Q. And the --

A. And --

Q. Pardon me.

A. No. Go ahead.

Q. And that dark material is as a result of decompensation -- decomposition of organic material like plants and animal life, isn't that correct?

A. Yeah, and it occurs where there's a low oxygen content because the soil is saturated. It also takes a long period of time. So it's an indication of stability.

And to further explain that, it -- it's actually a history right in front of you there. It's -- it is in a sense a -- let's call it a scientific history of what was going on for predevelopment.

Q. That particular band across there, do you have any idea the age of that deposition or that -- the creation of that deposit?

A. It's -- it's more than a few hundred years.

Q. Are you familiar with any of the paleo archaeological sites in the San Pedro?

A. I scanned through them. I didn't focus on them, no. I had too much other reading to do.

Q. Well, it's clear you've done a lot of it, and thank you for that.

But are you familiar generally with the discovery of a mammoth and with a hunting site by paleo people --

A. Yes.

Q. -- around 13,000 years ago?

A. Yes, I am. I read that. Same thing occurs up in the Verde Valley area, Sedona.

Q. And do you have any idea whether the age of that dark band material at this location is in any way related to that era --

A. No.

Q. -- in the San Pedro Valley?

A. No, sir, I don't.

Q. You clearly have done a lot of reading and documentary work. Are you familiar with any stratographic studies of the different layers, sediment depositions in

the San Pedro Valley?

A. No, I didn't -- I didn't study that, and that's out of my area of expertise. I did talk to people about this. But Arizona geological survey people who had done all the recent, you studies, in there, I did discuss it with them. But no.

Q. And you testified earlier that you're a volunteer, and I understand that volunteers have, unless you're retired, you have limited resources. So you didn't do any independent research in the deposition of soils in the San Pedro Valley, did you?

A. No. I read some in a soil conservation survey. And I only looked at the one at the upper end. But, no, I did not go into studying that. Like I say, I relied on experts. And I -- like, for example, I came up with a representative sediment composition for the whole river, and I discussed that with -- with experts.

Q. I remember that. And I think that you said that for purposes of establishing if this is -- if a problem with this word "hypothetical," then tell me.

But for purposes of establishing a hypothetical stream bed configuration in pre-1760 conditions, you used a sediment type of sand -- of sand, right? And sand and finer materials?

A. The -- well, this cut bank that we're looking at

here shows that the early -- or the material closer to the surface before head cutting occurs was clay, silts, and some sand.

Q. And is that closer to the surface, you mean above the black layer?

A. Well, the black layer is part of it, yeah. But in that general zone there where the river resided before all heck broke loose in regard to head cutting, yeah. It resided in that -- in that environment. That's different than the environment now.

Q. And would you characterize the soils below the -- types below the black layer in some way? How would you characterize those or the materials?

A. I didn't really -- I don't want to comment on that. I didn't really study that. I focused on where the predevelopment river was. That was my main focus.

Now I have a lot of experience with the river since roughly 19 -- in the 1970s on. I've been on that river a lot. But that was not a focus of what I was doing here, so I -- I don't want to answer that.

Q. Who's the person in that picture there?

A. I don't know.

Q. So it was a not picture you took?

A. No. It's a reference back there. The BLM hired Lo-Cal -- they call themselves Low Clouds Hydrology, but

it's a BLM report, Bureau of Land Management report.

Q. In your effort to determine -- is it safe to say you were trying to determine where the San Pedro was prior to 1760; is that correct?

A. In my report, I -- I said that we don't know for sure what -- when predevelopment was. And what I've been arguing about here is that before -- or since 1850, we know there's been big changes. So some time before 1850, you could -- you could say: All right. For some time back there where we could consider it natural, but I'm arguing that this method I used doesn't require you to pinpoint it. That's the beauty in this method.

Q. That's okay.

A. So somewhere back in time, and it could go back according to the history that we're aware of, it could go back 300 years to get to what we would consider a fully natural state.

Q. Yeah, I might have misunderstood your previous testimony. But back in the days when you were at Bisbee, remember that ordeal, the marathon man thing?

A. Yes.

Q. I thought you testified that you thought it was essential to the reconstruction of the river in its natural state to go back to prior to 1760?

A. To be -- to be absolutely sure you're out of the

effects of humans, yeah, you'd have to go back. I think I said something on the order of 300 years. But -- but it's not that important. In my mind, it's not that important precisely where that is.

Q. Okay. I -- referring to the slide that's on the screen, and it's -- I'm referring to it as page 30 of your appendix. Is that the right way to identify that?

A. Say that -- please say that again.

Q. Page 30 of your appendix, is that the correct identification for the slide on the screen?

A. I didn't number of slides on the appendix.

Q. Well, from that page in your appendix.

A. I'm looking at the appendix that's attached to the main report, so I can't -- I don't have a number for you. Let's see. Let's see if I can dig up.

MR. SPARKS: Mr. Chairman, may I approach the witness just for a second?

THE CHAIRMAN: Most certainly.

MR. SPARKS: Thank you.

Q. (By Mr. Sparks) I pulled this out of the book that you provided to me or to us. Is that the page from your appendix?

A. See, the appendix are the Power Points. The appendix is the Power Points. I don't have a report.

Q. So this -- this is a page out of the report then?

A. That's out of the top -- that's the -- that's the -- the print of the Power Point.

Q. And is it -- is the print of the Power Point page 30; is that what --

A. Yes.

Q. That would be the way to find it?

A. That's right.

Q. Okay.

A. Okay. I got -- I see your point. Yes.

Q. Thank you.

MS. HERR-CARDILLO: If I can help with the terminology, that's a handout that has two slides per page. So it's a printed handout, part of the Power Point program. So maybe we refer to the hard copy that was submitted as the handout.

MR. SPARKS: Refer to the hard copy as the handout?

MS. HERR-CARDILLO: Correct.

MR. SPARKS: Oh.

MR. HOOD: It's actually identified as the appendix.

MS. HERR-CARDILLO: Oh.

MR. SPARKS: Yeah, I thought it was but --

MR. HOOD: Appendix, page 30.

THE COURT REPORTER: What is your name, please?

MR. HOOD: Sean Hood.

A. Let me say one thing. And in regard to what we're looking at here, the purpose of this slide we're looking at is to show that there was a stable environment over a couple hundred years ago.

The period that we're looking at isn't necessarily the material I'm saying the river resided in. The cienegas tended to be on the sides of the river, both sides. They were not continuous. They were spotty. But they went all along the whole river. It wasn't a continuous cienega. It wasn't a continuous marshy area.

And some people are confused about these things in that they think that maybe they were in the river itself, but that's not true. They're on the sides, and the river is formed in the sediment as I described in my analysis. Does that help?

Q. (By Mr. Sparks) Sure. And if you are looking at that slide, you see that black layer that goes there? That black layer extends under the top -- the top material some unknown distance?

A. It varies. That distance would vary, yes.

Q. And that distance, there should be a similar black layer on the opposite site of the river; is that correct?

A. No, sir.

Q. I'm sorry?

A. No.

Q. No?

A. No.

Q. No. And the reason there wouldn't be a similar layer on the opposite side is what?

A. Well, you would have to assume that the cienega environment was on that side also, and it wouldn't necessarily be there. In some cases, we would find it on both sides. Now a lot of that evidence, of course, is gone now because it's eroded away. But so it would take a rather large, let's say, cienega environment to have it on both sides, but it could be on one side or the other or both.

Q. That would be an indication -- the slide at page 30 of the appendix would be an indication of a point on the river in previous time when it was a slow -- broad, slow moving river; right?

A. When it was natural and it was a meandering river, yes. And it's -- and like I say, I'll say it again, the purpose of this is -- this slide is -- this shows a stability. In order to get that environment to form, that dark soil, it had to be stable for a long time, thousands of -- probably thousands of years.

Q. And the thousands, I referred to the paleo site

10:46:36 with the mammoth, that was approximately 13,000 years ago.
10:46:46 Are you -- have you tried to identify the soils in, for
10:46:50 instance, this cross-section --
10:46:51 A. No.
10:46:51 Q. -- in terms of Pleistocene versus Holocene soils?
10:47:03 A. No, I didn't. Like I say, I relied on the
10:47:03 Arizona geological survey in particular on that particular
10:47:05 aspect of this.
10:47:06 Q. And the Holocene soils would be approximately the
10:47:10 last 10,000 years of soil deposition?
10:47:13 A. Yes, sir.
10:47:14 Q. When you relied on those studies, did you attempt
10:47:18 to determine the age of the soils in, for instance, this
10:47:26 example?
10:47:26 A. No.
10:47:27 Q. In terms of the record, would the soils above the
10:47:35 carbonaceous layer be younger or older than the materials
10:47:42 below it?
10:47:43 A. They'd be younger.
10:47:48 Q. And do you have any information that leads you to
10:47:54 conclude how long it would take to deposit the soils above
10:47:59 that carbonaceous layer?
10:48:00 A. That did not enter into what I did. Like I say,
10:48:04 I relied on -- on the people that specifically studied
10:48:08 this, the scientific experts.

Q. In any of your work, did you try to determine the lateral, the width of the stream San Pedro in any previous time to 1760?

A. No, I didn't -- I didn't focus specifically on precisely what you just asked, no.

Q. So in the width of the San Pedro, I believe, that one of the -- I'm sort of a victim of not remembering what your slide numbers were this morning, but it seems like there was -- it seems like there was a reference to a couple of observations in the river that were made firsthand about two years apart. I don't -- it seems like those -- that reference was around slide 39 or so of your deposition today?

A. Well, the first reference is by Parke in 1855, and that was the Pacific Railroad survey. And the other three were the wagon road survey and then this Tevis.

Q. Do you know how -- in those observations, do you know when the report was written compared to the reference to the observation, the year of observation?

A. That's an interesting question. They were -- no, I don't know exactly. I do know when it was submitted to Congress. And I think there are some dates on the signatures. Like when Lee reviewed Hutton's work, I think he signed it and -- but, you know, I don't think I have the date. This document, this -- I have a book that has

that document. And I remember looking at this, and I couldn't find a specific date on the signature in the document that was submitted to Congress. And I thought it was a little odd.

Q. I think your observation was that you thought it was really unusual that the reference in both observations or reports would be a slow and limpid river?

A. I thought the way it was stated, it was a little unusual. Now to explain that a little bit, there is a spring in Texas that was on the railroad route. So the surveyors had gone by a big spring in Texas called the Limpid Spring. And then "limpid" was a word used in the survey of the 49th parallel by -- and it could have been one of the surveyors here that on that 49th parallel survey, you know, when they were looking for a railroad up there.

So the word, to the best of my knowledge, the word was used three different times directly in connection with the surveying. And I do know there was a spring in Texas called that.

So I thought the way it was described, the similarity was remarkable. And that's when I went to the trouble to find out that -- I found that Hutton was involved in -- he was the engineer on both surveys. Nobody has ever told me that. None, in all the history

written about this, nobody's ever mentioned that.

Q. So you think he was referring to his earlier reference when he said "slow and limpid" then?

A. No, I'm not implying that. It's just I -- I think he made -- I think he made both observations.

Q. Do you know at what point in the river he was observing that character --

A. It's down near --

Q. -- characteristic?

A. -- the mouth of Aravaipa Creek, down in that general area.

Q. The general area of what?

A. In the Aravaipa Creek area. It's down close to the mouth. It's in that general area.

Q. Do you think he was observing Aravaipa Creek as --

A. No. It's in that area. That's all.

Q. Yeah. Now the reason you went to all this -- you -- I wanted to ask you also to clarify your reference to "base runoff." Is that a term that you created for purposes of this report?

A. For the term "runoff"?

Q. Base runoff.

A. Base runoff. No, base runoff would be natural base flow. And it's -- it's used -- it's been used by the

USGS.

Q. I thought you made a distinction in this report and your testimony between "base flow" and "base runoff."

A. Yeah. "Base flow" is a more general term that can be natural or unnatural. "Base runoff" is natural. When USGS uses the term "runoff," it's natural.

Q. Perhaps you have those -- those -- the terms inverted, "base flow" as a natural condition runoff?

A. Well, you could say it that way, and as long as you explain, all right, it's base flow, but it's the natural base flow. And a shorter way of saying that is base runoff.

Q. But base runoff includes surface water as well, doesn't it?

A. Well, the term "runoff" used alone -- like the term "flow" can either be from ground water or surface water. So what's your point?

Q. My point is only trying to clarify what your testimony is. And my understanding was that you were making a distinction between base flow and base runoff. And my understanding of what you said is that base flow was a natural condition runoff that would occur when -- in the absence of precipitation?

A. No. Base runoff, base runoff --

Q. I was saying "base flow."

A. "Base flow" is a general term. And I said "base flow," and then I qualified it by saying if it's for natural conditions, it would be such and such. You know, you could use it in that context.

Q. Maybe we could resolve it for the time being by asking you, does your concept of base runoff include precipitation, runoff from precipitation?

A. No.

Q. No?

A. Total runoff would -- well, you know, there's direct. I was very clear about this on covering what direct runoff was and what base runoff was. I showed several slides on that.

Q. So your reference to base runoff and base flow are referring to the same flow?

A. They're both flows coming from the ground. One's natural, and one is general. It could be natural, or it could be man-caused, man-affected, by wells and whatever.

I'll add something here. Perhaps you're not clear on this because you've read Arizona Department of Water Resources reports and Arizona Department of Environmental Quality reports. But the state of Arizona's been a little sloppy on this.

Q. Your suspicions about my having read that are accurate certainly.

A. Okay. Well, I -- I --

Q. I'm just trying to clarify the terms here.

A. I'll just throw something out here just in general. There are some early ADWR reports and Arizona Department of Environmental reports that refer to flow as natural when there was a lot of irrigation going on.

And that might affect -- I'll add one more thing here. My attorney friend here might be cringing right now. I was hired by two attorneys -- one of them was just in this room at our break -- just to analyze the Little Colorado River and what flows were being used there. And I determined that it wasn't runoff. It was affected by diversions. So the decisions made for this Commission to not include The Little Colorado might be affected on exactly what we're talking about on the misuse of what runoff is and what stream flow is.

Q. Let me see if I can understand. The reason why you didn't -- you're familiar with the concept of retrogressive analysis in the computer field, are you?

A. Retrogressive or do you --

Q. Retrogression, retrogressive analysis.

A. You mean regression.

Q. Regression?

A. Yes, I consider myself very experienced with statistical analyses.

Q. Did you have enough data to do a retrogression analysis of the San Pedro for purposes of this report?

A. No, I didn't. I didn't see a need for it. No, I didn't do one.

Q. And the reason you used the methodology that you did is that if you were looking at the San Pedro on February 14th, 1912, at that time, you saw a river that would not be navigable; isn't that correct?

A. At 1912?

Q. Yeah.

A. That's right. It was -- well, let's see. Let's just say that I wouldn't be looking at a natural river.

Q. And because you wouldn't be looking at a natural river is because of human activities prior to 1912; is that correct?

A. Yes.

Q. But that's a river that we found ourselves with on February 14th, 1912. It was that river that wasn't navigable; correct?

A. From what I know, parts of it would not have been navigable, yeah, all the -- you know, all the time. Now you want -- it's very hard to answer that question in a general sense.

Now part of the year, it might have -- you know, I would expect it to have been navigable. You know, in

10:59:39 the winter where there was low diversions and ET was low,
10:59:43 it might have been navigable.
10:59:57 Let me try to help you out here.
10:59:59 Q. That's okay. I just need to stick to my
11:00:01 questions here so I can get done what I need. I need your
11:00:03 help. That's for sure.
11:00:06 One of the things I wanted to ask you about is I
11:00:12 believe it was -- I don't see a reference number. You --
11:00:27 MR. SPARKS: Since it doesn't have a reference
11:00:28 number, may I approach the witness, your Honor or Mr.
11:00:32 Chairman?
11:00:33 THE CHAIRMAN: Yes.
11:00:56 Q. (By Mr. Sparks) This is a front and back, and I
11:00:59 don't know which is which, but I think that's the front.
11:01:01 Do you recognize that from your report?
11:01:04 A. No, I don't. But --
11:01:13 Q. Okay. If you don't, that's okay.
11:01:17 A. No, I -- I -- I'd have to look at my report. I
11:01:23 don't recognize that one slide.
11:01:24 Q. Okay. Let me just ask you a question about the
11:01:27 words on that page then. You refer to in your analysis as
11:01:37 that you refer to the mean in the various references that
11:01:46 you make, isn't that correct, the mean?
11:01:49 A. Well, I use "mean" or "average." I interchange
11:01:52 them. To me, they both mean the same thing.

Q. And "mean" and "average" mean the same thing, don't they?

A. Yeah.

Q. And the mean or average is like in an annual mean or average it's 365 days is the number of units you use to determine the mean average; correct?

A. Well, now "mean average" is kind of meaningless. I guess that's a pun on words. A common -- yeah, make a comedy out of this.

A common way of describing it is average annual runoff or average annual flow. And that would be the average for -- you could say, all right, the long-term average annual flow is such and such. And that would imply that for all the years of record, the average of all those years is such and such. Or you could say the average flow for 1967 water year was such and such. And that would be the average of 365 days.

Q. So you need to distinguish or you distinguish obviously between the annual flow, the mean annual flow, is the same as the mean average flow. It's the average of all the years of record; right?

A. I don't recall using "mean average" like you're implying. I don't recall that, and I did not create the --

Q. Okay.

A. This is not my table. I got this at Gookin's table.

Q. Yeah, well, it's -- that's good. No problem.

A. No, it's not -- that is a problem to me when you hand me stuff that I want to know if it's mine or not.

Q. Okay. I understand.

A. This isn't --

Q. You said it wasn't yours. That's the end of it. That's the end of that.

A. Okay.

Q. Now I just want to talk to you about the term "mean" and "average." They mean the same thing; correct?

A. They mean the same thing. And when you use them together, it's meaningless.

Q. Okay. Then we'll try to be meaningful here.

A. Okay.

Q. And you'll be in charge of meaningfuls because I -- you've been in charge so far. So I don't think working out --

A. Well, I'm an average kind of guy, so I'll try.

Q. That's right. Thank you. You didn't use -- in terms of daily mean flow, it would be for a year. It would be 365 days of flow; correct?

A. Well, to say that properly, it would be mean daily flow.

Q. There you go. Now if you did that for a year, the mean daily flow for a year, you would be taking the flow from each of those days and you'd divide it by the number of days; correct?

A. The mean -- the mean -- no, it's incorrect to say that the way -- to put it together the way you are. It's not logical.

Records of spring flow are published as mean daily flow. You can compute the average annual flow by taking the days for the year and determining the average of those mean daily flows. Now what that means is that that will be the mean flow, and you can think of it as days, or you can think of it as just the mean without a time, mean or an average, either way you want to say it. But when you determine the average annual runoff using USGS records, you are doing that using mean daily flow.

MR. SPARKS: Mr. Chairman, may I approach?

THE CHAIRMAN: Yes, you may.

Q. (By Mr. Sparks) Do you recognize that particular page?

A. This is similar to a page that was handed to me in Bisbee. And the claim was that this was something that Mr. Burtell had put together. But however that one he handed me was -- had a point on it. It wasn't a dashed line. It had a specific point for the Charleston gage.

Q. This isn't a page that you testified to in the past?

A. No, it's not.

Q. Oh. And this is not a page that you created?

A. No.

Q. Okay. In the appendices, you refer to, I think, a report. You made reference to a report of some beaver trappers, I believe, in around 1821, and the family name was Pattie. Do you recall that?

A. Yeah. I think it was a little after 1821, but it was right in the 1820s, yes.

Q. I think the date of his writing was about 1831. And that would be after he was -- he was in the San Pedro and Gila Valleys; right?

A. Yeah. Pattie came in twice over a two-year period. And he did not -- those were not his writings. He told the story to a gentleman who documented his experience.

Q. I think in those days, there were so many beavers in what is now called the San Pedro River that they called it the Beaver River, didn't they?

A. That's what he called it. And he trapped so many beavers the first time, he came back two years later at the risk of his life with a bunch of other mountain men and trapped more on Beaver River.

11:08:58 Q. I was intrigued by one of the pictures -- two of the pictures.

11:09:09 MR. SPARKS: Mr. Chairman, may I?

11:09:13 THE CHAIRMAN: Please.

11:09:16 Q. (By Mr. Sparks) I may be confused again, but I thought that this -- that this slide was out of your presentation. Is that out of your presentation?

11:09:17 A. The slide with the guys in the canoe, yeah. And those are more along the nature of cartoons, you know, just to kind of lighten up on the subject of beavers.

11:09:24 Q. Well, I'd like to lighten up on that subject. You --

11:09:26 A. This one is not mine.

11:09:31 Q. That one's not yours?

11:09:35 A. No.

11:09:38 Q. It's not out of your report?

11:09:38 A. No.

11:09:39 Q. Well, it's the other side of this page in your report. So -- but if you don't recognize it, it's okay. I just want to --

11:09:41 A. No, it's not okay. That's not in my report.

11:09:41 Q. No, I said, if it's not your report, it's okay. So the part that you do recognize is referred to as page 180 or slide 180?

11:09:43 A. 160. Your eyes are as old as mine.

Q. Yeah, that's just right. They're exactly as old as yours, only I only have one of them. So it's 160, slide 160?

A. The one you handed me is 160, yeah.

Q. Okay. And you do recognize that one?

A. Yeah.

Q. And that's from your report?

A. Yes, sir.

Q. Are you in that canoe?

A. No, those were -- that's just, like I say, that was a cartoon thing to just look at the effect of beaver dams. What I was trying to do is --

Q. Let me just --

A. Okay.

Q. -- ask this question.

A. All right.

Q. And this picture, to your knowledge, wasn't taken on the San Pedro?

A. No, it's not.

Q. Okay. Do you consider beaver dams an impediment to navigation?

A. The subject of this Commission is navigability, not navigation.

Q. Can you answer the question that I just asked, please? Would a beaver -- would a beaver dam be

impediment to navigation down a river?

A. What kind of -- explain what kind of navigation you're referring to.

Q. Well, referring to navigation in this canoe that you're not in this picture.

A. Okay. Could be a -- for a specific use, it could be a local impediment, and it can increase the depth of flow upstream of it. So it can be a benefit, too.

Q. And if there were hundreds of these beaver dams, would they be impediments in hundreds of locations?

A. It might be -- you might think of that a little along the line of the experience of the canoers and what they enjoy. But if you're going downstream, you might have a lot of fun paddling right over the things. And experts can do it.

So -- but, yes. Generally speaking, there would be -- there would be a -- I'm not -- I really don't want to answer that because it -- it -- it really narrows down to the nature of the type of navigation. And the subject of what I'm doing here is navigability.

Q. Well, I mean, I think you testified that somebody could buy a Sears canoe in 1912 and navigate in, what, six inches of water?

A. No. The minimum I used was one foot.

Q. Well, let's talk about that again. In terms of

your reconstruction of the -- of the San Pedro before human intervention, one of the things in your formula that is required is the width of the river in a stretch; correct? I mean, you used a formula, and one of the portions of the formula is necessarily the width of the channel; correct?

A. Yeah, I used the hydraulic geometry method, and I determined width using that method, yes.

Q. And in that method, there are several kinds of stream channels that you might come up with, and one of them is a parabolic stream profile?

A. The equations associated with the hydraulic geometry method are parabolas on log-log paper like USGS rating curves are used that are straight line.

Q. But there's also a possibility with given different variables of having a rectangular stream bed; correct?

A. Not in the free forming alluvial channel like the San Pedro or the Mississippi River or whatever, no.

Q. Well, let's talk about the Mississippi. I grew up on that river. And in terms of turbidity, what we always used to say around there is "too thick to drink and too thin to plow."

Is that turbidity? Are you familiar with that term?

A. Well, that's -- you know, I'm talking science here, not backwoods jargon.

Q. Yeah, that's a compliment, that backwoods part. People there would even use the more denigrating references.

In terms of the San Pedro, do you think that during our lifetime that the stream has really extremes in terms of runoffs; isn't that correct?

A. It's really extreme?

Q. Has really -- has real extremes in terms of the runoff?

A. You just defined Arizona rivers.

Q. And that's one of the Arizona rivers with extremes; correct?

A. They're --

Q. And you heard the Senator --

A. A one-word description of Arizona rivers is variable. You can use it, yeah.

Q. Under their natural conditions, they were vary -- they are variable; right?

A. The range of flow and so forth is pretty large here in Arizona, yes. Now you can get base flow environment where things get pretty steady.

Q. Yeah. And under natural conditions at the time of statehood, the stream was variable; correct? It flows?

A. The conditions at statehood were not.

Q. I'm sorry?

A. You said natural conditions at statehood?

Q. At statehood, the stream would have been variable flow?

A. You would have direct runoff and base runoff. The base runoff in the absence of evapotranspiration would have been very steady.

Q. Well, let's talk about that for a second. I think you said earlier in your testimony last time that the influx of riparian environment into the San Pedro caused a reduction in stream flow; isn't that correct?

A. Yeah, I would -- if you'll let me finish the thought about what I just said, in the absence of evapotranspiration, in other words, in absence of the trees along the river, the ground water inflow to that river was very uniform.

Q. Can you think of --

A. Now -- now --

Q. -- a situation where there's an absence of plant life along a river? It's the Los Angeles River?

A. I want to finish the thought. I'm going to tell you how the system works. And here's how it works.

Q. I'm sure you're going to do this even if I don't want you to; right?

A. Well, I can finish answering your question.

Q. Go ahead.

A. You have -- okay. Let me just do it real simple. Real quick. The ground water coming into that river in the absence of evapotranspiration, in other words, just coming through the ground would be very uniform throughout the year. The reason it varies is because of evapotranspiration. It's evaporation directly from the water surface as it comes out and from the trees, the plants.

Q. Are you familiar with the studies that --

A. And in the winter -- in the winter -- in the winter, there's hardly any. So the base flow is up pretty high. In the summer, there's a lot of ET, and the base flow's down real low.

Q. Are you familiar with the studies that show that the evaporation or transpiration from plant life along the river is about equal to the evaporation from the surface of the river?

A. That's not quite -- not quite accurate. Each plant has a different rate. That's not quite accurate. But something on the order, a general figure would be 4 to 5 foot per year per acre.

THE COURT REPORTER: Foot -- I'm sorry. Foot?

A. Foot per year, four or five feet of water a year

in a --

Q. (By Mr. Sparks) And was --

A. -- in a very wet environment or directly from the river?

Q. And what about the evaporation at the same sector in the river from the surface?

A. About the -- about the same, the direct -- it depends on the location on the river, but five foot a year is a very common evaporation from directly from the water surface. Depends on how much shading you have and so forth. But if it's in a canyon and if it's in a windy area, whatever, but anyway it's in that neighborhood.

Q. Let's go back to the profile of your hypothetical pre-1760 river bed. One of the -- you provided more testimony this morning. But one of the factors in determining that reconstructing the hypothetical river bed back in the day is the sinuosity of the river, isn't it?

A. The sinuosity was analyzed separately from the channel geometry.

Q. But you --

A. I used a method, and it's in the report, but I used an old, very reliable method to determine if it was a meandering river or not.

Q. But sinuosity is required calculation to determine one of the elements of that formula, isn't it?

A. Yeah. One -- like I explained this morning, yeah. The sinuosity controls the slope of the river. And so associated with the slope are the width, depth, and velocity. So it does affect the computation of width, depth, and velocity, yes.

Q. But the gradient of the river from one segment, from the high point in one segment to the lower point in a segment, that also controls or it influences sinuosity, doesn't it?

A. I'm using gradient and slope as the same thing. You mean gradient of the valley or gradient of the river or slope of the valley or slope of the river? What are you talking about?

Q. I'm talking about the slope of the river. And that is what influences the sinuosity, doesn't it?

A. No. The sinuosity influences that -- it determines that slope. What affects the sinuosity is the gradient of the valley and many other things.

And I showed that scale from the U.S. Geological Survey report that shows the balance involved in a river like this. It shows that if you alter the sediment size, it'll affect the whole system or, you know, and so forth. Or you change the discharge, it'll affect the whole system.

Now I don't want to go into trying to explain

that to you because it is very complicated.

Q. Well, the problem is I do want to talk about it.

A. Well, sir, there is a --

Q. So we get to talk --

A. There is a balance of --

Q. Right now, we get to talk about what I want to talk about. So --

A. Okay. Go ahead.

Q. If you just would -- if you just try to stick to this part for the time being.

Are you telling the Commission that the change in elevation of the bed of the river does not affect the sinuosity of the river?

A. If it is a uniform change and nothing else changed, I would expect everything to remain basically the same. But that's not what happened.

Q. Not what happens because between the Mexican border and the Gila River where the San Pedro flows into it, there's a 2,000-foot change, isn't there, in the elevation of the river bed?

A. No. There's a -- there's a grout over -- over the length, yeah, that establishes the gradient, let's say, of the valley. And within that valley is this sinuous -- well, what was this sinuous natural river, yes.

Q. And in the sinuous river, one of the factors that

you're trying to determine is in sinuosity is whether you should use something like a 1.3 or a 1.5, which is what you used in your study, or a 2 or a 4 in that formula; correct?

A. You make an -- I made an assumption as to what the sinuosity would have been based on classic work. And I used Leopold's -- Leopold Maddock's number. But I could have gone down a little lower if I'd wanted to. But I stuck with the old -- the old guy, the guy that was a little -- actually a little older than you and I.

Q. I'm for sticking it out with old guys, you know. That works for me.

A. Yeah. So -- so I just selected that number. And like I say, I did it because I wanted to be conservative. I'm not trying to create some wild, you know, navigability thing here. I'm trying to present what I think it really was.

Q. And one of the other factors that you -- so you determined that 1.5 was going to be the -- would be the one factor you would use related to sinuosity; correct?

A. That's the number I used to determine the slope of the river in the subsequent computation.

Q. And another thing that you used was the assumption that it was a fine sand bottom in the river; isn't that correct?

A. No. I assumed the entire environment was what I said: It was basically sand, silt, and clay.

Q. And if the environment was actually sand, gravel, and cobbles, then it would be a different kind of river bed; correct?

A. I wasn't focusing on the river bed. I was focusing on the river shape, and I was focusing on depth, width, and velocity.

Q. But you were focusing on the contour of the channel for all of this testimony, weren't you?

A. When you say contour, do you mean cross-sectional shape or what do you mean?

Q. The shape.

A. The cross-sectional shape? Will you be specific with the question, please.

Q. And you were --

A. Was that the -- was that what you were talking about?

Q. That's what I'm talking about.

A. The cross-sectional shape. Okay. You can go into your hydraulic geometry theory and go into the reference I gave on Osterkamp's report, and you will find that on a cobble river when you apply this technique, you will actually get a deeper, narrower river, all other things remaining stable.

Q. You also may be getting a braided stream with lots of riffles; right?

A. You -- yeah, you get riffles, yeah. You get rif -- what I'm saying is you get more depth and therefore more, more, let's say, more -- you might be all year you could -- you might come up with a conclusion it was navigable. It might be, you know, navigable all year if you'd done things like that.

However, the difference is you get for these little differences in the channel material or the material that the river is formed in that forms the shape of the channel, the differences aren't all that great from one shape to the other and therefore the effect on the analysis of the navigability.

Q. But in your analysis, one of the things that was a constant was that there was a sand, fine sand, and clay composition of the stream bed in pre-1760 periods; correct?

A. You keep saying 1760. I don't know where you got that. I've been saying --

Q. Well, I thought I got it from you, but if you want to use a different reference --

A. I used a different -- in my report, under natural conditions, let's just say under natural conditions, that somewhere back there, it became natural. And I'll argue

my method doesn't require you to pin it down to 1760 or anything like that. It would definitely be before 1850.

But under those conditions, I concluded that it was a sand -- basically a sand, silt, clay environment. And I plugged that into the hydraulic geometry equations developed by Osterkamp which are refined from the original ones from Leopold. And I --

Q. But you needed --

A. And I came up with the velocity, depth, and width.

Q. Right. And that's -- that type of composition of soils was necessary to your conclusion here; correct?

A. Yes. But like I just said, it's not that sensitive to the type. You can -- okay. If you made it all sand, it would tend, it would tend to widen it out and make it very shallow. And it would start going into a braiding environment. It would want -- it might want to go in that direction. It would start approaching that kind of channel.

Q. Yeah.

A. But it wasn't that. It's critical that there's clay in it and silt.

Q. Well, it's also critical that you use the factor of 1.5, isn't it, in sinuosity?

A. That's basically separate from the analysis. The

1.5 gets you the slope, and -- and -- and that's it.

Q. And the other thing --

A. So now --

Q. -- that was necessary is for you to confine the channel; isn't that correct?

A. The 1.5 was necessary to what?

Q. It's also, in order to arrive at the conclusion that you made, it's necessary for you to have a confined channel for purposes of the stream flow?

A. The channel has to exist in some kind of environment that has some kind of limits on it. In other words, it exists in the valley floor.

Q. And if you had a 12-foot width channel, you could perhaps get a foot of water in that channel where if you had a 35-foot channel, you might have only an inch and a half of water in that channel; right?

A. Well, the Holocene environment that you mentioned was quite wide. And a free forming river like the San Pedro had plenty of room to form, you know, a nice meandering channel regardless of the sinuosity that you might want to use.

Q. It would have been --

A. Now --

Q. -- wide and shallow; right?

A. If it was sand.

Q. And it --

A. If it was just straight sand, but it wasn't. Now --

Q. And over time, it began entrenching because, you say, of human conditions, but it would have been entrenching under natural conditions, wouldn't it?

A. I don't know. There -- a meandering -- a meandering channel formed in its own alluvium like the San Pedro is --

Q. But under the geomorphology --

A. -- is -- is --

Q. -- it's trying -- that water is trying to reach the ocean, isn't it?

A. That has nothing to do with --

Q. Well, in the geomorphology of the San Pedro River, the water's always trying to reach the ocean, isn't it?

A. It's flowing up. In Nevada, it's trying to seek big close basins.

Q. I'm talking about the San Pedro. Are you -- did you get to Nevada on me here?

A. Well, some rivers flow into closed basins and some like in Death Valley. And the San Pedro though is flowing into the Gila and the Colorado and on down into the Gulf of Mexico -- or California.

11:31:32 Q. But the geomorphology of the San Pedro River from
11:31:36 the Pleistocene until right now has been one where the
11:31:40 land is wearing down and the bed is being eroded; isn't
11:31:46 that right?
11:31:46 A. Generally speaking, it's in an eroding
11:31:58 environment, yes.
11:31:59 Q. And from the period of -- of that paleo site
11:32:07 about 13,000 years ago through the Holocene period, is it
11:32:11 reasonable to conclude that the area of the San Pedro
11:32:16 River as being -- has been in a warming and drying period?
11:32:21 A. The Holocene geologic epoch is a warming
11:32:31 environment. It's a post glacial environment, yes.
11:32:34 Q. And it's a -- and a drying environment?
11:32:36 A. A what?
11:32:38 Q. It's been more and more arid?
11:32:40 A. It's been warming.
11:32:45 Q. But don't you have an opinion about -- about the
11:32:49 precipitation in the San Pedro Valley over a period of
11:32:52 time?
11:32:52 A. No, I don't. For the purposes of this study, I
11:32:58 presented a dendrochronology analysis for the last few
11:33:03 hundred years, and it shows there was no trend. You can
11:33:11 have an arid environment on a glacier.
11:33:35 Q. Could you please put up slide 58 on your report,
11:33:39 please.

A. (Complies with request.) My eyes are getting as bad as yours. Oh, wait a minute. I'm having trouble reading this thing.

Q. There you go.

A. Is that it?

Q. I think so.

A. All right.

Q. You created that slide to show the Commission how the stream flow would look if you stacked up the highest flows on the left side of that -- of that slide to the lowest flows on the right side of that slide; correct?

A. That's what -- a flow duration curve for, say, annual runoff is a compilation of daily discharges in descending order.

Q. So the answer's yes?

A. That's -- in general, that's what this is.

Q. And then if you put up the slide that is, I believe, 65.

A. Okay. Is that it?

Q. That would be it. That's another example of the flow duration curve. And that's the same way you derive that is to stack up the highest -- the highest flows on the left side and the lowest flows on the right side of that?

A. That's what it represents, but that's not how

that was made.

Q. And then how did you make this one then?

A. Well, I explained it there.

Q. Okay. Well, we don't need to do that again.

Do you have -- is this particular slide for a specific year or period of time?

A. No. This is the slide that's designed to show the technique I used to determine the -- the typical or the natural and ordinary condition. But this is a kind of a tricky way -- not tricky, a clever way to show an ordinary condition or an ordinary year.

Q. And back to slide 58, is that for a specific year?

A. No. That would be the long-term average. That would be -- that would be a typical -- a typic -- well, yes, in a sense it would. It would be the ordinary year. An ordinary year, that's what it represents.

Q. Ordinary in which period of time?

A. In any -- predevelopment.

Q. Predevelopment?

A. Yeah.

Q. And you don't have any data on the weather or precipitation in that period of time, do you?

A. I told you I used the dendrochronology from a University of Arizona study that showed that there was no

change in the climate.

Q. During what period?

A. During the last few hundred years.

Q. But I thought your predevelopment period went back to before 300 years?

A. I said, to be safe, you would go -- you could go back that far or even farther. But I'm saying very clearly, as before 1850, definitely.

Q. So the period and quantity of precipitation from before 300 years ago in your tree ring, your reference was to tree ring studies; correct?

A. That's the one that shows there hasn't been a trend in climate.

Q. Okay. And does it show that there has -- that the pattern of the rainfall has --

A. No.

Q. -- has been the same?

A. No, it doesn't go into that. It's just an unchanging climate environment. So it allows you to use current conditions. And with appropriate adjustments for the impacts of humans, you can -- you can make an estimate of what it was under natural conditions.

Q. Would you expect that the timing of the precipitation back in the predevelopment period and the timing let's say now are roughly the same?

11:39:23 A. There would be an implication of that. What's
11:39:29 really -- there's an implied similarity to it, yes.
11:39:49 Q. I think you told the Commission that basically to
11:39:52 describe an Arizona stream, "variable" is a good example;
11:39:57 correct.
11:39:58 A. If you're going to use one word, say "variable."
11:40:06 Obviously the explorer to describe them, each spring is
11:40:12 unique. But for example right now the Verde River at
11:40:15 Paulden is probably flowing about 20 CFS, plus or minus 2.
11:40:23 MR. SPARKS: Mr. Chairman, may I approach?
11:40:24 THE CHAIRMAN: Certainly.
11:40:25 A. So there are exceptions.
11:40:27 Q. (By Mr. Sparks) Given your credentials with the
11:40:30 USGS, you may recognize that. Do you?
11:40:33 A. Yeah. This is the way of -- yes, this is a
11:40:42 product of their data system, yes.
11:40:45 Q. And what is the period of time for that product?
11:40:56 A. Well, period of record is -- of the graph itself?
11:41:11 Q. Yes.
11:41:11 A. It would be beginning date of June 4th, 2012,
11:41:22 ending date of June 4th, 2013.
11:41:25 Q. And the location of that particular graph gage is
11:41:33 what location?
11:41:35 A. It's near Tombstone.
11:41:38 Q. And what you see is -- what are the lowest flows

that you see in that graph?

A. Zero.

Q. What are the highest flows you see approximately?

A. Well, those are daily discharges, so we're not looking at instantaneous. We're looking at mean daily. And it's about 460.

Q. Cubic feet per second?

A. CFS, yes.

Q. And that's an example of the variable that you would use to describe the Arizona stream; correct?

A. Generally speaking, one word, that'll do it. And there it is right in front of you.

Q. And that is a glimpse of the San Pedro during -- between July -- July 2012 and May 2013, approximately a year; right?

A. Yes. Yes.

Q. So when the senator testified that people have reported to her that sometimes we have a lot of flow when it rains and sometimes we have little or no flow?

A. Yeah.

Q. That's an example right there in Tombstone; right?

A. Yeah.

Q. And that really is the way the river runs. Sometimes there's almost no flow, and sometimes there's

extreme flows?

A. You're departing from the analysis I did. I did predevelopment analysis for -- for a highly --

Q. I want to talk about this --

A. -- for a highly affected man -- man, you know, affected system. Yeah, that's what you have here, yes.

Q. Well, do you think that the flows would have been any less extreme during predevelopment conditions?

A. Yeah. The base flow would have been a heck of a lot more.

Q. And are you telling the Commission that you think that the base flow would have been adequate at all times during predevelopment period for your navigability stretch that you recommend to the Commission?

A. I said in the report real clearly, 80 percent of the time.

Q. 80 percent, but that's based on that flow contour you made; right? It shows all the highest flows on the left side and the lowest flows on the right side?

A. You can take this. And if you want to -- if you want to go through and manually figure that out from this plot, you can do it. Or you can just concatenate them, so to speak, and plot them in descending order and do it real quick.

Q. But the fact is --

A. So you can do it either -- you could do it either way.

Q. Try to address yourself to this for a second.

The fact is that the flow contour is an artificial picture of the way the river runs and --

A. Wait a minute.

Q. -- this example right here in your hand is the example of how the river actually runs.

A. No.

Q. Isn't that correct?

A. No, I don't understand. What do you mean by "flow contour"? Is that what you're saying?

Q. The record uses, you use a contour slope which is right up there on the picture, a flow curve?

A. No. That's called -- let's be specific. Let's be correct here.

Q. Okay.

A. That is a flow duration curve, not a flow contour curve.

Q. Okay.

A. You see the title of the picture up there. It says Flow Duration. Okay?

Q. I can read that.

A. Okay.

Q. Even in my impaired condition and being a

challenged reader, I can read that.

A. Yeah.

Q. So the flow duration. But you are saying that that's a flow duration curve you have there, no? You are saying that, aren't you?

A. That's what a flow duration curve looks like. Yeah, you bet.

Q. Okay. And the actual way the river runs is more correctly shown by this particular example out of the USGS records, isn't it?

A. No, sir.

Q. No?

A. For a specific time, that is the record of spring flow. But that's not a representation of, say, the natural and ordinary. That's a specific time.

What I'm doing with the flow duration curve is -- is giving -- is presenting the ordinary condition.

Q. You're trying to remove the highs and low flows out of the real way the river runs?

A. Not at all. Sir, you do not understand what a flow duration curve is.

Q. You'd be surprised at what I don't understand, and the length of list --

A. Well, no, I'm --

Q. -- is really long. So let's deal with not what I

don't understand but what your report says.

You want the Commission to think that for 80 percent of the time in predevelopment conditions, the river would have produced a flow that would make that stretch that you're talking about from the Charleston gage, what, down to the Gila River navigable? And it would do so because that's the way the flows would look?

A. The flows at a specific --

Q. Is that yes or a no?

A. No.

Q. Okay. Good. Then let's go to the next question.

Would you not -- would you expect the flows to be extreme and variable in predevelopment conditions?

A. They would be -- yes, that's a general characteristic of Arizona streams. But --

Q. Okay. That's good enough. I think that's where we're going to call it a day here. I think you need a break.

A. Are you through?

THE CHAIRMAN: Got another 10 minutes here.

MR. SPARKS: I'm sorry?

THE CHAIRMAN: Got another 10 minutes here before lunch.

THE WITNESS: Sir.

MR. SPARKS: Oh, I mean that I need a break.

THE WITNESS: Are you through with your questions?

MR. SPARKS: Yeah.

THE WITNESS: Okay.

MR. McGINNIS: Mr. Chairman, I was just going to -- Mark McGinnis for SRP. I going to suggest you might want to mark and identify that last exhibit and admit it just for purposes of the record as they talked about it a lot.

MR. SPARKS: I don't know how we're doing these.

THE CHAIRMAN: Most appropriate.

MR. MEHNERT: I'll give it a number mark, and I'll make a good copy, if you want.

MR. McGINNIS: It might be good in the transcript to have the number --

THE WITNESS: Here, you can have these back.

THE CHAIRMAN: I'll give them to --

THE WITNESS: I don't want them.

MR. SPARKS: I don't blame you.

THE COURT REPORTER: Okay. No talking. Okay. Where would you like this marked?

THE CHAIRMAN: Do you want them in your name, or do you want them in your client's name?

MR. SPARKS: That's the exhibit.

MR. MEHNERT: I can mark it during lunch, but I

-- I can mark them on the phone if I've got the thing first.

THE CHAIRMAN: Okay.

MR. MEHNERT: Keep it in sequence.

THE CHAIRMAN: That's just in case there might be other questions regarding some of Mr. Parke's exhibits. You have to be able to give them to them so they can refer to them.

And we recognize that those of you who are here did not have the opportunity to review those. We'll let you have the copies that are available if you'd like to look at them.

THE COURT REPORTER: What do you want me to do with these?

THE CHAIRMAN: We want you to hold on to those until we conclude right now. Then Mr. Mehnert will take those and mark them. And you will be able to see what they are.

(Exhibits X012 through X013 were marked for identification.)

THE CHAIRMAN: Mr. Sparks, are you through?

MR. SPARKS: Yes, your Honor.

THE CHAIRMAN: Okay. Then we can get started with -- who's next?

MR. HOOD: Mr. Chairman, Sean Hood. I have just

a few questions for Mr. Hjalmarson. I think we can probably get him done before the lunch hour. I don't intend to be more than a few minutes. I know you've maybe heard that before. I see that look, and I deserve it. But I intend to be brief, or we can break now.

THE CHAIRMAN: No, no. We want to -- we want to soldier on.

THE COURT REPORTER: Thank you very much.

THE CHAIRMAN: That's pronounced Hood, H-o-o-d. Mr. Hood, go ahead.

MR. HOOD: Thank you, Mr. Chairman. Commissioners, good morning. Sean Hood on behalf of Freeport-McMoRan.

CROSS-EXAMINATION

BY MR. HOOD:

Q. Good morning, Mr. Hjalmarson. Good to see you again.

A. Good morning.

Q. I have -- I meant what I said. I just have a couple questions for you, sir.

I want to go back to your conclusion on your redirect where you stated your ultimate opinions relating to your belief that in its ordinary and natural condition, the San Pedro was susceptible to navigation 80 percent of

the year; is that accurate?

A. Below Willow Springs.

Q. Okay. And if I understand your Power Point correctly, that's based upon your calculations that for 80 percent of the year, the maximum depth was one foot; is that accurate?

A. Yes.

Q. And so for the other 20 percent, the maximum depth is less than a foot, and you agree that's not susceptible to navigation?

A. Using that standard I used, yes.

Q. So your benchmark for what is susceptible to navigation is one foot of maximum depth?

A. That is the standard, yes. That's -- that's a federal stan -- that's basically a federal agency's opinion and not mine. I just used their standard.

Q. And that's -- that's -- and we don't need to dredge out all the documents again, but that's the recreational standard that we discussed I think at some length in June?

A. Yes, sir.

Q. Okay. Very quickly, you, as I recall your June testimony, you talked about Cananea, but at the end of the day, you did not include any potential impacts in your calculations; is that right?

A. Yeah, that's right, and I haven't during the entire analysis.

Q. Okay. And so again tying back to your discussion today about mines, Bisbee, Cananea, you've discussed some potential impacts, but you haven't quantified them or included them in your analysis; is that accurate?

A. Yes, sir.

MR. HOOD: That's all I have.

THE CHAIRMAN: Thank you. Mr. McGinnis.

Is there anyone besides Mr. McGinnis that has further questions for Mr. Hjalmarson? And, Joy, are you going to have some follow-up?

MS. HERR-CARDILLO: Three so far.

THE CHAIRMAN: Okay. We'll let Mr. McGinnis go. How's the court reporter doing?

UNIDENTIFIED SPEAKER: Excuse me. We have one question.

THE CHAIRMAN: You have one over here? Okay. Then we'll do Mr. McGinnis over here, and then Joy will get the last shot.

MR. McGINNIS: I'll try to be brief because I'm just --

THE CHAIRMAN: Old lawyer joke.

MR. McGINNIS: I know. Everybody says that.

CROSS-EXAMINATION

BY MR. McGINNIS:

11:53:04 Q. Mark McGinnis for the Salt River Project Wind
11:53:07 River. Just hopefully just a few questions to clarify
11:53:10 only what you talked about this morning because I know we
11:53:13 spent a long time in Bisbee together.
11:53:15 It was my understanding when you were talking
11:53:17 about the first or second slide that you did in your
11:53:21 redirect this morning, you said that this formula, the
11:53:25 geomorphology formula, is that -- do you know the formula
11:53:29 I'm talking about?
11:53:30 A. Yeah.
1 :30 Q. Q equals W times D times --
11:53:33 A. Here, I'm displaying it now.
11:53:35 Q. Okay. Maybe it's the slide before that?
11:53:39 A. Before that?
11:53:40 Q. Yes.
11:53:45 THE CHAIRMAN: It was the one with the long
11:53:47 formula on it.
Q. (By Mr. McGinnis) Think that's it.
A. Okay. That's the one there.
Q. No, it's -- okay. Doesn't matter. One of the
two. My question's really not -- I don't think you have
one with the formula.
1 :54 My understanding of your testimony this morning

said you could use that formula to do a cross-section or you can also -- the formula could also be used to go down the stream?

A. That's right.

Q. Is that right?

A. Okay.

Q. And you didn't do the analysis going down the stream; is that correct?

A. That's right. And I said that only for people that might want to dig into this for their own personal edification. Be careful because when you go down a stream, that method is designed for a flow of a specific frequency like the average annual flow down the San Pedro River. There's a hydrology -- hydraulic geometry method associated with using it that way. This is at a specific cross-section.

Q. Okay. So you did one particular line across the stream, one cross-section; right?

A. That's the concept, yes.

Q. Where is that cross-section located on the river?

A. Anyplace.

Q. You don't know where it is?

A. Doesn't matter. It's for the reach of river that meets the criteria for using the method.

Q. So that particular cross-section that you derived

might not be representative of the actual conditions at any point on the San Pedro at any time; correct?

A. (No audible response.)

Q. It might not actually depict anything in real life ever; isn't that true?

A. It might not -- it's a rep -- I'm not going to answer that yes or no. It's a representative cross-section of the channel that forms under natural conditions. And there could be variation of -- of that representation. And I showed that on a slide in my original talk where on bends and stuff, you can get a deepening of the channel on one side or the other or this or that. So, yes, there is a variation, but this is a -- an -- what's considered a good solid representation of the typical shape and size of that channel.

Q. As you sit here today, can you point us to any particular point on the San Pedro River at any time in history that is exactly the same as what you've modeled here?

A. Well, I'd be awful close.

Q. That wasn't my question. Can you point to any one that's the same as what you have here, any place any time in real life?

A. That you'd have a shape like that?

Q. Yes, sir.

11:56:32 A. Yeah, it happens all the time on -- there's a lot
11:56:37 of rivers that's undisturbed rivers, you know, natural
11:56:40 rivers.
11:56:41 Q. Tell me one place anyplace on the San Pedro at
11:56:44 any time in the last thousand years where you can say,
11:56:47 This shape, this exact shape that I've used here, is
11:56:51 present, any, any?
11:56:53 A. Well, no, we don't have any record of that.
11:56:56 Q. That was my question. So if you do a single
11:57:00 cross-section across the river and, say, there's a sandbar
11:57:03 10 feet down -- down the river from that cross-section,
11:57:07 your cross-section wouldn't take that into account, would
11:57:09 it?
11:57:09 A. No.
11:57:13 Q. If that sandbar goes all the way across the river
11:57:17 that would stop any sort of boat or canoe going down it,
11:57:21 your cross-section wouldn't take that into account; is
11:57:24 that correct?
11:57:25 A. Okay. That would be correct under that
11:57:33 hypothetical.
11:57:34 Q. If there are impassable rapids 10 feet down the
11:57:36 river from your cross-section, your analysis wouldn't take
11:57:39 that into account either, would it?
11:57:41 A. That anal -- if we had an impassable rapids down
11:57:45 the river, I wouldn't be using this method on that

particular river.

Q. Okay.

A. It wouldn't apply.

Q. Given that you use this method, if there was a rapids, a set of rapids that were impassable, just downstream from where your cross-section is, your cross-section analysis wouldn't consider it, would it?

A. It wouldn't be representing that particular rapids, yeah.

Q. If there were -- was a waterfall on the river 10 feet down from your cross-section, your analysis wouldn't analyze that either; right?

A. I wouldn't be using this analysis on that river you're -- that hypothetical river you're talking about.

Q. So if there were sandbars or rapids on this river, you wouldn't have used this type of analysis?

A. If there were, say, rapids, that might be a point where you'd want to segment it according to the Montana decisions. You might want to segment it, i.e., like the Missouri River was.

Q. Okay. My question was, Is your analytical method appropriate for a river that has rapids and sandbars?

A. There's very small riffles and pools in rivers like -- like what I'm using here. The method would apply to conditions where you'd have riffles and pools. And

occasionally, you have tributary, you know, in-flow that'll cause, you know, deposition of sediment and so forth and temporary damming and this kind of thing. Now that would be kind of a natural condition, but when I'm describing it as a natural and ordinary condition per se, I'm -- I'm not considering that.

Q. So your analysis doesn't take into account any rapids, any sandbars that might have existed on the San Pedro River?

A. They -- those wouldn't be considered natural and ordinary. But like I'm trying to describe, they would occur occasionally during, you know, as a result of storm runoff and so forth. It could happen, yes.

Q. So is it your opinion that sandbars are not considered as part of the ordinary, natural condition of a river?

A. You can get sandbars forming in a, yeah, in a meandering river. It's very, very common, not very large ones, but you get sand movement and what you might want to call a sandbar. It's called pools. You get small pools and riffles associated with this kind of river.

Q. So sandbars are part of the ordinary, natural condition of the river?

A. In a small scale, yes.

Q. Okay. Same thing about rapids? Would you agree

that they're part of the ordinary, natural condition of a river?

A. Yes, small ones.

Q. How big would they have to be to not be part of the ordinary, natural condition in your opinion?

A. Well, under -- under a river with this channel material, you can't get big rapids develop, you know, that'll -- that'll last very long. The river will adjust to it because the sand is mobile and then, you know, free to form. And it wants to form this characteristic shape.

Q. So it's your understanding that in its ordinary and natural condition, it would not have been possible for rapids to exist in the river, San Pedro River?

A. Only for short periods of time. But for the ordinary condition, they wouldn't -- it wouldn't be -- anything of any magnitude would not be considered ordinary, that's right. That's what I'm saying.

Q. When we talked back in Bisbee, we had some discussion about the amount of water per ton of copper produced at the mines. Do you recall that?

A. Yes.

Q. And I asked you some questions because your reference for the amount of water per ton was from a relatively recent publication. Do you recall that?

A. Yes.

Q. And in your testimony this morning, you said, Oh, here is an older reference that shows that it's more pertinent to the thing I'm trying to show; right?

A. I showed that because it's almost the -- there's no significant difference between that number and the number I used in Bisbee.

Q. Okay. What was the year of the publication that you relied on this morning? Do you recall?

A. 1960s, I believe. And but they were using data that go way back, and they even used Copper Queen. They had water use per ton or whatever for the Copper Queen.

Q. But the publication was from the 1960s; is that correct?

A. Yeah. You want me to go to that reference? I have it.

Q. As long as we both agree it's from the 1960s, I don't think we need to spend the Commission's time doing it. But if you think there's a question it might not be 1960s, you can feel free to look at it. So...

You testified, I think, this morning some about that mine and about the water for that mine coming from 35 wells. Do you recall that?

A. Yes.

Q. Do you know where each of those wells was located?

12:02:48 A. I explained why -- you know, I have a -- okay.
12:02:55 They're shown on Don Poole's ground water report, the USGS
12:03:02 ground water report.
12:03:07 Q. I just asked if you knew or not. We don't need
12:03:10 to see it.
A. Yeah, you can --
12:03:11 Q. Do you know where --
A. It's a --
12:03:11 Q. -- each one of them is?
12:03:11 A. It's a published report. I have -- Don Poole
12:03:22 specifically gave me a plot of all those wells. I have it
12:03:27 with me.
12:03:27 Q. Have you done any analysis to determine the
12:03:31 impact of pumping from those wells on the surface flows of
12:03:37 the San Pedro River?
12:03:37 A. No. No. And on the upper part of the -- in that
12:03:42 particular area on the San Pedro, the ground water
12:03:46 modelers are having a heck of a time modeling the thing.
12:03:50 They can't get good agreement between the natural,
12:03:53 observed water levels and what the model is showing. And
12:03:59 I've even talked to -- I've talked to Don Poole about
12:04:00 that, and Don just scratches his head. He said, "I can't
12:04:03 get a good calibration in that."
12:04:05 Q. So as you sit here today, if you know that the
12:04:07 water from those mines came from those 35 wells, you don't

really know if that water has had any impact on the river or not; right?

A. Let's put it this way. The wells are in the San Pedro watershed. And we do know that when a well pumps water and uses it, that is water that eventually would get to the river.

Q. But you haven't done any analysis to determine the magnitude of those impacts or the timing those impacts on the flows in the river in its -- it's --

A. No, I haven't. I --

Q. -- natural condition?

A. All I'm --

Q. She's going -- excuse me. She's going to get really mad. She needs me to finish my question. Okay?

Did you understand my question?

A. No, I have not -- I have not, as the other gentleman asked about the Cananea mine, I have not associated directly an amount of water use at the mine to a particular natural base flow of the Verde -- or of the San Pedro River.

Q. Is it your testimony today that it's not possible for the water in a river in its ordinary, natural condition to be turbid?

A. It's very unusual under natural conditions unless you've had like a recent flood that brought sediment down

into the river and all this stuff. You know, and it takes a while for it to clear up and become, you know, limpid again.

Q. So on a given day of observation, it is certainly possible that one could look at a river in its ordinary, natural condition and perceive that water in that river as turbid?

A. It is possible, yes.

Q. You testified some this morning that you thought the Indians along the San Pedro were hiding their irrigation. Do you recall that?

A. There's references that discuss why Indians did not want to be detected.

Q. Other than that, do you have any evidence to show that there was any significant amount of Indian irrigation on the San Pedro that was hidden from non-Indians?

A. I showed you the Congressional document dated 1919. I showed you that, and I showed you exactly what it said. It stated the number of Indians and said they were there. They have been there since that time, since the present time, which meant 1919.

Q. Approximately how many acres do you think somebody could irrigate with a direct diversion out of the river and have that be hidden?

A. I don't know. And you will have to refer to the

document in regard to how -- how -- I have the document. I'm holding the document right here.

Q. It's safe to assume these weren't farms in the hundreds of acres; is that correct?

A. I don't know. There are 75 Indians. They were saying there's at least 75 Indians in there. We do know that the San Pedro was a path of travel for explorers and whoever. And we do know that they were selling, you know, product, agricultural products, to people.

Q. But as you sit here today, you don't have any basis to think there were hundreds or thousands of acres of irrigated farm land irrigated directly out of the San Pedro River that were hidden by the Indians, do you?

A. That's -- that's true. What I am saying is that there were Indians in there that were farming, and therefore they could -- would be diverting flow. And therefore, that's why there was no flow in the river at those times.

Q. Okay. Last few questions I have for this.

I'd like you to go to slide 48 of your presentation from this morning, if you have that up, the last slide of what you did this morning?

A. 45.

Q. Okay. This is the -- my understanding is this is your list of ways in which you believe your opinion is

conservative; is that correct?

A. These are some of the reasons, yes.

Q. Could you read the last one there for me.

A. Yeah. This section's Riffles. Yeah, small riffles that are typical along rivers like the San Pedro. Yeah, that's true. Small riffles and pools are typical of a river like that.

Q. But the fact that those conditions could be highly variable don't necessarily -- that doesn't necessarily make your report conservative, does it?

A. Yes, it does. Well, okay. This is the reason why I did it is because you have this condition. So what I've done is I've taken -- I've taken conditions that give you the smallest depth. When you add everything up that I've done here, it's biased in the sense that it's conservatively small. And the reason for it is is because of these variable conditions that I'm talking about right here. That's why I did it.

Q. And you're -- you give a conservative depth across a cross-section at one point on a hypothetical river; right? Well, I think you just told us that in the last 10 minutes or so; right?

A. I can't -- I can't get that specific about it. But at every point where I had a decision on what to use, I used a value that would give me the least navigable

environment.

MR. McGINNIS: No more questions, Mr. Chairman.

THE CHAIRMAN: Thank you. Ms. Fitzpatrick? Please go ahead.

MS. FITZPATRICK: Tana Fitzpatrick for the Gila River Indian Community.

CROSS-EXAMINATION

BY MS. FITZPATRICK:

Q. Good afternoon, Mr. Hjalmarson. We actually just wanted to know the name, date, and the author of the -- I think it's the -- I can't read it, the report that's propped up against that --

A. Oh, this one?

Q. Yes.

A. This is by -- were you here at the Bisbee?

Q. I was not.

UNIDENTIFIED SPEAKER: No.

A. Okay. Well, this I kept holding up at the Bisbee. This is the one that says you need to use 1850. This is the Arizona Geological Survey Report. It's open file report 96-15. And --

Q. (By Ms. Fitzpatrick) What's the date on it?

A. The date is -- this is the revised copy, revised October 1996.

Q. And who wrote it?
A. Pardon me?
Q. Who wrote that report?
A. Gary Huckleberry.
MS. FITZPATRICK: Thank you.
THE CHAIRMAN: Thank you. Ms. Herr-Cardillo.
MS. HERR-CARDILLO: Cardillo.
THE COURT REPORTER: Ms. Fitzpatrick, do you have a card on you?
THE CHAIRMAN: Here we go. We'll get you a card.
THE COURT REPORTER: Thank you.
THE CHAIRMAN: Do you prefer Christmas or birthday?
THE COURT REPORTER: Thank you.

REDIRECT EXAMINATION

BY MS. HERR-CARDILLO:

Q. I have just a couple questions that I just want to clarify. When Mr. Sparks was asking you some questions, he asked you about whether the river was navigable in 1912. And you talked about the fact that the river in 1912 is not in its natural condition. He pressed you as to whether the river was navigable. And you said you weren't sure whether you could navigate it in 1912.

I just want to clarify. You were not using the

legal definition of navigable in your answer regarding whether somebody could go down the river in 1912; correct?

A. You're correct. Yes, that's correct. Yes.

Q. Okay. I'll keep these short and sweet. I just want to make sure there's no misunderstanding.

Also when you were talking with Mr. Sparks, you had some discussion about evotranspiration, ET -- I'm probably mispronouncing it -- and talking about the effect that ET had on the base flow.

I just want to reemphasize a point you made in -- earlier in your testimony today, that there actually is a recent study that indicates ET in prior times, predevelopment times, would have actually been less than what you've used in your calculations; is that correct?

A. That's exactly right. And I showed that on one slide where it could have been 40 percent of what it is now.

Q. Okay. Mr. Hood asked you very few questions today. One of them, he talked about your conclusion that for 80 percent of the time there was at least one foot of water in the river in its predevelopment condition.

He used the term "maximum one foot," but I think what he intended to say was "minimum one foot." Was it your conclusion that 80 percent of the time the river had a minimum of one-foot depth?

A. Yes, or it was at least one foot.

Q. At least one foot?

A. At least one foot.

Q. Right. Mr. McGinnis asked you a number of questions about your -- the methodology you used and whether it was exact and whether there was actually a point on the river that you had perfectly described. Is the methodology that you used, this modeling, hydraulic geometry?

A. Hydraulic, yes.

Q. Hydraulic geometry. Is it an accepted scientific method used by experts in your field?

A. Yes.

Q. And it's a predictive modeling; correct?

A. Yes, it's commonly -- that's one of the many uses for it. And like it's a model used in or a method used in the National Engineering Handbook by the Department of Agriculture. And in that handbook, it is used for predicting or for channel design.

Q. Okay. And experts rely upon those, the results of those models?

A. Absolutely.

Q. Okay.

A. Yes.

MS. HERR-CARDILLO: I have nothing further.

12:14:59 THE CHAIRMAN: Thank you very much.

12:15:01 Are there any questions from the commissioners or
12:15:03 Mr. Breedlove? Mr. Hood wants to stand up and defend
12:15:06 himself.

12:15:08 MR. HOOD: I'm sorry. Can I clean one thing up,
12:15:09 Mr. Chairman?

12:15:09 THE CHAIRMAN: Yes, you may.

12:15:11 MR. HOOD: Sean Hood again. Freeport-McMoRan.

RECROSS-EXAMINATION

BY MR. HOOD:

Q. I just want to go back to our discussion, Mr.
12:15:17 Hjalmarson. We were discussing your cross-section and the
12:15:19 depth that you calculated. And 80 percent of the time,
12:15:23 you calculated there was a foot of depth or more. The
12:15:26 maximum part is you're talking about maximum depth in the
12:15:31 parabola; correct?

12:15:31 A. That's the maximum part. And because of the
12:15:35 shape of the parabola, that would be very representative
12:15:37 of quite -- quite some width but in essence be the same
12:15:42 depth. So...

12:15:43 Q. Just -- just -- well, just to be clear, what
12:15:45 you're talking about is maximum depth, the maximum depth
12:15:48 for that cross-section?

12:15:49 A. That's right.

MR. HOOD: Thank you.

THE CHAIRMAN: Mr. Hood, the maximum depth was what?

MR. HOOD: The maximum depth is 1 or greater 80 percent of the time.

MR. HJALMARSON: The maximum depth of water.

MR. HOOD: Right.

THE CHAIRMAN: Thank you. Any other questions? Mr. Hjalmarson, it appears that you're done.

Ms. Cleary, will an hour be enough?

THE COURT REPORTER: Sure.

(A luncheon recess ensued from 12:16 p.m. until 1:15 p.m.)

THE CHAIRMAN: Well, some watches say 1:15, and we apologize for shortcutting your lunch, but we're going to go move on down the road here.

Let the record reflect that the commissioners are all present, Mr. Breedlove is present, and Mr. Mehnert is present.

Mr. Hood, would you like to go ahead and proceed.

MR. HOOD: Mr. Chairman, I would. Thank you very much. Sean Hood again on behalf of Freeport-McMoRan.

And just for the record, with us this morning was Shilpa Hunter-Patel with Freeport, senior water counsel. And of course now we have testifying Mr. Burtell.

RICH BURTELL,

called an expert herein was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HOOD:

Q. Would you please identify yourself and introduce yourself to the Commission.

A. My name is Richard Burtell. I am principal and owner of my own consulting firm known as Plateau Resources. And I am contracted by Freeport-McMoRan in this matter.

Q. In general terms, what was it that Freeport-McMoRan asked you to do in connection with these proceedings?

A. In this proceeding, they asked me to evaluate whether the San Pedro River was navigable in its ordinary and natural condition at statehood.

THE WITNESS: Oh, is this --

THE CHAIRMAN: It's not for amplification. It's for a recording.

MR. HOOD: It's for recording. Okay. I tapped on it and didn't hear anything.

MR. MEHNERT: Sean, you're okay.

MR. HOOD: I'm okay. Good. Thank you.

THE CHAIRMAN: If you want to move back --

01:16:39 MR. HOOD: Hearing me usually isn't the biggest problem in the room.

01:16:46 May I approach? I've got some copies of the declaration for you, gentlemen.

01:16:50 THE CHAIRMAN: We have given up the witness protection program.

01:16:54 MR. HOOD: That's already in the record?

01:16:57 MR. MEHNERT: Oh, yeah, yeah.

01:16:58 MR. HOOD: This is just for reference.

01:17:00 THE CHAIRMAN: We will be informal, shall we say.

01:17:05 MR. HOOD: Great.

01:17:07 THE CHAIRMAN: That's it. You're out.

01:17:20 MR. HOOD: What I've just handed out is or are copies of Mr. Burtell's declaration. It's already in the record. I just wanted you to have ready copies available to you.

01:17:32 Q. (By Mr. Hood) Mr. Burtell, let's start by going through a summary of your opinions, and then we'll backtrack and get into the meat of it as we go. Okay?

01:17:41 A. Sure.

01:17:41 Q. Summarize for us what your opinions are in this case.

01:17:44 A. As indicated in my declaration, after looking at various lines of evidence, which we'll get into in some

01:17:49

detail probably here this afternoon, I concluded that the San Pedro River, in my opinion, was not navigable in any of its portions from the international border all the way to its confluence at or before statehood.

Q. In its ordinary and natural condition?

A. In its ordinary and natural condition.

Q. And, again, without getting into any painstaking detail, just generally, what were some of the factual circumstances that led you to believe that the San Pedro was not navigable in its ordinary and natural condition at the time of statehood?

A. I think we're very fortunate that we, unlike Mr. Hjalmarson, I feel that the natural conditions that we have -- sorry, the historic accounts that we have are very important lines of evidence to describe what the flow conditions were in the river in its natural and ordinary state. So I relied on those.

We also are fortunate to have stream flow data from the early 1900s for a portion of the river that I also believe is an important line of evidence indicating that the river is not navigable in its ordinary and natural condition.

And there's other information I present in the report, one relating to military bases. There were military bases in the area in the 1850s and into the '60s

and '70s to deal with the Apaches that had established a stronghold in the area. And those military bases need to be supplied. And there's no evidence, as I'll get into later, that those military bases, even though they had to get supplies transported to them, and no evidence that they used the river for transportation of that.

And then also I have information, both historic and recent, regarding beaver dams along the San Pedro River that I think are important lines of evidence related to obstacles to navigation along the San Pedro River.

Q. So you've looked at records that relate to the depth of the stream. You've looked at historical records that show no meaningful navigation for commercial purposes, and you've looked at impediments. And all of those things cumulatively lead you to the conclusion that?

A. Yeah, I think what's important when you look at this issue of whether a stream is susceptible to navigation or actually navigable is not just any one factor but looking at a series of factors and how those factors taken in combination lead you to one conclusion or the other.

And as I described what I have done here this afternoon and, if necessary, tomorrow, I would hope that the Commission would take from my work that you don't have to rely on a model, a hypothetical model to try to figure

out what happened. I think there is ample evidence actually from the area that paint a picture of a non-navigable river. And I think, if I could be so bold, I think the Commission needs to focus on real lines of evidence as opposed to a model which is trying to try to predict something that is very difficult to do.

Q. So in referring to the model, you're of course referring to Mr. Hjalmarson's work, and you've been present at the hearing leading up to this point both in Bisbee and here today?

A. That's right.

Q. And you've read his -- you've read his Power Point and his other materials. And have any of those materials or testimony impacted your opinions?

A. No. I -- I believe Mr. Hjalmarson has put in a tremendous amount of effort in his work, and I applaud his efforts. However, I strongly disagree with him.

I don't believe that what I have seen from what he presented to the Commission, I believe his report was in May, and then both his testimony in Bisbee and his testimony here this morning, nothing that he's presented changes my conclusions in my declaration as to navigability of the river.

Q. Let's back up, talk a little bit about your background and your qualifications. And then we'll get

into the substance of your declaration. Okay?

And for the Commission's reference, Mr. Burtell's CV has been attached as attachment A to the declaration before you.

Mr. Burtell, I'll let you run with it. Please give the Commission a sense for your background and your qualifications.

A. I'm not one to toot my own horn, so I'll try to keep this somewhat brief. I got my bachelor's degree in geology from the University of Pittsburgh. So I'm an eastern guy. Came out to Arizona to attend graduate school at the University of Arizona. When I got out of graduate school, I went to Florida for a year and I worked for the U.S. Geological Survey where ironically I did a lot of stream gaging and a lot of stream flow work.

Then I moved to Colorado. And for the next 10 years in both Colorado and Arizona, I worked for environmental engineering firms. That then led to me joining the Arizona Department of Water Resources in 1999, if memory serves. And I worked for DWR for about 11 years. And during that time, I managed their adjudications section.

I've had a lot of people ask me and I think this Commission, if any, would find it ironic that this is a navigable stream adjudication. My adjudication was a

little different. We were looking at, as I think all of you know, the adjudication of surface water rights, which is a distinction.

However, there's a lot of parallels and similarities between the adjudication of surface water rights and this adjudication. And that is while I worked at DWR, I had to become well versed in Arizona streams and how those stream flows had changed over the years and looking at historic records. So I've had a lot of opportunity to immerse myself in this issue. And as Mr. Hjalmarson did in his report, there's a lot of information to look at. I think a lot of that information is very valuable for this Commission, and I've tried to include that in my declaration.

Q. And part of your -- during a portion of your time at DWR, you were the manager of the adjudication section. And you've touched upon that a little bit. How many years were you the manager of the adjudication section?

A. I guess it was about two or three years after I joined, I became the manager. At that time, the staff was quite small. And then it grew. And I guess at the largest staffing period, there were 15 folks that worked under me, a variety of folks, hydrologists, geologists, GIS specialists. I had quite a group under me. And then I left ADWR in February of 2011 to start my own firm.

01:24:59 Q. Would you agree that a significant portion of the
01:25:04 work you did as manager of the adjudication section
01:25:08 related to the San Pedro River?
01:25:10 A. Yes, quite a bit. Ironically, again, this
01:25:14 Commission has started with the San Pedro River. Those
01:25:18 folks, many lawyers which are in this room know very well
01:25:21 that the San Pedro River watershed has been the starting
01:25:25 point for much of the general stream adjudication of which
01:25:30 I provided technical support to the Court.
01:25:34 Most of the issues started in the San Pedro at
01:25:36 least in the Gila adjudication. So it has afforded me the
01:25:41 unique opportunity, perhaps, to really dive into the data
01:25:45 for the San Pedro River. So many years had been focused
01:25:48 on the river. I've had many trips up and down that river
01:25:51 looking at what the flow conditions are now.
01:25:55 Q. You -- in jumping into your approach for
01:26:00 evaluating the navigability or the non-navigability of the
01:26:05 river, what steps did you take to evaluate the appropriate
01:26:08 time period of ordinary and natural conditions?
01:26:11 A. I understand when I first got involved in this
01:26:14 case that a important driver are two court decisions, the
01:26:20 Arizona appeals decision. And I know I'm not a lawyer,
01:26:23 but there's an official name for that. But that Arizona
01:26:26 appeals decision as well as this PPL Montana case.
01:26:30 So I read those cases carefully. And what struck

me about both of them, particularly the Arizona appeals case, was the importance of looking at the river in its natural and ordinary condition. And in fact, the Arizona appeals decision, as I recall, and I could pull the language out, was very specific about what natural and ordinary is. They went and actually defined what those conditions were.

So because I had previously worked in the -- in a navigability case, I took to heart the fact that many previous courts and this Commission had looked at historic data. And it was important to look at what data was available that, again, represents the river in its natural and ordinary condition. So that was a driver throughout my testimony.

I disagree with Mr. Hjalmarson in many areas, but one of the main areas is that there is not good data, which I feel there is, that describe the river in its natural and ordinary condition. I believe that data does exist, and I've put it in my declaration.

But it's critical that we look at the river to the degree we can in its natural and ordinary condition specifically as it relates to diversions, that there is not evidence that the data that I used shows there was substantial diversions at the time. Or in other words, if I'm including data in my report, those data better not be

01:27:59 1 substantially affected by diversions. If they are, then
01:28:03 2 that's not necessarily representative of natural and
01:28:05 3 ordinary conditions. And you, the Commission, shouldn't
01:28:07 4 be looking at them.
01:28:08 5 Q. Let's take a look at your declaration. If you
01:28:12 6 could just walk us through the way its organized?
01:28:14 7 A. Sure. You folks have that in front of you. I'm
01:28:23 8 happy to report for maybe some of you or maybe unhappy for
01:28:23 9 others that I do not have a Power Point. So I am going to
01:28:26 10 look over at the Commission often during my testimony here
01:28:30 11 and also during my cross, which I'm sure Ms. Herr-Cardillo
01:28:34 12 will do rigorously with me, and I want, if possible, to
01:28:40 13 have you guys refer to things in these handouts that Mr.
01:28:42 14 Hood will be giving you, so you can follow along.
01:28:45 15 If you take a look at the second page of my
01:28:48 16 declaration is a contents page. And that pretty much
01:28:51 17 summarizes it. Just to put it in my own words, after an
01:28:56 18 introductory statement and summary of opinions, I go into
01:29:00 19 data evidence on ordinary and natural conditions. And as
01:29:05 20 we'll talk about in some detail, I feel that there are
01:29:09 21 strong lines of evidence, both historic accounts and
01:29:13 22 historic stream flow records, that provide an indication
01:29:16 23 of those. I also discuss long-term stream flow records
01:29:21 24 for the gages, and I'll describe a bit more about why I
01:29:24 25 included those.

01:29:25 The next section talks about the absence of
01:29:28 commercial boat travel at or prior to statehood. An
01:29:33 important factor in evaluating whether a stream is
01:29:36 navigable, and it's not the only factor, but an important
01:29:38 factor to consider is whether or not there was any
01:29:41 historic evidence that any commercial boat travel actually
01:29:45 existed on these -- on this river. And so I provide some
01:29:49 evidence that indicates that there was not that boat
01:29:54 travel at that time.
01:29:55 The next section which I refer to as the reported
01:30:00 San Pedro Lake. The Center For Law in the Public
01:30:05 Interest, and if it's all right to the Commission, I'll
01:30:08 refer to them as "The Center." In one of their memoranda,
01:30:12 they talk about a lake that a former resident of the area
01:30:19 reported. I addressed that so-called lake in my
01:30:23 navigability determination as well. And then I provide
01:30:26 some conclusions.
01:30:27 There are also several tables and attachments and
01:30:31 one figure. The figure, it's not the best and I
01:30:35 apologize, but it does provide geographic reference to
01:30:39 some of these stream gages. It's a big watershed with
01:30:42 lots of tributaries coming in and lots of stream flow
01:30:47 gages up and down its length.
01:30:48 So sometimes I might ask you folks if you're
01:30:51 confused as to geographically where we're at to take a

look at that figure. My tables, in my opinion at least, are critical. They provide, again, I feel, strong lines of historic evidence indicating that the San Pedro River is not navigable. And so I'll walk through some of those tables with you folks. And some of the attachments I might also have you guys refer to. They build on some of the other comments that I make in my report.

Q. Let's jump, Mr. Burtell, right into section 2. We've already sort of gone over some introduction and summary of your opinions.

So section 2 then is sort of the first substantive area. It's Ordinary and Natural Conditions. And why don't you walk through your approach.

A. Yeah. As I indicated before, I -- one area that I disagree very strongly with Mr. Hjalmarson is that the San Pedro River in the 1940s -- or 1840s and '50s and '60s had been affected by man and was not in its ordinary and natural condition at that time.

As we get further into my testimony this afternoon and, if necessary, into tomorrow, I am very prepared to talk about that issue. It seems to be a foundational difference between Mr. Hjalmarson and I. He feels very strongly that by the 1850s, the river was entrenched and because of that there is no question that entrenchment was caused by man. Thus, the river was not

01:32:24 in its ordinary and natural condition. And pretty much
01:32:27 everything in my report relating to that data is of no
01:32:31 use. He discounts it. And he follows then to develop his
01:32:35 model and uses his model.
01:32:37 He and I disagree very strongly there. I think
01:32:41 his model is seriously flawed. And I, quite frankly,
01:32:45 don't feel that it even had to have been developed based
01:32:47 on the data that was right in front of us. And, again,
01:32:49 I'll say I feel very strongly that we are blessed in some
01:32:55 regards for the San Pedro River that we have so much
01:32:57 historic data for this period that is useful. So I
01:33:01 compiled that data.
01:33:02 Now I want to point out that the data that I
01:33:05 actually tabulated here, and we'll get into, all came from
01:33:10 the Fuller report which has been referenced many times by
01:33:19 Mr. Hjalmarson. I think all of you know the Fuller report
01:33:19 was prepared on behalf of the state land department, and
01:33:21 it is considered a benchmark work, if you will, trying to
01:33:25 summarize all of the historic data and more recent data
01:33:29 for the river system.
01:33:30 So these quotes, which I'd now like to walk
01:33:33 through, if I can indulge the Commission. These came
01:33:38 right from the Fuller report, again, prepared on behalf of
01:33:41 the state land department.
01:33:42 Q. Let me back up one moment, Mr. Burtell.

A. Sure.

Q. I just want to, before we jump into some of the quotations -- and are you jumping to Table 1?

A. I was going to go to Table 2.

Q. 2, Table 2. Sorry.

A. Or, no, no, no. I'm sorry. Table 1 --

Q. Table 1.

A. -- which is the historic accounts, yes.

Q. Okay. Before we get there, I just want you to talk a little bit more about this period of time that you believe represents ordinary and natural conditions for the river. Explain for us in a little bit more detail why you feel there's this period of time from somewhere in 1840 up until the 1870s that provides us this glimmer back in time.

A. Yeah. As Mr. Hjalmarson indicated, there is a rich history in the San Pedro River. When the Spanish explorers, Father Kino, first entered area, there were Indians there. I believe it's pronounced Sobaipuri. I'm just going to say Indians since I'm probably pronouncing it wrong. But there was a -- there was a presence of Native Americans there at that time.

Over the years since that period, the Apaches developed a stronghold in the San Pedro River watershed. And the Apaches' presence in the watershed was so

significant that it prevented -- well, not only did they push out Spanish settlers and then later Mexican settlers, but then when the United States acquired that portion of Mexico, the area was largely abandoned.

And the reason we know it was largely abandoned is we had the 49ers. They were on their way to California, passing through. We had, as Mr. Hjalmarson indicated, military expeditions. Surveyors both of railroads as well as stage coach roads, they passed through the area.

And so there's no question that there were folks who were passing through the area and they recorded what they saw. And what they didn't see was people. They saw an area that was abandoned. The Spanish and the Mexican settlers had haciendas. Those haciendas were abandoned. About the only thing that was left, from what I can see Mr. Hjalmarson indicated, were cattle. The cattle that had previously been at these camp -- or at these haciendas were running wild.

Because the area was largely abandoned, it then affords us a unique ability then to look at what observations and data these folks recorded at the time and say to ourselves: "Hey, this area is abandoned. There is not an effect of man on the river."

So what data is provided there should be looked

at carefully for, again, information includes as to what the navigability conditions were of the river. So with that said --

Q. Let's -- you know, and let's -- let's talk. You referenced some of what Mr. Hjalmarson had to say about this 1950 cutoff --

A. Yes.

Q. -- and entrenchment. Maybe we ought to address that now.

A. Yes.

Q. And you've heard -- you heard his testimony, and we've all seen now the Huckleberry report, as I'll call it, which is Arizona Geological Survey, June 1996. I believe it's already in the record.

And, Mr. Burtell, why don't you discuss -- you've now had an opportunity to review this report?

A. I have.

Q. We hadn't seen it before the June proceeding. But now you've had a chance to look at it; is that right?

A. Yes. And I, again, ask the Commission to focus on Huckleberry's report in so much as it was a foundational source of evidence by Mr. Hjalmarson.

In Bisbee, he was adamant. I believe he waved the report in front of the Commission and said: "It's all here. The answer is all here." And what he was referring

to is Mr. Huckleberry's statements that the San Pedro River in the 1850s had evidence of entrenchment.

But what he doesn't say and when you actually look at Huckleberry's report is Huckleberry never said in his report -- in fact, since that time, Huckleberry has said something much different than that. Huckleberry never says that that entrenchment was caused by man. He never says that in his report.

So I'd like to refer some pages out of Huckleberry's report, and you can look on for yourself. Let me get to my page here. And this is for purposes --

Am I going too quick for you? You're okay.

Okay. If you take a look at page 12 of Mr. Huckleberry's report that Mr. Hjalmarson used, again, as a foundation for why he even needed to do his model. You take a look at the first paragraph and you go down a few sentences. He says, Mr. Huckleberry says: "In general, descriptions of the lower reach during this period are consistent. A small unentrenched stream with low but generally consistent flow. The numerous Sobaipuri," if that's pronounced right, "irrigation ditches described by Kino and Mange," Mange was a captain who followed Kino along his travels, "implied that the river in 1697 was unentrenched at least at the Sobaipuri villages." They also describe marshy conditions indicating shallow water

tables, and they reference Hendrickson and Minkley. "The river also contained numerous beaver ponds and edible fish."

Q. Let me stop you real quick before you jump into your -- what you draw from this.

Just for background purposes, why is there some relevance to the existence of irrigation as it relates to the existence or nonexistence of entrenchment?

A. What Huckleberry says in his report is that where you would see an irrigation ditch, one can then imply that the river is not entrenched. So --

Q. Because?

A. Because if you have an entrenched river, the entrenchment would cause the river to be below the typical floodplain. And because these irrigation ditches were gravity fed water, if the river is below the floodplain, then --

Q. That makes irrigation difficult.

A. -- it makes irrigation difficult because they didn't have pumps back then. So it's going to be hard to gravity lift the water if you will up into your canal and down into your ditch.

So Huckleberry uses the presence of the Indian villages and their associated irrigation as an indication that the river was unentrenched at those points, but he

doesn't say anything, Huckleberry doesn't, about whether or not the river was entrenched anywhere else nor does he make any conclusions about whether or not if there was any entrenchment whether it would be caused by man or anyone. All he says is that there's an Indian village. That means that there's entrenchment -- I mean, that there's no entrenchment.

Q. So the upshot here is back in the 1690s or whatever time frame we're talking about -- we're talking about the 1600s?

A. 16 -- late, yeah, 1690s.

Q. You have certain points where presumably you could infer there's not significant entrenchment, but we don't know what was happening elsewhere on the river?

A. That's correct. And I think what's -- if we want to just -- and if you don't mind, I'd like to spend a few more minutes on this and then we'll move past this topic.

There is a map that was prepared by a historian. His name was Bolton, and it was prepared in 1919. And what Bolton did is Bolton took Kino's diaries and Mange's diaries. And these explorers were very careful about indicating as they walked up and down the river where they were. And they would say, Traveled so many leagues down the river. And they would observe one thing or the other.

Well, what Bolton did is Bolton -- and he's

01:41:54 1 considered the chronicler of Kino. He was the one who
01:41:58 2 originally transcribed Kino's diaries from Spanish into
01:42:03 3 English. And what he did is he prepared a map based on
01:42:07 4 those accounts of where the Indian villages were.
01:42:12 5 And that's being passed out to you. And what I
01:42:14 6 did is I took Bolton's map based on these -- these diaries
01:42:20 7 of Kino, et cetera. The only alteration I did to them is
01:42:25 8 I highlighted where the Indian villages were. So if you
01:42:28 9 see in green, you'll see where the Indian villages are.
01:42:32 10 And I also labeled where the rivers were, the Babacomari,
01:42:36 11 the San Pedro, and the Aravaipa, for references.
01:42:38 12 So what you can see is you can actually see where
01:42:40 13 the Indian villages are that Huckleberry relies on as an
01:42:44 14 indication that the stream was not entrenched. Now as you
01:42:49 15 notice, a couple things should come to mind. The Indian
01:42:52 16 villages are only -- are primarily in the middle to lower
01:42:56 17 San Pedro. There's only one in the upper. So for Mr.
01:43:02 18 Hjalmarson to take Kino's observations via Huckleberry and
01:43:08 19 assume the whole San Pedro River was entrenched --
01:43:09 20 Q. Unentrenched?
01:43:10 21 A. -- unentrenched is not, I think, a fair reading
01:43:13 22 of the record because Indian villages were only in certain
01:43:17 23 areas on the river.
01:43:18 24 But I think even more interesting to me is that
01:43:21 25 if you believe this presumption that if there is an Indian

village and irrigation, that means the river isn't entrenched, why don't we now then leap ahead in time to 1899. And in 1899, the USGS had a fellow go down the San Pedro --

Q. Read the title of the map, if you would.

A. The figure I'm now referring to is Canals Diverting Water from the San Pedro River in 1899.

Q. March 1899?

A. March 1899. So he was there during the irrigation season. The fellow who went down the river's name was F.H. Newell. And what you'll see is a figure that has a map on one side and the table on the other.

And what the map shows is all of the irrigation canals up and down the San Pedro River in 1899. And the table next to it shows how much water was being diverted into those canals in 1899. This is 1899, 50 years after Mr. Hjalmarson said the river had already been affected by man. But what you find is there's actually more irrigation canals and diversions in 1899 up and down the river than there was when Kino went -- observed the Indian villages in 1690. So --

Q. Are these also gravity-fed irrigation?

A. These are gravity-fed. And they actually have the diversion amounts. So if you believe Mr. Huckleberry's argument that irrigation canals equal

unentrenched, in 1899, the river was less entrenched than it was in 1690s. There's irrigation canals up and down the San Pedro River. So Huckleberry's argument, again, focused on if there was an Indian village and irrigation canals, that means that the river was unentrenched.

Well, as you see, there was only selected villages where it's unentrenched. You come hundreds of years later, 50 years after Mr. Hjalmarson says the river has been affected by man, and there's more irrigation canals suggesting the river is even less entrenched. I have a hard time believing Mr. Hjalmarson would ever admit that in 1899 the river was less entrenched than it was at Kino's time. But if that's --

Q. For a matter of perspective, when did the period of significant entrenchment begin?

A. The research that I've read, including The Center's submittal, Ecology and Conservation, and we'll get into this in detail in a minute, the researchers that are presented in this report indicate in late 1890s and then extending into the early 1900s is when entrenchment began in the lower San Pedro River and worked its way upstream. And it wasn't until, I believe, the 19 -- in the 19 teens, 1913 or 15, that entrenchment had reached the Charleston area.

Q. So what -- let's take a step back.

A. Sure.

Q. What is the import of all this evidence as it relates to these localized observations of entrenchment in certain areas in the early 1800s leading up to Mr. Hjalmarson's magic 1850 time period?

A. Yeah, there's no -- when you consider how many irrigation ditches there were in 1899, it challenges the basic assumption that man had any effect on the entrenchment of the river, certainly any entrenchment that was observed in the 1840s and '50s. And it's such a critical point, I believe, for the Commission to consider because Mr. Hjalmarson said he developed his model because he didn't have any data that represented natural and ordinary conditions.

And that presumption is based on Huckleberry. So you go to Huckleberry. And then what do you find in Huckleberry? Huckleberry is making his assumption that an unentrenched river occurs where there's irrigation ditches. But we have in 1899 irrigation ditches all up and down the San Pedro River, leading one to, again, believe that the river was less entrenched in 1899.

So certainly the historic accounts that I use, why wouldn't they be just as valuable? The river was less entrenched than it was in the 1690s when Kino first went through the area.

Q. And of course you're not suggesting it was less entrenched. It simply illustrates that one exists -- one localized area where irrigation is available, all that speaks to is whether there's entrenchment at that location?

A. At that location. It's a site-specific thing. And I think what's most critical is that -- let's put the words in the horse's mouth, and that is Huckleberry. In 2009, and this is a report that was submitted by The Center.

Q. Read the title, please.

A. Ecology and Conservation of San Pedro River. The Center provided to the Commission three chapters. And I would like to go to the chapter that was written by Mr. Huckleberry some 13 years after he wrote the report that Mr. Hjalmarson was so adamant we use.

If you take a look at towards the end of the document and turn to page 259. And again this is of --

Do they have this, Sean?

Q. It's in the record. It was --

A. Oh.

Q. -- submitted by the Center.

A. Okay. I apologize.

Q. Let me go -- let me -- you know, let me provide you with copies.

01:48:47 A. Yeah, I think this is critical for the Commission
01:48:48 to look at. And I'll just again reiterate until you folks
01:48:52 tell me that you're tired of hearing me say it and that
01:48:54 you got the point the first time.
01:48:56 And that is, Mr. Hjalmarson ran his model because
01:49:00 he felt like there was no historic data that was of any
01:49:04 value. And there was no historic data of any value
01:49:06 because he said the river had been affected by man.
01:49:10 I'm now going to read you a quote from the very
01:49:13 man that Mr. Hjalmarson uses as the basis for his
01:49:17 argument, and that's Huckleberry. But now I'm going to
01:49:20 show you Huckleberry 13 years after he wrote his report
01:49:24 for the Arizona Geologic Survey. If you take -- turn to
01:49:27 page 259, and the section is entitled Historic Changes.
01:49:39 It's towards the back. All right. Bear with me here.
01:49:56 All right. It's the last full paragraph towards
01:49:58 the bottom of the page starting with: "The probability
01:50:01 that incision along the San Pedro was caused by a
01:50:05 combination of natural climate variability and human
01:50:08 alterations of the landscape creates a problem for
01:50:12 resource managers. Given the San Pedro River's history
01:50:17 due to climate variability, how does one separate natural
01:50:21 from anthropogenic changes? Arroyos and gullies that form
01:50:27 through the San Pedro River Valley by the late 1800s were
01:50:35 attributed by many to overgrazing. Yet the San Pedro

River and many other streams in southeastern Arizona had downcut and backfilled at least five times prior, Walter and Haines 2001."

Here's the key. "Rivers like the San Pedro are complex open systems that adjust channel size, shape, and configuration in response to changes in runoff and sediment yield from drainage basins. Such changes can have multiple causes. And it may not be possible to determine to what degree river metamorphosis is human induced."

Q. It doesn't sound to me that Huckleberry is opining that any entrenchment that occurred prior to 1850 was attributable to human impacts?

A. Not only does he say that, but the entrenchment that occurred later, starting in the late 1800s and going into 1900s, he's not even sure what caused that or whether humans had any effect on that.

So it seems like more than a bit of a stretch for Mr. Hjalmarson to conclude from Huckleberry 1996 that just because there was local areas of entrenchment on the San Pedro River that that was caused by man and that you can't use any of the data.

Mr. Huckleberry doesn't even agree with that presumption of his own data 13 years later in his report. He has uncertainty as to whether man had any effect on the

entrenchment of the river even the large entrenchment that was observed and reported in newspapers in the late 1800s.

So it's because of that that I feel so strongly that we shouldn't discount these historic accounts that we have, that we have a unique opportunity to look through a window of time when these explorers went through the area and see the river before it was affected by man.

Q. Are you aware of any evidence suggesting that human impacts caused any entrenchment that occurred leading up to 1850?

A. Up to 1850, no. Now the closest, again, you could see is what Huckleberry said, but he relies on irrigation ditches. So with that said --

Q. And Huckleberry doesn't describe any human impacts that would have caused entrenchment pre-1850, does he?

A. No, he does not. He does not discuss that.

Q. Let's stay with the entrenchment topic a little bit. And entrenchment -- and part of the quotation you referenced, I think, touches upon this. This is a natural occurrence; is that correct?

A. Yeah. As was indicated in that quote that I referenced and Mr. Sparks, I think, explored the topic a bit with Mr. Hjalmarson this morning is that there is geologic evidence of several periods of entrenchment in

the San Pedro River over time long before there was man there or certainly man having any substantial effect.

Because of these evidence of down cutting, long before man had any presence in the watershed, it's clear that entrenchment is a natural condition. Man comes onto the scene in some numbers in the late 1800s. And so some researchers have tried to do a cause and effect. Entrenchment occurred. Man was here. That means man caused entrenchment. But that's not a fair analysis to do because there's historic entrenchment long before man had a presence in the area. You can't just assume because man was there and entrenchment was occurring that one caused the other.

Q. And there also was an earthquake associated with this late period of entrenchment. Again, this is well after your historic accounts. But -- but just staying with that late period of entrenchment, there was an earthquake; is that right?

A. Yeah. Mr. Hjalmarson, I believe in the Bisbee hearing, was asked about, I think by Mr. McGinnis, about this earthquake. There was a very large earthquake. I think it was testified to in 1887. And it was -- the epicenter was in Sonora, so south of the border. But it was not an insignificant earthquake. I think, please, someone correct me in the audience if they know, but I

think on the Richter scale, it was well into the 7s. This was a large earthquake, so large in fact that it caused geysers to come up in the St. David area which then later led to wells being put in there, et cetera.

As to whether that earthquake had any effect on the arroyos, this entrenchment, Mr. Hjalmarson indicated, as I recall, that he had talked to several experts and the experts he talked to indicated that there wasn't any relationship between that earthquake and the entrenchment.

Once again, however, a document presented by The Center, this ecology report, suggests otherwise. And the quote I'm going to read you now is from two researchers that those of us that are students of the area, Hereford and Benticort, probably published more on that area than anyone else related to its geomorphology. And they have a different conclusion about the importance of the earthquake. So let me turn to that. And, again, you guys can read along, if you would like. Apologize as I find the page number here. If you turn to page 242.

Oh, they have this now, Sean?

Q. They do, yes.

A. Page 242, this is again in Hereford and Benticort's chapter of this report that was submitted by The Center. And the title of that chapter is Historic Geomorphology of the San Pedro River. Been talking a lot

about geomorphology and the importance of that.

Here's their quote. I'm under the section on 242 regarding earthquake, couple paragraphs down toward the bottom. "However, it cannot yet be discounted that geohydrologic phenomena associated with the 1887 earthquake set the stage for arroyo initiation. The earthquake conceivably could explain the remarkable synchronicity of arroyo cutting throughout southern Arizona and northern Sonora. One might expect channel adjustment to a 32 kilometer fissure in the floodplain or to the changed configuration of ground water surfaces. The immediate withdrawal from artesian aquifers probably produced changes in head that might have accelerated rates of compaction by reducing buoyant forces. The same effect, perhaps not at catastrophic, can stem from pressure losses in artesian aquifers during extremely dry periods."

Here's the point: "Regardless, investigation of the possible links between the 1887 earthquake and subsequent channel entrenching is long overdue. A first step would be to examine evidence for fissures in the 1937 aerial photos of the San Pedro, provided that arroyo cutting did not eliminate such evidence."

Mr. Hjalmarson discounted out of hand that the earthquake could not have had any effect on entrenchment.

Hereford and Benticort in a document submitted by The Center suggested that issue has not been resolved. And in fact and my reading of this would suggest that the earthquake very much could have had an effect on entrenchment.

Q. So we're making our way towards your historic accounts. Again, this work we've been doing up to this point is to set the stage for your period of time that represents natural and ordinary conditions.

A. Hopefully, if I've done anything here with the Commission at this stage that I at least got you to think about whether Mr. Hjalmarson's argument that by the 1950s man has caused entrenchment in the river is flawed. I think I presented evidence even from documents presented by his client that that simply isn't the case.

I'd now like to describe some of these historic accounts which, again, I think, provide a unique glimpse into what the river was at this period of time unaffected by man.

Q. And while you're flipping, for the record, they're discussed in paragraph form on page 2 of Mr. Burtell's declaration. And I believe Mr. Burtell is going to proceed with Table 1 which lays them out in turn. Is that accurate?

A. That's correct. And so if you would now turn

into my declaration to table 1, and it's an oversized table. And what it has is a series of direct quotations from the Fuller report by these very historians. And like Mr. Hjalmarson, in many cases, I have gone back and looked at the original quotations from the original books. Many of these are on line, so it's not as much of a task as you might think to find several of these documents on line. They've been imaged in. These are old documents, and they're of great historic significance.

I'm going to read some of these to you because I think, again, the importance of empirical evidence outweighs a hypothetical model nine times out of ten or ten times out of ten. And so I'd like to, again, indulge you to read some of these quotes and hear these descriptions of the river in the words of the people that went through the area.

Q. And just for clarification, the table that Mr. Mehnert just helped me pass out is a reproduction of Table 1. It's just a little bigger and easier to read.

A. All right. For purposes of organizing these historic accounts, I divided the river up into the upper, middle, and lower San Pedro, not for segmentation purposes like PPL Montana, but simply geographically, roughly divided into thirds, upper San Pedro River from the international border down to the town of Benson, middle

San Pedro River from Benson down to Redington, and lower San Pedro River from Redington to the Gila confluence.

Start with the upper San Pedro. Most of these accounts, I should also point out and I think Mr. Hjalmarson indicated, were made by either military folks or surveyors, people that are trained to make careful accounts of what they are seeing. So I think right off the bat in light of who made these accounts, they have even more value that these are not just happy go lucky folks passing through the area. These are people trained scientifically to observe things.

One such person was a fellow named Gray, in the upper San Pedro River, he passed through the area at Lewis Springs. We know he was at Lewis Springs because he was a surveyor and he actually took the latitude with survey instruments exactly where he crossed the river.

You break out an atlas of Arizona, and his latitude is exactly where you cross at Lewis Springs, of great relevance, I believe, to the Commission because Mr. Hjalmarson said that that is where he believes the navigable stream starts is at Lewis Springs. So I'd like to read to you Gray's account.

One thing that the Fuller report did not include that I dug out Gray's report -- and when you read through it, and I believe Mr. Hood has a copy of Gray's actual

account if you want to see it -- he passed through the area of April of 1854. Fuller just talks about it being 1854. But when you read his accounts, he passed through the Willcox playa in April, kept going west and eventually hit the Santa Cruz River also in April. So he crossed over the San Pedro. You can conclude he was in the San Pedro River in April.

Knowing what month of the year that these fellows passed through the river is important. Mr. Hjalmarson testified depending on the time of year, the river might have more or less flow in it. So when Gray passed through the area in April, April is a time that when you look at current stream flow records, like at Charleston, April is a time when the flow in the river is about at its median level. That is, about half the time, the river flows more. About half the time, it's less. So April is a pretty interesting and valuable snapshot for us. The river flow is median flow conditions.

Gray describes the river at Lewis Springs where Mr. Hjalmarson says navigability starts. "The San Pedro River where we struck it in latitude 31 degrees," 34 feet -- "34 minutes," excuse me, "is a small stream at this stage, about eight feet wide." Eight feet wide, barely much longer than this. "And shallow between steep banks 10 feet high and 25 to 50 feet apart. At three

points that I have crossed it, it is a living stream with large fish, occasional bunches of mesquite and cottonwood are seen upon its borders."

This is April, the time when there's median stream flow conditions in the San Pedro River. The actual width of the flowing stream is only eight feet wide. And he calls it shallow, not in my opinion probably something that you could easily navigate.

Now let's head a little bit to the north, or downstream. We're now in the middle San Pedro River. And I'm going to talk about two accounts here. Now Mr. Hjalmarson spent quite a bit of time this morning saying, "Oh, well, these accounts were all by the same people and so maybe this doesn't really say that the river" was -- "had discontinuous flow."

I couldn't disagree with him more. The Hutton and Leach accounts that are in this table are grouped together. They were both made in 1858. So I'm not saying that Hutton and Leach are different people. They were talking about the same survey.

So in March and April of 1858, also a time when the flow in the river was at its median point, if not higher. In March, there's even more flow in the river. Hutton describes the river as follows: "The San Pedro River at the first point reached in the present road has a

width of about 12 feet and a depth of 12 inches flowing between clay banks 10 or 12 feet deep, but below it widens out. And from beaver dams and other obstructions overflows a large extent of bottomland forming marshes densely timbered with cottonwood and ash thus forcing the road over and around the sides of impinging spurs," obstacles for navigation, I would say.

I'll continue: "The stream is not continuous all the year but, in the months of August and September, disappears in several places rising again however clear and limpid."

Mr. Hjalmarson was real hung up on the "clear and limpid." I'm not so concerned about that because the September 1850 quote by Leach is talking about the same survey of the river. Here's what Leach said, perhaps on behalf of Hutton or Hutton on behalf of Leach. It was during the same survey said in September of 1858: "Exceedingly to the surprise of every member of the expedition who had passed over this route in the months of March and April, it was a discovered after a march of a few miles," and I should say where they're at when they were making these descriptions, they're at the narrows, so roughly at the halfway point between the upper and lower San Pedro.

In month of April. "It was discovered after a

march of a few miles that the waters of the San Pedro River had entirely disappeared from the channel. Where the present reporter took quantities of fine trout in March and April, not a drop of water was to be seen."

This was in September, so this was after the monsoon had occurred, not before the monsoon which most people say is the driest time of year in the river. This was after the monsoon. Not a drop of water in the river. Pretty strong evidence in my opinion that the San Pedro River in 1858 was not a continuous perennial stream.

1854, some four years before Hutton and Leach were describing their road that they were surveying, a fellow named Parke, another surveyor, talked about his observation. Again, this is a separate account. This isn't the Hutton and Leach are the same people argument. This is four years prior. Parke also went through the area. He says, "In the gorge below and in some of the meadows, the stream approaches more nearly the surface and often spreads itself on a wide area producing a dense growth of cottonwoods, willows and underbrush, which forced us to ascend and cross the outjutting terraces."

They were having trouble going down the river because of all this vegetation. "The flow of water, however, is not continuous. One or two localities were observed where it entirely disappeared but to rise again a

few miles distant clear and limpid."

This was four years before the Hutton and Leach. So we've got two independent historic accounts four years apart that both talk about discontinuous flow in the middle San Pedro River. But we're not done.

Now let's go to the lower San Pedro River. Now we're going from Redington down to Gila. Now we're talking -- now we have a whole different group of people out there. This was an early survey that was done when the United States first acquired these territories, this part of the Arizona territory.

In November 1846, November now is even later into the year when, again, if you look at median -- when you look at stream flow records for current gages, there's even more water in the stream in November. The plants aren't transpiring. The river is flowing pretty good in November. Emory, they're a few miles above where the San Pedro River joins the Gila. In November, they say -- Emory says, quote, "An insignificant stream, a few yards wide and only a foot deep," his words. A fellow named Johnson that accompanied Emory during that survey says, quote, "an active man could jump across."

Again, a far stretch from streams that I have seen courts call navigable. This is a stream that an active man could leap across, hard time thinking that that

would be a navigable stream.

Parke, who also, I mentioned, talked about within and above the narrows in 1854, when he got down to near the confluence of the San Pedro with the Gila, he says, quote, "Water sinks below the surface and rarely runs above it."

Mr. Hjalmarson would have us discount all of these accounts simply because, in his opinion, man had caused entrenchment in the river. I think that's ridiculous. I think these accounts are valuable, and there's no evidence he's presented that indicates that the river was not -- that river was affected by man at this time.

And just to put a ribbon around it, this fellow, Tevis -- now I'm a student of Tevis, and the book that Mr. Hjalmarson held up, I've also looked at that book. What Mr. Hjalmarson didn't tell you is the account that I'm going to read I don't believe is hyperbole. It came from a letter, if you look at that book, it came from a letter that Mr. Tevis wrote to his parents while he was in Arizona. Now I don't know about you, but I'm not sure that if I'm writing a letter to my parents I'd necessarily be bragging. But I'm going to let you listen to his own words and let you decide whether or not it's hyperbole and should just be discounted out of hand, which is what Mr.

Hjalmarson did this morning.

Tevis describes the San Pedro River as follows. We don't know where he began his trip down the San Pedro, but we know where he ended. But as you read it, you can tell that he probably went at least 20 or 30 miles. But again I'll let you listen to his own words.

Q. And just for the record, where he ended up is downstream of Aravaipa?

A. Yeah, he ended up at the confluence of Aravaipa with the San Pedro River. And at that point, there was a trail that then led you, if you read his account, this letter that he wrote his parents, that then leads to there's a trail at that intersection that led to Tucson. And that's where he was heading. After he went down the San Pedro, he kept going over to Tucson. So we know that that's where he is when he got off the river.

"The San Pedro River, as they call it, is a stream, one foot deeps, six feet wide and runs a mile and a half an hour." He actually tried to estimate how much flow was in the river. "And in ten minutes fishing, we could catch as many fish as we could use. And about every five miles is a beaver dam. This is a great country for them. And we went to the river and watered. And it was running fine, and a half mile below, the bed of the river would be as dry as the road. It sinks and rises again.

And we went down as far as the Aravaipa. And eight miles below that, the Pedro empties into the Gila River."

I have a hard time thinking that Mr. Tevis, writing a letter to his parents, had read the accounts of any surveyors that were referring to limpid water. He was writing a letter to his parents and describing what he saw. I didn't see a lot of hyperbole in that description. It seemed like he was being pretty fair about what he was seeing.

In their entirety, these accounts, I believe, present several conditions on the San Pedro River at a time when they were unaffected by man or anyone else that shows a river that was either shallow where there was water. And where there was water, there were marshy conditions, there were prevalent beaver dams.

But there are also areas of the river where there wasn't any water or, where there was, it was only intermittent and flowed at certain times of the year. In their entirety, these accounts, I think, are invaluable and provide a picture of the river that for practical purposes commercial navigation would not have been feasible.

Q. One other historic account that you looked at was the international border survey; is that right?

A. Yes, as I mention, it's in one of the attachments

to my declaration. This perhaps is of less relevance to the Commission now than it was when I prepared my declaration because where this account was made was at the international border.

Mr. Hjalmarson has indicated that in his opinion, the San Pedro River was not navigable at that point but only became navigable downstream at Lewis Springs. The international border had been surveyed several times starting in the 1840s. And it was resurveyed yet again in 1891 and 1896.

Based on some data that I'll get into in a minute, the USGS at that time indicated that there wasn't any diversions in Mexico at this period of time. So what the surveyors saw when they were surveying the international border and across the San Pedro River provides yet another glimpse of what the river was in its natural and ordinary condition. And they describe the San Pedro River which in this case is consistent with what Mr. Hjalmarson's saying that it wasn't navigable at the international border. They described the river as, quote, "ordinarily a stream of about 15 feet in width and six or eight inches in depth, fringed with a fine growth of cottonwood and willow."

One other point I think I should make that these surveyors point out that I don't think the Commission

should overlook is these guys kept heading west and finally hit the San Pedro River -- I'm sorry, hit the Colorado River. And when they hit the Colorado River, they talk about the Colorado River was navigable at the time and that there were steamboats going up and down the Colorado River. They certainly make no mention that the San Pedro River was susceptible to navigation when they crossed it in the 1890s. They don't even mention it.

I will describe -- I will say with their description of the Colorado River when they finally reached it, they said, The Colorado River, quote, "generally navigable by light draft steamers throughout the year for several hundred miles above its mouth."

The pages from their survey are in the attachment here. I find it not coincidental that they would talk about the navigability of the Colorado River but don't make any mention of the navigability of the San Pedro River during their same survey.

Q. I think you looked at one other surveyor. Is that Gray?

A. And we already discussed Gray.

Q. Just got to Gray; right?

A. Yeah, in the upper.

Q. The other thing you looked at in addition to your historic accounts were stream flow records; is that right?

A. That's right. I now refer the Commission -- I've asked you to kindly look at Table 1. Now I'm going to have you look at Tables 2 and 3 in my declaration. And these tables are data that came from the USGS for stream gages in the upper San Pedro River. All of these gages are in the area roughly in the Fairbanks area upstream.

What I've done in Table 2 -- and I'll let you folks get there. While you're getting there, let me point out that, as I've said earlier in my testimony, I am more than aware of the need to evaluate stream flow data at a time when it was unaffected by diversions. If there were substantial manmade diversions, then the Commission may pause and wonder whether that's representative of natural and ordinary conditions.

Q. Maybe you need to do some accounting for whatever diversions take place.

A. If you're going to use that data, you'd better be aware of what those diversions might be and, to the degree you can, add them back into your data so you paint a picture of an unaffected river by diversions.

We didn't need to do that with these accounts that are in Table 2. I looked at data, again, from the USGS. And what I compiled here is median stream flows that the USGS measured.

Mr. Hjalmarson and Mr. Sparks spent some time

talking about medians and averages this morning. I won't go into that at a great detail here other than to say what's presented in this table is not average flows, which are affected by, as you know, when you take an average of something, if you have very large, in this case, stream flows that occur like in the monsoon, that could skew your average. And your average might not be representative of what typical stream flow conditions are.

What's compiled here are median stream flows. That's half the flows are less; half the flows are more. Pretty much roughly in the middle, typical. So what I did is I used the stream flow data that the USGS reported at these gages, at the Charleston gage and at the Fairbanks gage. And I looked to see how the USGS reported these gages and if there was any substantial diversions occurring upstream of them.

And if you take a look at footnotes 3 and 4, I present the USGS's words as to their description. And Mr. Hjalmarson's aware of this having managed a group with the USGS. When you present stream flow data for USGS gages, USGS routinely describes what type of diversions are upstream of the gage that could have an effect on those flows.

As to the Charleston gage, they described in 1911 about 50 acres irrigated above the gage. For the

Fairbanks gage, it's a bit more complicated. This gage is actually downstream of a dam and diversions, but they were very careful to not only take the amount of water that crossed over the dam, but then they added up all the water that went into the diversions and added that up and gave us values for that.

So these data then, I believe, provide yet another glimpse and another piece of evidence that shows that the San Pedro River was not navigable in its ordinary and natural conditions because these gages are collecting data that were not affected by any substantial diversions upstream.

So what do the data show? What I present here again is the median stream flows that were reported at these gages. And they're listed accordingly by month. So these are monthly median stream flows.

As you know, stream flows -- Mr. Hjalmarson said it, and I couldn't agree more. Good description of stream flows in Arizona, variable. That point, I agree with him on wholeheartedly.

So it's important not to just look at an average annual or a median annual flow. You've got to look at it month by month. Monsoon floods have a big effect on the flows down there. If you look at the data month by month then and you look at these discharges, you'll see

discharges that typically outside of the monsoonal months are less than 30 or 40 CFS. In fact, more times than not, the flows that were recorded at these gages were more on the order of 20 CFS. 20 CFS.

Some time maybe today, if not tomorrow, if I don't ramble on too much, there are some court cases where other streams have been deemed non-navigable. And when you compare the amount of flow in those streams that were not navigable to the amount of flow in the San Pedro, it's almost laughable. Streams that were deemed non-navigable have thousands of CFS of flow. Here we have streams that barely on median level get over 100. So the difference is remarkable.

Q. And does that difference also reflect in the relative depths between the San Pedro and other water courses that have been deemed non-navigable?

A. Yes. And when you look at these other streams that have been deemed non-navigable, they often talk on the order of three feet and more of average depth of water in these streams.

By comparison, look at the depths that were recorded in Charleston and Fairbanks. Now you might ask, How did these depths get recorded? When the USGS was on the San Pedro River at this time collecting the stream flow data, they would periodically go out to these gages

and they would take what's referred to as a direct stream flow measurement. They'd actually go out there and measure the flow directly. They'd see how wide the channel was, how deep it was, and what the flow was. They did that because they wanted to see how well the calibration was for their stream.

These stream gages just measure the elevation of the water over time. So you've got to relate the elevation to the flow. So how do they do that? They take these direct channel measurements and develop a staged discharge relationship. So they were actually out on the San Pedro collecting true channel dimension characteristics.

Fuller, in his report, took those data and created staged discharge relationships. And he did that using old data from the early 1900s. So what I simply did was I used the median stream flow data that were recorded by these gages and put those into those staged discharge relationships and came up with the depth of water at those gages at the time.

And when you look at these, I'll point out again, we're not talking three or four feet of water. I believe, if memory serves, and I believe I state it in my declaration, 40 percent of the time at Charleston, the median flow was less than a foot. Even Mr. Hjalmarson

would agree that flow less than a foot is not navigable. I don't think that's the only condition that you would look at. But even he would agree that less than a foot is not navigable. So 40 percent of the time, you don't even have a foot of water at the Charleston gage.

Fairbank, unfortunately, we don't have as much data for but once again paints a picture. The important thing about Fairbank is look at the January, February, March, and April; again, these are months when the trees are not transpiring water. And there's a lot more water in the stream than there is just before the monsoon. We don't have a foot of water there either.

These stream flow data, what I find important about them is not only that they're important in amongst themselves, but they substantiate and verify the historic accounts. The historic accounts that I talked to you about earlier, again, paint a picture of a very shallow stream at various seasons of the year. These stream flow data support that and are very consistent with that.

And finally Table 3, this is a table for the Hereford gage. Now the Hereford gage, this table might be less relevant to the Commission than it was before Mr. Hjalmarson's testimony because Hereford is located upstream of Lewis Springs. Mr. Hereford -- or Mr. Hjalmarson, again, has indicated that in his opinion, and

I'm assuming The Center would believe this, his client, that the San Pedro River did not become navigable until you reached Lewis Springs. Hereford is upstream from it. Okay?

These data are -- we don't have a staged discharge relationship for Hereford, but we do have is stream flow. We have discharges that were actually measured by the USGS. Once again, we have a case where these data were collected over several years. Notice the date. These are post statehood. I'm aware that these are post statehood, and I'm aware of the fact that using data post statehood presents a challenge unless you can demonstrate that those data are of value to the Commission in that they provide information accordingly.

When you look at footnote 3, it describes the fact that the USGS reported little, if any, diversions upstream of the Hereford gage during this period following statehood. In my opinion then, this gage data provides further evidence and value to the Commission on what the stream flow conditions were at this time.

I don't have depths. But I ask the Commission to look at the flows. And once again, we are not talking about thousands of CFS that might be associated with a navigable stream. We're talking about less than 50. In fact, most months, less than 10, median stream flows. Try

to imagine floating a boat for navigable purposes in 5 or 10 CFS of water, and I just shake my head. It's just -- it's unreasonable to assume. And maybe that, I don't know how Mr. Hjalmarson came to the conclusion that Hereford area and anything above Lewis Springs was not navigable, but this data certainly supports that.

Q. Mr. Burtell -- let's flip back to the body of your declaration. Page 4, you have a -- your next subheading is Long-Term Stream Flow Records.

A. I presented this, this section of the report, and this is associated with a table, and I would ask the Commission to turn to Table 4. This was largely in response to a memorandum that The Center submitted.

Ms. Herr-Cardillo in one of her memorandum, I believe this was a 2012 memorandum, presented data from the Fuller report related to average stream flows that have been measured on the San Pedro River at various stream flow gages.

As we've talked about this morning and I've been talking about during my testimony, it is misrepresentative in my opinion, and I think most hydrologists would agree, to use average stream flow conditions rather than medians. The data that Ms. Herr-Cardillo presented in her memorandum from the Fuller report were average stream flows.

And what I did for comparative purposes in this table is presented the median stream flow data that Fuller also presents in his report. So I'm using the same source of data that Ms. Herr-Cardillo used for her averages, but I'm merely presenting the median stream flows rather than averages.

And that's presented here for six different gages. And when you look at those median stream flows and then relate them to rating curves at these gages where, again, you can relate the discharge to the depth based on actual field measurements, you get average channel depths based on median flows all less than a foot.

Now I'm not saying to the Commission or to anyone else that this is necessarily representative of natural and ordinary conditions because this was using data that was up through the late 18 -- or 1980s. And so these data could have been affected by diversions. And so I'm not saying that this is evidence that the stream was not navigable based on these factors. I have other factors that you don't have to make that correction for.

But what this does show is that The Center's use of average data is -- paints a picture that is not characteristic of typical stream flow conditions. These stream flow conditions show a much shallower stream typically.

02:29:27 Q. Staying on this point, as it relates to the San
02:29:27 Pedro River, the typical event that is going to skew an
02:29:30 average is going to be the monsoonal rains; is that right?
02:29:33 A. That's correct.
02:29:34 Q. You have a short period of time where you get an
02:29:36 awful lot of rain, an awful lot of runoff, and your flows
02:29:38 are going to be much higher than they typically are. And
02:29:40 it's going to pull your average way higher than it would
02:29:44 be if representative of normal conditions?
02:29:46 A. (Witness nods head.)
02:29:47 Q. Okay. And these monsoonal events, if they're
02:29:51 heavy enough, they're going to really skew the average;
02:29:54 isn't that right?
02:29:54 A. That's right. And in fact, I have been on the
02:29:57 San Pedro River, I think it was four or five years ago, in
02:30:01 August. And I had -- and maybe some of you have had the
02:30:06 opportunity to see a monsoonal flood event go through the
02:30:10 San Pedro live and in person, and it's a humbling
02:30:12 experience. Hopefully you're on a bridge looking down on
it.
02:30:15 But as we observed -- and I'm trying to remember,
02:30:18 after the fact, I looked back at the stream flow record at
02:30:21 the Charleston gage. And I believe it was like 4 or 5,000
02:30:24 CFS had passed through the area. But there were large
02:30:29 cottonwood trees that were going down the river. It is a

time, and we even see it here in the valley during monsoonal storm events, where the last place you probably want to be is on that river, certainly in a boat trying to conduct a commercial enterprise of any value.

What is interesting though about those extreme flow events is that if you use average stream flow data and not medians, those really big flow events are getting worked into your number. But that's not fair when you think about it because those would be times when you'd never in your right mind try to have a commercial enterprise along the river.

So it's disingenuous to try to be using averages that have these big flow events when those very flow events are times when the river wasn't navigable. They'd have to be subtracted out. Fortunately, when you look at medians, since medians are right in it middle, those high flow events don't get counted in because you're focused more on what's right in the middle. Half of the flows are less. Half the flows are bigger.

Q. The next -- the next topic in your declaration, section 3, relates to the absence of boat travel. And you've touched upon this a little bit, but why don't you walk us through section 3.

A. I will. And let me say right off the bat, as you know, based on the description of my background, I'm not

an attorney. I would never try to draw a legal opinion. That's not my job. My job is to look at factual information and go from there.

But what I am cognizant of in reading the important case law related to this navigability hearing is the, again, PPL Montana as well as the Arizona appeals case. And what they talk about is the fact that just because there wasn't historic evidence of navigation, you can't necessarily conclude that the river wasn't navigable, all right, that there is a possibility, and it's part of our definition, that if the river is susceptible to navigation that you need to consider both.

If it was actually navigable, you have evidence of steamboats going up and down the river, that could certainly help your case. But just because there wasn't a steamboat going up the river, that doesn't necessarily mean you can conclude that the river's not navigable. So I understand that distinction.

I think, however, when there is a clear need or demand for navigation, as there was in this area, that the Commission needs to look carefully and consider the fact that if there was a need to transport goods or people commercially along the river and none of that was occurring, then that's a pretty valuable piece of information that builds on to all these other pieces of

evidence that I've been talking about.

So with that said, military bases, a lot of why this report is so thick -- and I apologize for making it thicker than it probably should have been -- is I have sections from two books that were written related to early military posts in Arizona.

As I mentioned earlier, the Apaches had established a stronghold in this area in the early 1800s and pretty much had chased out any Spanish or then at that time Mexican settlers. And they pretty much ran the area down there.

After the United States acquired this area, they wanted settlers to move into the area. But the settlers couldn't get into the area because of the Apaches. The warfare, for those of you that are students of it, was brutal, brutal on both sides. It was a time of extreme unrest where settlers -- and there are accounts, and Mr. Hjalmarson's probably read about them as well, of men working their fields and getting butchered by Apaches. So settlement was a, to say the least, a risky business back then, very risky.

So what are we going to do about this? Well, what the United States government did is the first military base that I'm aware of was established at what -- it was later referred to as Camp Grant. But prior to the

civil war -- I believe it was 1858 or 1859 -- Fort Breckenridge was established where the Aravaipa Creek joins the San Pedro River. And it's in the lower San Pedro.

That military base, when you look at the old accounts, and Mr. Hjalmarson's probably looked at it, was specifically put in to deal with the Apache presence in the area and to try to settle the area. When the civil war then broke out in the early 1860s, it was abandoned and burnt to the ground, I should add. And then after the civil war, they went back into the area and they reestablished Fort Breckenridge, renamed it. It was called Fort Aravaipa at one time. But then it got the more common name Camp Grant. And it was actually a camp. People referred to it as a fort.

Needless to say, it was a active military base from the early -- well, 18 -- after the war, 1867 or '68 all the way up through 1872, I believe, when it was moved over to Mt. Graham. But during that period when it was in operation, as I understand, there was well over 200 soldiers stationed at this military base.

What these textbooks that I present in my declaration talk about is how this military post and military posts throughout Arizona were supplied. These guys were out on the frontier, needless to say. How were

they going to get supplies? Well, when you look at old newspaper accounts and you look at these books, things like flour, you know, very basic, bacon, these things, these supplies, had to get transported to these military bases. How did they get transported there?

Well, if you read those textbooks that are, again, included as attachments here, they talk about a whole infrastructure that was established to try to supply these military bases.

The only account of any boats used to supply these military bases was the Colorado River in Arizona. And what they did is some supplies came from San Francisco. They came down, and they would navigate up the San -- up the Colorado River to Yuma where they had -- as we all know, there was a settlement there -- and up to La Paz.

And from there, the supplies were unloaded off the boats and then transported inland to all of these military posts throughout Arizona by ox train. And these books talk in excruciating detail. It's remarkable that these data are available, but the military are really good about recording all of the supplies that they needed and how much it cost to ship them.

There's no discussion of boats, no discussion at all. It was by ox train, and it's expensive. And

02:37:41 1 certainly I don't think it's a leap of faith to conclude
02:37:44 2 that if there was a navigable river that they could use to
02:37:48 3 support supplies, let alone troops, they would have used
02:37:51 4 it. There was a need. They were trying to settle the
02:37:54 5 area. They were trying to push the Apaches out and allow
02:37:58 6 settlers to come in. And yet there was a river right in
02:38:02 7 front of them. They were -- a road, as we've talked
02:38:05 8 about, was built, the Leach road, down along the San Pedro
02:38:12 9 River to get supplies to Camp Grant. Nary a mention was
02:38:15 10 made of using the river for navigation.
02:38:17 11 So my point here is just because there's no
02:38:19 12 historic evidence of boat travel on the San Pedro River,
02:38:23 13 that, in itself, doesn't mean that the river was not
02:38:26 14 navigable. But by goodness, there was a need to transport
02:38:30 15 goods and supplies and they didn't use the river. And
02:38:34 16 that, to me, needs to be explained. And the only
02:38:41 17 explanation that I have is consistent with all the other
02:38:42 18 evidence that I have. And that is, physically, they just
02:38:45 19 couldn't use the river for that purpose. Thus, they had
02:38:48 20 to use a road.
02:38:50 21 Q. Let me read a quotation from United States versus
02:38:53 22 Utah which is 283 U.S. 64 at page 82. And this is a 1931
02:38:59 23 decision. We'll talk a little bit more about this later.
02:39:02 24 The quotation is -- and it dovetails with what
02:39:06 25 you were saying about the mere absence isn't definitive in

a vacuum. "The evidence of the actual use of streams and especially of extensive and continued use for commercial purposes may be most persuasive, but where conditions of exploration and settlement explain the infrequency or limited nature of such use, the susceptibility to use as a highway of commerce may still be satisfactorily proved."

And your point here is the conditions of settlement and the military presence don't explain an absence of need for navigation. It's quite the opposite?

A. Quite the opposite. There is a need. And beyond Camp Grant, after the civil war, two military posts were established in the upper San Pedro River to the south.

One, I believe, was called Camp Wallin, and it was along the Babacomari River up near the town of Elgin, had to get supplies to that. And also one that we still are familiar with today was Fort Huachuca. I believe originally it was called Camp Huachuca. That was established in the 1870s.

Also, both of those military posts were put there to deal with the Apache presence in the area. Again, none of those posts based on detailed research that was done on how those posts were supplied talked about any boat travel that was used to either transport troops or supplies for those troops to those camps. They all went over land. They all went on roads. They never used the San Pedro

River. The need was there, but they simply could not use the river.

Q. And you touched upon how this is consistent with the other lines of evidence you looked at, low flows, discontinuous flows, obstructions?

A. Unpredictable flows with --

Q. Unpredictable flows.

A. -- again, the monsoonal floods. You can imagine, you know, you've got a barge full of flour and bacon trying to get to a military camp, and you're trying to ride out a monsoonal flood.

I mean, I'll use Mr. Hjalmarson's word this morning. That, to me, is comical. If you've ever seen those -- those storm events and those flows, the water is so turbulent, to try to successfully navigate meaningfully down that river during high flows would be more than a dangerous undertaking. It would be foolhardy.

Q. And median flows are so low that it's not -- it's not susceptible to --

A. The median, yeah, the median flows are such that to try to transport any goods on the river when you only have -- when you have less than a foot of water is -- it's just not practical.

Q. The next section of your declaration is titled The Occurrence of Beaver Dams. And here you get into some

more historic accounts. Can you walk us through this?

A. I will. And Mr. Hjalmarson seems to make some light in his presentation regarding some of those photos and beaver dams. I view the issue of beaver dams much more seriously than he did. And the reason I say that is based on historic accounts as well as more recent occurrence of beaver in the upper San Pedro River, these critters were prevalent and resilient both at the same time. We've talked about -- Mr. Hjalmarson talked about James O'Pattie that went through the area twice. And I have that in my declaration, both in 1824, '25 and in 1827 and 1828.

And when you look at his declaration -- or when you look at Pattie's narrative of his account, nowhere does he talk about stream flow conditions. I need to point that out. All Mr. Pattie talks about related to the San Pedro River was how common beaver were, that he collected 200 pelts during one of his trips down the river. He never talks about stream flow conditions.

But you could certainly infer, and this is where I do agree with Mr. Hjalmarson, that beaver were not a rare occurrence based on Mr. Pattie's testimony -- or Mr. Pattie's narrative, his -- his -- his log from the area, that they're common. And if weren't common, he wouldn't have been able to trap 200 beaver pelts during one season.

I'm not an expert on beaver trapping, but that's a lot of beaver to capture over a period of a couple months.

So the historic records suggest that they're common. And I mentioned during -- as I bored you with those historic accounts, the fellow Tevis who wrote the letter back to his parents, he said that beaver were observed approximately every five miles on the section of river that he was. Now the San Pedro River from the border to the mouth, I believe, covers some 120 miles. So in that that portion that Tevis navigated, he was seeing them every five miles.

Q. Beaver dams?

A. Beaver dams. Just to show you now -- oops, now come to the present time. And this common occurrence of beaver is not an unusual thing if you look at the current period of time.

According to the BLM, they manage a conservation area in the upper San Pedro referred to as the San Pedro Riparian National Conservation Area. In my declaration, I have photographs that were taken by the BLM of SPRNCA in April of 2012. I also have a newspaper account where they interviewed a biologist who works for the BLM and also an annual report by the BLM related to SPRNCA. And these documents talk about in 1999 and in 2000, the BLM introduced beaver back to SPRNCA.

02:45:02 1 Now they indicate, and I haven't substantiated
02:45:04 2 this, that around 1894, I believe, they said there were no
02:45:08 3 longer any beaver in the upper San Pedro. Well, come 100
02:45:12 4 years later, the BLM is now managing this area referred to
02:45:18 5 as SPRNCA. They introduced beaver into the area, and they
02:45:21 6 introduced a pretty modest number, as I recall, into the
02:45:23 7 area. 15 beavers were introduced between 1999 and 2000.
02:45:28 8 By 2008, so less than 10 years later, those 15 beaver had
02:45:34 9 increased to 150. And 46 beaver dams were counted.
02:45:40 10 Now if you look at SPRNCA, it starts at the
02:45:44 11 international border. It's got a little break in it
02:45:46 12 called the gap area, and then it continues up to around
02:45:49 13 St. David. It covers about 40 miles. So you've got 46
02:45:55 14 beaver dams counted in about a 40-mile stretch. That's
02:46:00 15 not, in my mind, a insignificant number of obstacles that
02:46:05 16 someone would have to encounter.
02:46:13 17 Mr. Hjalmarson has indicated, Well, those
02:46:13 18 beavers' dams can get washed out by flood events.
02:46:15 19 Understood, and they were. You look at the accounts of
02:46:17 20 that biologist, which is in my declaration, a big storm
02:46:21 21 came in 2008 monsoons, blew out those beaver dams. As Mr.
02:46:26 22 Hjalmarson's indicated, or I think he did, some people
02:46:28 23 would view this rather humorously. One of the beaver that
02:46:32 24 -- they were all tagged -- ended up all the way down at
02:46:34 25 the Gila river confluence. So they were in for quite a

ride.

But what's important to me is that a mere four years later, in 2012, the beaver had reestablished themselves in that same area. And according to the biologists from the BLM, in 2012, their numbers were down but now they were at 100. And there were 30 dams.

So my point is this: These beaver dams currently, let alone historically, were not a rare event. They were very common. And if I was trying to navigate down the San Pedro River and transport goods and supplies and every mile or so you had to either get out of your boat, unload all your supplies to move around this beaver dam or, as Mr. Hjalmarson somewhat comically said, just ride over the beaver dam, well, maybe that's a fun thing if you were recreationally traveling down the river. But this isn't about recreation. This is about commercial boat travel at and before the time of statehood.

To be navigable, there has to be some meaningful commerce that's being conducted here. That wasn't happening. So with all of those beaver dams, you can just imagine the type of obstacle that that would pose to someone.

The other thing I think that's interesting, and if you have the time to look at those pictures of the SPRNCA area, is the SPRNCA area because it has been

largely unaffected by any development, there used to be irrigation going on in SPRNCA, that has all been discontinued, is that portion of the river is returning to its natural state as it was before there was any pumpage going on in the mid 1900s.

I've heard the phrase used, "The river is healing itself." You know, now that these meanders have reestablished, you've got a system that's looking a lot like it probably did before there were all these irrigated fields in the mid 1900s. We've got a river system which is pack filled with beaver and lots and lots of beaver dams. Again, I believe that poses or would pose a substantial hurdle for anyone trying to conduct any type of commercial enterprise along the river.

Q. How did the obstacles that beaver dams present interplay with the low flows that you've determined based upon historical accounts and the stream flow data?

A. It's just one more line of evidence. I'm trying not to, unlike Mr. Hjalmarson's put all his eggs into his model, in one basket, I've looked at several independent sources of evidence. And I think these beaver dams are yet one more indication of the hurdles that someone trying to use the river for commercial navigation would have faced. They're not -- they're not uncommon.

And the other thing, and Mr. Hjalmarson mentioned

this this morning, is that above the beaver dams that some water might get ponded up and afford some deeper water there. Well, of course, after one of these monsoon floods blows out the beaver dams, those levels are going to come back down again until the next beaver dam is built.

So trying to navigate the San Pedro River when beaver dams are coming and going, it would be hard to do any planning or to have any assurance that the river you're going to see that month or that year is loaded with beaver clogging up the river or not.

Q. You might prefer to transport your goods by land --

A. Which was --

Q. -- in ox carts?

A. Which was done. And that's simply what they did. And, again, the historic evidence of these military posts, there's just not a mention of them supplying those military camps with anything other than ox trains going up and down roads along the river.

Q. So that the impediments that these dams represent, it's actually a compounding factor when you take it into consideration along with the doubts?

A. Absolutely. So you've got cases where you've got obstacles to overcome. Once you overcome that obstacle, based on the flow accounts of these historic explorers

through the area on the other side of the -- once you get over the beaver dam, you're not now hitting a four or five foot pool of water that you can gently float down.

The area was marshy. Many of the explorers talk about marshy conditions along the San Pedro. So not only do you have obstacles to overcome. You've got marshy conditions where you're fighting vegetation-infested -- or not infested, but choked channel that would cause navigation concerns to be even more problematic. But that's where there's water.

You go further down the San Pedro, and as these explorers indicated, the water disappears in places. It either doesn't flow at any time of year or it's seasonal. So taken together, all of these things in combination, to me, paint a picture of a river system that just is not susceptible to natural -- or to navigation either in its -- either susceptible or actually navigable.

Q. Mr. Burtell, you talked about the marshy conditions that existed in the stream's ordinary, natural conditions. Let's take a look at the Hendrikson and Minkley map.

A. Yes.

Q. And this is a map that I spent a little bit of time with Mr. Hjalmarson on in June in Bisbee. And it was in the existing record in a document called Desert Plant

Special Issue, which is Exhibit 12 to the prior round of proceedings.

A. And I have a copy of that, if anyone is interested. Here it is. This was submitted by The Center, again, as one of their exhibits. So this wasn't submitted by Freeport. What I did, and you can if you're interested, I took a couple of maps out of this report. And these maps are specific to the San Pedro River.

And what Hendrikson and Minkley were focused on were marshy areas and cienegas in the southwest prior to man's development. Some of these marshy areas in the early 1900s or late 1800s were drained primarily due to malaria issues. So they tried to turn the clock back and look at where these marshy conditions existed before Anglos came in and drained them.

And so there's two maps. The map on the left they took from another researcher known as Brown and Others. And it shows Brown and Others' attempt to map those streams in Arizona that were perennial prior to any diversions by man. And I apologize. It's a little tough to see. But when you look at the middle and lower San Pedro, you'll see a reach of the San Pedro which they show as ephemeral. And that is ephemeral at all times, not just currently, but ephemeral prior to any diversions.

Q. In its ordinary, natural condition?

02:53:43 A. In its ordinary, natural condition. And I should
02:53:45 point out that this Brown and Others map was actually a
02:53:49 reference in the Hydrologic Atlas 664 that Mr. Hjalmarson
02:53:55 used adamantly, I should say, as one of the foundations
02:53:58 for his model.
02:54:00 If you look at that Hydrologic Atlas, there are
02:54:04 several references that are used, that the USGS used to
02:54:09 help describe predevelopment ground water conditions. One
02:54:11 of those references is this very map that shows breaks in
02:54:14 perennial flow.
02:54:15 I think that's a critical point to make to the
02:54:19 Commission because Mr. Hjalmarson has continued to say
02:54:21 that in his opinion his records indicate that the San
02:54:25 Pedro River was perennial in its entirety. One of the
02:54:29 references in this document that he used suggests
02:54:32 otherwise.
02:54:34 What Hendrickson and Minckley did is on the right
02:54:38 side, their, again, focus was cienega, marshes, and -- or
02:54:43 cienegas and marshes. And this is a bit easier to read,
02:54:47 but this is also the San Pedro River. And you can see the
02:54:50 legend. It says, cienega, riverine marsh. And in their
02:54:54 opinion, based on their review of the historic record,
02:54:57 from the international border downstream about halfway,
02:55:00 they characterize the river as a cienega or a riverine
02:55:05 marsh.

I think any of you that have had the pleasure of trying to walk through or navigate through a marsh knows that it's a mucky, unpleasant experience. I'm going to use the words of Hendrickson and Minckley rather than my own. I know those aren't as prevalent here in Arizona. I'm from back east where they're much more common. But Hendrikson and Minkley, similar to me, realized the importance of these historic accounts and how these historic accounts provide a unique window into what conditions were back then.

And I'm going to read -- again, this is from Hendrickson and Minckley -- a quote from Leach. We talked about Leach this morning. Leach was working on the wagon road with Hutton. He described the San Pedro River around the narrows area as follows: "Extremely boggy. It has to be crossed by making a brush bridge. I was obliged in order to manage my team" -- he was trying to get his team of livestock through the area -- "to jump in beside them and get wet above the waist. Here it is lined with a poor growth of swamp willow and other brush so it cannot be seen until you come within a few feet of it. And then the bank is perpendicular, not affording an easy access to its water which, though not very clear, is good. The banks in bed are extremely boggy, and it is the worst place for cattle and horses we have yet been -- we have yet been,

being obliged to watch them very closely."

The presence -- and I will also add one other point from Hendrickson and Minckley. And that is their description of what a cienega is, also from their report. They describe cienegas and marshy areas in Arizona as follows: "Dense stands of sedges and charophytes" -- I looked up what charophytes are, and they are an aquatic plant species -- "fill shallow braided channels between pools or deeper narrow vertical walled channels may be heavily vegetated with" -- and they have a bot name for watercress and another plant species which I had to look up, Ludwigia natans, which is another aquatic plant, "and other macrophytes. Pools often have vertical walls of organic sediments" -- Mr. Sparks talked at length with Mr. Hjalmarson about that this morning -- "and undercuts below the root system. Submerged macrophytes are commonly rooted in locally gravelly substrates."

That is Hendrickson and Minckley's description what a cienega or marshy area would be at the time. This was presented by The Center and in my opinion provides yet another potential obstacle for folks trying to navigate the San Pedro River.

You have areas where based on their evidence and their description that the channel would be clogged with vegetation. So it's not only just getting over the beaver

dams. Once you got over the beaver dams, again, you're not going to then necessarily hit a nice clean stream. You're going to hit areas which are marshy, which are again clogged with vegetation. This just builds on a series of compounding factors which would challenge anyone trying to navigate the river.

THE CHAIRMAN: Mr. Hood?

MR. HOOD: Yes, sir?

THE CHAIRMAN: I sure think this is a good place for a break.

MR. HOOD: This works perfect for me. Thank you.

(A recess ensued from 2:58 p.m. until 3:17 p.m.)

THE CHAIRMAN: The Commission is present. Mr. Breedlove is present. Mr. Mehnert is present. The witness is present. Mr. Hood is ready to begin.

MR. HOOD: Thank you, Mr. Chairman.

Q. (By Mr. Hood) Mr. Burtell, we finished up by talking about the cienega riverine marsh conditions as illustrated in the Hendrikson and Minckley map among other evidence in that regard.

And now I want to switch. I want to go back to your declaration where you talk about the supposed San Pedro Lake. And I don't think we need to spend a lot of time there. Mr. Hjalmarson did not contend there was such a lake. And so but nevertheless why don't you briefly

give an overview of your review of that issue.

A. Yeah, and I could ask the Commission to look at page 5 of my declaration. There is a quote that I took from The Center's September 7th, 2012 memo that caused me to wonder whether such a lake exists let alone whether it had any bearing upon navigability of the San Pedro River.

And these are the words that Ms. Herr-Cardillo included regarding this issue. She said: "Although there are no documented historic accounts of boating, included in the oral histories of the state report was an account by a Mr. Houston Evans who responded to a mass mailing letter. According to Mr. Evans, who lived near the river during the 1940s," period. There was a problem with that sentence. "Mr. Evans recalled that the river had clear water about two to three feet deep year around during the 1943 to 1945 period. He said that there was a large lake in the middle of the river between Aravaipa/San Pedro confluence in Dudleyville that is no longer there. He, along with other young family members and friends, would canoe down the San Pedro River from the Mammoth area down to the lake where they had a raft."

And then she cites state report, appendix C, page 53. Needless to say, that's a pretty provocative account that Ms. Herr-Cardillo included in her memorandum. So I wanted to look independently to see if there was any

independent evidence that would support the account of that Mr. Evans.

And so what I did is I looked at available historic survey maps that were done in the 1870s, historic topographic maps that were done -- I believe one was in 1911, and the other in the 1940s, as well as aerial photography from the 1930s and 1940s. All of these are lines of evidence, if you will, or data that occur on or before when Mr. Evans said such a lake existed on the San Pedro River.

And what I found was no evidence of a large lake along the San Pedro River in this area that Mr. Evans indicated. If you're interested and for your own reference, I provided to the Commission an attachment E of my declaration, these maps of the San Pedro River, again, from these various time periods. And I welcome you to look through those and judge for yourself whether a large lake as described by Mr. Evans existed in this area. I could not see one.

The only lake that was reported anywhere in this area was -- is what's referred to as Cook's Lake. But Cook's Lake is not on the San Pedro River. It's actually adjacent to the San Pedro River. And in my declaration, I give the dimensions of that lake as it was mapped in 1949, just a few years prior to Mr. Evans' account that he and

young family members canoed through this area. And they indicated that based on the mapping, it's about 500 feet long, less than 200 feet wide. But it's about a half mile east of the San Pedro River. It's not actually on the river.

So I don't believe that Mr. Evans's account can be substantiated in any way based on these maps and aerial photographs which I think are strong evidence that can be used. If such a lake existed and it's large as was described, you would see something in all those independent sources of data. But you simply don't. So...

Q. The last section you have here, your conclusions. And if you could just reiterate them again. And then we're going to go through some of the issues that Mr. Hjalmarson raised.

A. Sure. Apologize if I'm repeating myself. But I think that you could summarize what I have been boring you with here this afternoon in just a couple of sentences. And that would be by looking at several independent lines of evidence, you can draw the conclusion, I think strongly, that there is no indication that the San Pedro River was navigable in its ordinary and natural condition from the international border all the way up to the confluence with the Gila, either actually navigable, that is, there was actually navigation that has occurred, or

would the river be susceptible to navigation based on that data.

So I think that -- that would summarize it.

Q. Let's go to the first topic I want to visit with you regarding Mr. Hjalmarson's testimony relates to human impacts and in particular mining impacts.

A. Sure.

Q. And, again, you've been present for all the testimony, so you're aware of what his testimony was on that point. And, again, he didn't include -- he didn't quantify any impacts or include them in his calculations, et cetera. So I don't want to spend too much time on this. I don't think it's warranted. But I do want to touch upon it somewhat briefly.

A. Sure.

Q. The mining issue, was there any mining at all prior to your -- in the area prior to your historic accounts?

A. No. The historic -- if you refer to my declaration and look at that table that I spent so much time reading the accounts from, you'll see that the accounts range from -- the earliest is 1846, and the latest is 1858. And there is no evidence that I could find either presented by Mr. Hjalmarson or that I have read in the record that any substantial mining activity

requiring any substantial quantities of water were occurring in the San Pedro River at the time those historic accounts were made.

So to bring up the issue of mining as a potential concern as to impacts on the river doesn't have any bearing on my historic accounts.

Q. What about as mining activities relate to the stream flow data that you do rely upon in the very early 1900s?

A. As Mr. Hjalmarson indicated and other documents substantiate, in the -- starting, I believe, in the 1880s going into the 1890s and forward, mines, copper mines, did become developed in the area. The three mines that he mentioned obviously were Cananea, which is in Mexico up near the border between the San Pedro River watershed and the Rio Sonora -- I believe it's called watershed in Mexico. And then the mines in both Bisbee and Tombstone.

So while the stream flow data were being collected that I present in the early 1900s, those mines were in operation.

Q. Okay. What, if any, impacts did those mining operations have on your stream flow data?

A. Mr. Hjalmarson has -- has done a lot of speculating, I feel, in his presentation as to the effect that those mines would have on the river. But I've never

seen any report or study that he has shown that actually demonstrates the effect that those mines had on the river.

In fact, one thing he said this morning struck me that I noted was the attempts by the U.S. Geological Survey to prepare ground water models for the area. They tried to incorporate those mines into their ground water model. And of course the mines are in a hard rock area. The -- most of the -- these flow models are in the alluvium that are adjacent to the hard rock area. And I don't think it's wrong to put these words into Mr. Hjalmarson's mouth that, quote, "They're having a tough time correlating or getting those hard rock areas calibrated in with the rest of their alluvial model."

So when I heard that, that was yet another piece of evidence that he has not shown, I don't think, to the Commission, certainly not to my satisfaction, any hard numbers that show those mining activities had an effect on the river.

And I will just throw one other anecdotal piece of information out. When I worked at the Department of Water Resources, I did a report related to the Tombstone mine workings. And I'm sure many of you have heard about this. Tombstone is an interesting area for a lot of reasons. But what some people may not have heard is that the Tombstone mine workings eventually shut down due to

too much water. They get their water supply from the Huachuca mountains in about a 30-mile pipeline that's been in the news.

Probably heard about the fire washing it out. So they get a lot of the water for the town from the Huachuca mountains on the other side of the San Pedro. When they started mining and got deeper, they hit a lot of water in the mine workings in these carbonate areas. The same carbonate areas that the USGS is having a tough time calibrating in with the rest of their flow model.

But they pumped that water out of the mine workings. And what did they do? They dumped it into Walnut Gulch that flowed down into the San Pedro River. So I'm certainly not going to present in front of the Commission that I've done an analysis. But there is a possibility that the deep watering of those mine workings and dumping that water -- and I have pictures if it would be of interest to the Commission -- I didn't bring them with me -- where there is, and I'm not exaggerating, thousands of gallons a minute of water being pumped out of the workings and being dumped into a tributary that goes right to the San Pedro River. Theoretically, those flows, if they actually reach the river, unless they soaked in, could have increased the flows in the San Pedro River, not decreased.

Q. Let's take a look at -- do you have the USGS ground water flow model document?

A. I do.

Q. Let's just take a quick look at that. This is just to give a little perspective, I think, of the map, Mr. Burtell.

A. If you take a look, this is a -- this is a model that Mr. Hjalmarson discussed and, as I understand, used or certainly referred to in his evaluation of the area.

And as Mr. Hood says, it provides some geographic reference for just the distance that we're talking between the Cananea mine workings and where my stream gage data is coming from. The Cananea mine, as you can see, is right at the border of the watershed to the south. And if you look at the scale on the map and you measure it out, it's about a 40-mile distance from the Cananea area up to Charleston where I have gage data. So that's quite a distance for potential impacts to migrate, if you will, down the river.

Q. Over a fairly short period of time?

A. Over a very short period of time. That's correct. And in fact you're familiar with the -- this is a document we've been over, The Ecology and Conservation of the San Pedro River document which is a Center submittal. And I discussed this with Mr. Hjalmarson.

But you're familiar with the quote with the indication there that most of the water supply and water impacts for mining, this is referring to the Cananea, occurred on the Rio Sonora side of the watershed, although some were in the San Pedro watershed.

And I think that is a reason among reasons including the fact the GS is having a tough time modeling any effects from the dewatering of these mine workings on the alluvial system that it's difficult for Mr. Hjalmarson to put any number on how much stream flow the San Pedro River was actually affected, if at all, by these mining operations.

Q. Are you aware of any evidence that would suggest that the activities at Bisbee and Tombstone prior to those early 1900 stream gages would have any impact on the flows there?

A. No. And I'm not sure this is the best time to present it, but there is some historic base flow data that I identified as I was researching this project. It's somewhat provocative. And what's provocative about it is it --

Q. Why don't you give a brief summary of how it relates to the mining issue now, and we'll get into the base flow data as we go.

A. Sure. This is a document that was prepared --

and, Sean, do you have a copy of this for the Commission?

Q. Read me the title.

A. Trends in Stream Flow of the San Pedro River.

Q. Yeah.

A. Southeastern. This document was prepared by the USGS in 2006. And what it did, among other things, was evaluate the low flow, the base flow, at Charleston. And they started their evaluation in 1930 and continued it through 2004 roughly.

And what they did is they looked every month from 1930 through 2004 at the lowest flow that was measured in the San Pedro River by month at Charleston. And what they did is they -- and if you take a look, there's two columns. The column on the left is these low flow measurements by month, a series of dots. And these graphs are organized by month starting with January at the top and then working your way down. There's a second page that continues with July all the way through December.

What struck -- and then there's a second column next to it. And what the USGS did, and Mr. Hjalmarson talked about this, is when you get high flow events or a very rainy year, there can be water in the stream that soaks into the banks that then comes back out, if you will, when it's not flowing. And that can have an effect on base flow conditions.

Well, the USGS considered that and actually adjusted these low flows, these base flows, for variations in precipitation. So on the other side is what the USGS believes is the true low flow unaffected by precipitation.

What I'd like the Commission to consider is that if mining was having an impact on the San Pedro River and its flows, then it would be reasonable to assume that mining, since it occurs in all the months of the year, that those base flows would go down over time as the effect of those mine workings expand and dewater the system and have an effect on the river.

But what you find is I ask the Commission to look at the low flow graphs for January, February, or March. And what you see is that the base flow for those from 1930 through 2003 or 4 is flat at 10 CFS. So I ask the Commission to consider if mining work was having a significant effect on base flows in the river, why is it not showing up in these base flow accounts?

Now there are other months when the base flow over time from the 1930s to present has decreased, but the USGS explains that due to the riparian vegetation along the stream.

During the colder months, the plants aren't transpiring water. But if Mr. Hjalmarson suggests or implies mines are having an effect on the river, then why

isn't there any change in base flow? It's simply not reported at the Charleston gage.

So to excuse the expression, he's kind of looking for a canary in the coal mine, in this case, a hard rock mine, but it's just not showing up. The base flow in January is flat from 1930 to present. So I just don't see any evidence nor has he presented any evidence that suggests that mining is having an effect.

And I was going to ask Ms. Hunter-Patel, who works for Freeport, precisely what year it was that the Bisbee mine workings shut down, but I believe the mining continued into the 1970s if not early 1980s. So there was a period when there was mining, and then the mines shut down, but there's no increase in base flow. So if mining was having an effect, not only should you see a decline when mining is occurring, but when mining stopped, where is the rebound? Why isn't there any increase in the base flow? It simply hasn't occurred.

So I have to take from that that Mr. Hjalmarson's implication that mining could have an effect on the stream flow simply isn't supported by the data from the USGS.

Q. With the end result being that your stream flow data from the early 1900s, you believe, is still representative or ordinary and natural conditions?

A. Absolutely. I have not seen any estimates from

him that are substantiated that shows that my stream flow values from the USGS from the early 1900s are representatively low because effects from mining. He simply doesn't present that data.

Q. Let's talk -- let's shift gears now to another source of impact discussed by Mr. Hjalmarson, and this is the cattle issue.

A. Sure.

Q. The large herds of feral cattle.

A. Yeah. And Mr. Hjalmarson, I thought, did a good job of introducing into the record, and this was certainly a point brought up in the Fuller report, about when the Apaches essentially invaded the area, perhaps they would argue they were there before, but when the Apaches became a strong presence in the San Pedro River Valley, they forced Spanish and Mexican settlers to evacuate.

What was left behind were their herds of cattle. And the first, as I understand, post-Mexican explorers that went through the area, namely, Commander Cook, who was leading the Mormon battalion, talked about seeing these vast herds of cows through the San Pedro. I've seen various estimates. I believe Mr. Hjalmarson has referenced 60,000 cows. And his premise is that that many livestock would have an effect on the river.

So what I did is I tried to look into that issue

a bit more. And Mr. Hjalmarson talks about how much those cows could potentially affect the river if in the summertime. And I think he said 25 gallons per head of cattle per day. If you add all that up with 60,000, hey, you start talking about water. But is it that much water? He estimates that in the warmer summer months that up to 2 CFS, 2 cubic feet per second, could have been diminished in the flow if those cows were affecting the river.

A couple points of clarification on that. All those cows would have to be immediately upstream of the area that you're looking at. So if there's a historic account, for example, that's midway in the San Pedro and half the cows are downstream, how are the cows downstream of your historic account going to have any effect on your stream flow?

But more provocatively is the issue of how persistent were these huge herds of cows? And one thing that struck me is a reference that was provided by Fuller of a fellow who was actually driving a herd of cows from Texas to California during this period of time. His name was Bell, and he passed through the area -- I should say Cook passed through the area in 1846. And Mr. Bell passed through the area in 1854, so some eight years later. Imagine, if you will, a fellow with his compatriots, his cowboys, are leading a herd of Texas cows from Texas over

to California. They go through the San Pedro River area. He was aware of Cook's accounts of all these cows. Now he --

Q. Will you identify the document, if you --

A. Oh, I'm sorry.

Q. -- could.

A. Mr. Bell wrote a log of his trip through the San Pedro River, and he entitled it A Log of the Texas-California Cattle Trail, 1854. And like I said, he passed through the area eight years after Cook made these accounts of numerous cows in the area. He was in the San --

Q. And his account -- his account is produced here as part of the Southwestern Historical Quarterly, volume 35; is that right?

A. Yes, yeah. Thank you for reminding me. This, his log was published. They actually got a copy of his handwritten diary, and this Texas Historical Society printed his log over a couple of issues of its quarterly.

This quarterly is actually dated 1932, but his log was written as he was passing through the area. And we know it's precise because I'm going to read for you in a second the precise days he was waking up and what he's observed those days. And he was aware of Cook and the cows that Cook saw. If I would ask the Commission to look

at page 305. And Mr. Bell mentions the lack of cattle that he saw. And let me read what he said very quickly.

"I forgot to mention that Cook," that is, Cook of the Mormon battalion, "reports numerous wild cattle which I suppose was left by the people of the rancho. We saw no signs of them. We camped for the night and sent two men back for the steer."

Again, they're leading their own cows through the area.

He then proceeds to go through the area. Now that -- that quote, he says, is on September 2nd. Now September's a pretty warm time. I've been down in the San Pedro River area in September, and it's still pretty warm. And if I was a cow, I'd probably want to be along the San Pedro River to get a drink quite frankly.

On September 5th, 1854, he says, and I quote, "Had an unpleasant night. Left camp at 9:00 o'clock. Found plenty of water known as the head waters of the San Pedro."

On September 6, "Left about 9:00 o'clock. Crossed the San Pedro River several times." He never mentions, and I will leave the Commission to come to their own conclusion. I don't want to put words in Bell's mouth. He never mentions any observations of cows in his area of the San Pedro River where he crossed. So that led

me to believe that perhaps it's not safe to just assume that these 50 or 60,000 cows were necessarily still there when many of the historic accounts that I have went through the area. And I --

Q. Didn't it cause Fuller to question whether they were still around?

A. That is true. Fuller, in his report, actually makes that same reference. And I'll take it even one step further to talk about Hendrickson and Minckley. And if you'll give me a minute to pull out where their report is. This point was not lost on Hendrikson and Minckley. Another Center document which talked about how prevalent these cows actually were.

They say -- now you might ask me, Joy might ask me this, Well, Mr. Burtell, where the heck did all the cows go? Well, Hendrickson and Minckley, a Center document, addresses some possibilities. They say -- and this is on page 144 for the record. They say, "Wild herds appear to dwindle rather quickly, possibly to due to hunting by Apaches, military expeditions, and 49ers."

So I don't think it is fair to make the assumption that there was 60,000 cows, the whole period of time when my historic accounts were made, running around the area. There is conflicting evidence that suggests that those number of cattle dwindled. And thus any

impacts associated with those cattle would have decreased as well.

Q. Let's assume that the cows were still there somewhere --

A. Yeah.

Q. -- sight unseen. And they were continuing to graze, and they were continuing to use the river as a source of water. How would their grazing impact the natural offset of water that they're consuming versus the ET?

A. Yeah, a couple of things that are interesting to think about. Some might find what I'm going to say rather unusual. But you could argue in one way that the presence of huge herds of livestock in the San Pedro River could have actually increased the amount of flow in the river for two reasons. Number one, the cows eat vegetation, including grasses along the river. And those grasses along the river are sucking up water that otherwise could reach the river.

So the grazing of those herds could have actually decreased the amount of near river riparian vegetation and actually resulted in some increase in flow. I have not quantified it. And if Ms. Herr-Cardillo asks me, I'll say it's simply a possibility. But I think it's worth considering that cows could have actually increased the

flow.

And the other thing, and many folks have talked about the influence of the cows on potential entrenchment, is that if there were cows in the area, could they have actually caused more runoff to come into the stream because there's less vegetation on the slopes? That would have actually increased the flow of the river if there was more runoff.

So I don't think it's the fair to only assume that cows could have a negative or decreased effect on the flow. I think it could also be argued that in some way cows could have increased the flow on the river. All I'm suggesting is that you need to be fair. You can't just assume 100 percent sure there are 60,000 cows and they're all drinking water immediately upstream of one of my historic accounts and that you've got to throw them out because it affects the river. I just don't think that's a fair characterization of the data.

Q. Well, let's take Mr. Hjalmarson's 2 CFS without question for the time being. Okay?

A. Sure.

Q. What impact is 2 CFS truly going to have on the stream?

A. If you take a look at the flow accounts that I compiled with the U.S. Geological Survey. And I encourage

the Commission to look at those again. As you may recall, for most months, the flows were less than 20 CFS or less than 30 CFS.

Even if Mr. Hjalmarson's correct that all 60,000 cows all year long were drinking 25 gallons a minute immediately upstream of where one of those gages are, in his opinion, that would add a couple of additional CFS onto it. So we go from perhaps 15 CFS up to 17 CFS.

So I think it's -- I think it's dangerous to make implications of large impacts on the river when you actually look at the numbers and the numbers are very minor as to what those effects would be.

Q. 2 CFS sounds like it's almost de minimus?

A. Not only almost de minimus, but that is in the warmest summer months. Mr. Hjalmarson was clear that on the night -- I'm paraphrasing, but I think his presentation said on a warm summer day how much a cow would drink.

I encourage the Commission to consider that my former employer, the Arizona Department of Water Resources, they have guidelines as to how much water a cow would use if someone is applying to appropriate surface water. And I have a copy of the guidelines. And unfortunately, I didn't present a copy. But if anyone is interested, it's available on line.

Their guidelines for how much water a cow uses, and I suspect this is an average over a year, is not 25, not 25 gallons per head, but it's 12, half of what Mr. Hjalmarson talks about on a warm summer day. So even if the two CFS is accurate, which I don't agree it is, over the year during the cooler months, cows aren't going to drink as much water. It's probably more on the order of 1 CFS, using his own, I think, somewhat inflated estimates of the impact of cows.

Q. Without accounting for the offset in ET and so forth?

A. Right. Which, again, potentially could have increased the flow. You talked -- you mentioned a couple times this notion that for the 2 CFS to actually impact the location where you have this historical account data, all 60,000 would have to be upstream of the person making that account. It's obvious why that is. Why do you suspect that that's not a reasonable suspicion.

When Bell passed through the area in 1854 leading his own herd of cows, he makes no reports of any large herds that he saw. As I read from Hendrickson and Minckley, their conclusion is, Hey, maybe the Apaches had herded them up, maybe took them to other areas, the 49ers, the Apaches, military had actually slaughtered the cows themselves and used them.

So I think it suggests that the cows were either probably dispersed throughout that watershed, if not adjacent watersheds and/or their numbers had just decreased. I certainly don't think that Mr. Hjalmarson has presented any evidence to say with any certainty that all 60,000 cows were still there when my historic accounts were made.

Q. And even if they were, their impacts were de minimus?

A. At most, a couple of cubic feet per second using his assumptions.

Q. Let's move now to your reaction to Mr. Hjalmarson's model.

A. Okay.

Q. Okay? And you probably have a couple different subtopics there?

A. Yeah. And I -- I apologize in advance to the Commission and the audience. As we saw this morning and in Bisbee when we start getting into these models and cross-sections, it can get -- can get pretty technical. I guess it's just the nature of the business. But I will do my best to simplify it, even hopefully that I can understand it.

I view his model again, and I think he said this clearly, it was developed because he felt that there was

not evidence of -- of from the San Pedro River that were not already affected by man. So there was no evidence of ordinary and natural conditions either in the stream flow record, historic accounts, or otherwise. So he was left -- he had no other recourse, I think he made clear, than to develop this model and, based on this model, estimate for the Commission what predevelopment stream flows were in associated depths.

Like any model, you have model inputs. You have assumptions which are the basis of your model. And then you have model outputs. And I ask the Commission's patience, if you will, but Mr. Hood and I would like to present to you some concerns I have with all three of those. And I'll just say again, with the model inputs, the model assumptions or, that is, the foundation of how his model works, its nuts and bolts. And then how well does the model actually hold up to reality.

So we'll walk through each one of those, but I just want to let you know that we're going to kind of march down this path. And, please, if I'm saying something that's confusing, don't be surprised. It is a complicated matter. And I think as we saw this morning, it gets pretty technical pretty quick.

Q. Okay. Well, let's start with the model inputs.

A. As I understand now from Mr. Hjalmarson's report

and two hearings, I have now a much clearer understanding of what those model inputs are. I'll just say that -- well, he focused on three areas of the river. He focused on actually four, but he later said the fourth was not important. And the fourth that I'm saying he indicated was not important was at the international border. Because he concluded that the river wasn't navigable in that area, he said that we shouldn't really look or be focused on that. And I understand that.

So then that leaves us with three other points on the river that is the foundation of his model. And that is at Charleston, at what's referred to the narrows, and he calls that the join, which is the join between the upper and lower watersheds as was characterized by another USGS researcher, and the mouth of the San Pedro River near where it joins the Gila.

I don't have -- at least with respect to his model inputs, I don't have a problem or I understand what he did for the narrows, the join. But I do have serious concerns with his other two data points, the Charleston data point and the narrows data point. And I'll work my myself downstream, and we'll start with Charleston.

As was emphasized this morning, which made me feel that I did understand his approach, his model starts with predevelopment, average predevelopment stream flows

at those gage points and builds from there. It's like a stack of cards that was being built on that foundation.

The Charleston stream gage predevelopment flow, he indicated, was based on the full period of record for the Charleston gage. He took all of the -- I think he mentioned several thousand daily mean stream flows for that gage, averaged them all up, and you get 52 CFS.

However, he said, you can't stop with 52 CFS. You have to add on top of that the base flow that was lost since predevelopment times. So because he's using stream flow record that's more recent, that's not enough. You need to correct it. You need to adjust it up because base flow is lost more recently that was there in his opinion before. So he added 10 CFS.

Q. Where did he get his 10 CFS?

A. If you take a look at his report -- and give me a second. I will pull up his report. And to the degree I can, I will -- and I know it -- I think it would help everybody, including the court reporter and certainly the Commission, I'll try to give you slide numbers versus appendices numbers. So I'm going -- and this is where having a Power Point would actually help.

If you look at page 72 of Mr. Hjalmarson's report, he has a table. And he said, These are all the estimates of predevelopment stream flow at the Charleston

gage. And he then points out that he picked the lowest. He picked the lowest of all of those and said, okay, that's predevelopment base flow. That base flow is no longer in the river. I'm going to take that, which is equivalent to 10 CFS, and add it on top of the 52 CFS. What do you get? 62 CFS. And that, he said, was the predevelopment annual flow at the Charleston gage.

There's one problem with that. And that is, if I can ask the Commission to refer again to this.

Q. Identify it.

A. Oh, I'm sorry. Apologize. This, again, is the USGS professional paper 1712. What this USGS professional paper shows is that that 10 CFS that Mr. Hjalmarson said is now gone that has to be added on top of the 52 CFS, it's still there. It's still there during the months when the plants aren't transpiring water. He's double counting for those months. He added. Again, he assumed that the full period of record for the San Pedro River gage at Charleston results in a 52 CFS. But he added a full 10 CFS on top of that. The only way he could do that is if he assumed that that base flow was gone. But take a look at the USGS gage data for January, February, March. What is it? 10 CFS.

The base flow is not zero now. This data was from 1930 up through 2004. The base flow during those

months is 10, if not 11. So you can't simply take 52 CFS, which is the long term average, and add on top of it 10 CFS because you assume it's all gone.

Now there are months when the base flow is less than 10 CFS, particularly in the warmer months. The USGS explains that due to riparian vegetation. Riparian vegetation is a natural condition along the river. That 10 CFS is constant from the 1930s all the way up through 2004 or 5. It hasn't decreased. So for the months when the plants aren't transpiring water, for Mr. Hjalmarson to add 10 CFS on to that is double counting. You can't be adding 10 CFS onto a stream for those months when the base flow hasn't changed.

Q. So he's artificially increasing his discharge figure which then gets plugged into his other calculations. And at the end of the day, you're going to have a depth that's not accurate.

A. Because at Charleston, that model input is 62 CFS. That's a larger value of discharge. And ultimately his depth measurements are based on discharge, so that's an error.

And, again, I believe that he is, even though he has repeatedly said that his model is conservative and if anything underestimates the width of these channels, I haven't -- I don't understand how he can say that the

Charleston base flow historically was 62 CFS.

Q. Was the mouth the other?

A. The mouth is the other area. And this is also perplexing to me. This is a second document. And, Mr. Hood, I don't know if you have a copy of this for the Commission.

Q. I'm sure they're sick of more documents, but I do have it. Can you identify the document for us for the record.

A. Yes. It's entitled Preparation of Average Annual Runoff of the United States, the so-called Krug report, which Mr. Hjalmarson used to estimate what the predevelopment stream flow was at the narrows and also at the mouth. When you --

Q. Do you know why he didn't use this for Charleston?

A. I do not. The U.S. Geological Survey presents a runoff number for Charleston, but he chose not to use it. And what I find interesting about that is that one of the reasons why Mr. Hjalmarson relied on this document is that the USGS adjusted the runoff at these gages for upstream diversions.

And I remember it was clear at Bisbee, he was adamant that that's one of the values of this document is there's an independent estimate by the USGS of how

diversions have affected these stream flow gages. So you can't just use the gages in their current state if diversions could have affected these.

Well, Krug did that exercise. He adjusted the numbers. And you know he adjusted the numbers for diversions when you look at -- and if I can ask the Commission to refer to page 317 of Krug's report. And as Mr. Hjalmarson described in Bisbee the U.S. Geological Survey in Krug divided a large area, the whole United States, quite frankly, into these hydrologic cataloging units, which is a fancy way of saying watersheds and sub-watersheds.

What's of interest to us is what's referred to as hydrologic cataloging unit 15050203, pretty much two-thirds of the way down. And what you can see is what the USGS did, as I understand what Krug said, is they used existing stream flow gages where they had data. They adjusted those data to account for any diversions that are occurring upstream. A key point for the Commission, correct? We're trying to look at streams in their natural and ordinary condition unaffected by diversions. And, thus, once they did those corrections, they could then proceed with estimating what the runoff was from these drainages unaffected by diversion, the natural runoff.

What I found more than a bit perplexing is the

USGS actually provides a corrected, that is, corrected for diversion, number for the San Pedro River at Winkleman. If you look down at the list of stream gages on page 317, you'll say it's -- you'll see it says San Pedro River at Winkleman, Arizona. And you come across, and there's Drainage Area, the Years of Record, Mean Discharge, Runoff, which is listed at 15, and then Adjusted Runoff, which is listed at 0.19.

Then please look at the final column that says, Remarks Code. The first remark is I. And if you flip to the previous page, page 59, of Krug's report, I is, quote, "Adjusted for Diversions." So these are the flows at these stream gages that have been adjusted for what the USGS thought were the diversions that would have caused them to be unrepresentative of what natural flow is.

Well, the adjusted runoff at the San Pedro River at Winkleman, which is right near the border, is 0.19 inches which over that drainage area works out to about 63 CFS. Mr. Hjalmarson's estimate for the average flow at Winkleman or at the mouth was 113 CFS.

So I do not understand why Mr. Hjalmarson used in his model a flow at Winkleman which is at the edge of his model of 0.19 inches of runoff which is equivalent to about 63 CFS adjusted for the diversions when he uses 113.

Now I find it interesting also because he chose

not to use the Charleston gage data here. He took Charleston and built upon it and took the long-term period record and then added the base flow on top of it. So I don't understand why he did that. So perhaps I will be given an explanation of that. But at this stage, I don't understand why he did that. And I think that flow is uncharacteristically high of what the USGS says is the adjusted stream flow.

Q. Switching back to Charleston and referring to the remarks code for Charleston, I don't see an I there. What is the relevance of that?

A. According to USGS and Krug, at least, they did not adjust the flow at Charleston for reasons that I can only imagine was because they didn't feel that there were any substantial diversions upstream of Charleston that would cause them to make that change.

And I should point out that the Winkleman gage is located no more than a mile upstream of the confluence. So to the degree that there is a small portion of the San Pedro River that's within that last mile of the watershed that could have affected flows, I can't think that would be a very substantial amount, not when the watershed covers some almost 4500 square miles. So the gage is very close to the mouth, one mile above.

Q. Let's go to -- you have Mr. Hjalmarson's Power

Point?

A. I do.

Q. Let's go to page -- or slide 97. And this is the graph where he plotted the Charleston point and we've talked a lot about this graph.

A. Sure.

Q. First thing I want to discuss, he -- you were sitting in the hearing room when he described having omitted the, quote, unquote, Mexico data from this chart?

A. That's correct.

Q. Right? What is the impact when you're charting something of omitting the lowest figure at the bottom of the chart?

A. I didn't understand why he necessarily omitted that figure. If you'll give me a second, I will -- there it is. Thanks.

Usually when one is checking the calibration of one's model, you don't selectively choose not to look at various data. You use all the data that you've got and let it see what it says.

Because he independently evaluated the predevelopment flow at Charleston, he felt in his Power Point presentation that you could use the other points where he estimated predevelopment flows as a check.

Now he was adamant in Bisbee, and I understood

his point, that he did not use that chart, that graph, as the basis of his Charleston numbers, simply as a means of checking, as an independent check of whether that model makes sense.

I did the same thing. I did include -- or I did include all of his data points, those at the border, those at the narrows, and those at the mouth based on his model. And when I plotted that --

Q. Can you identify the name of the graph?

A. Yes. I called it Hjalmarson's San Pedro River Predevelopment Runoff versus Drainage Area. And then in italics under that, All Data Used.

So, again, these are the data from his own -- these are data that were used as input to his model as to what the predevelopment stream flow was at various points along the San Pedro River. And I'll just say again, I fully understand Mr. Hjalmarson's argument or statement that he did not base some graph like this on the numbers that he used for Charleston. He based Charleston on the long-term flow record and added that 10 CFS of base flow on top of it.

However, he did show this as a potential check on his model. And when I took his same points and brought them into the common spreadsheet program called Excel that I think most of you probably have used yourself and let

the computer simply draw a smooth curve through his points. I didn't get his 62. I got more like 55, which is a lot closer to the long-term period of record for the gage, the 52 CFS, which he then added 10 CFS on top of it.

So I don't believe Mr. Hjalmarson has provided convincing evidence that his Charleston number is accurate that he used as input for his model.

Q. Your check here provides further evidence that adding that extra 10 CFS doesn't work out?

A. It shows that it's problematic.

Q. Have we covered everything on the inputs that you wanted to discuss? Are we ready to move on to the calculations?

A. Yes.

Q. Okay. Let's start -- let's start with the width discharge calculation which Mr. Hjalmarson also identified as equation 1.

A. Give me a second. I will --

Q. I have -- I have it notated here it's on page 1 -- or sorry, slide 117 of his Power Point.

A. Thanks. As was discussed at length this morning, I think less so in Bisbee, an important assumption or an equation that's a foundation of his predevelopment model is this relationship between discharge and width.

As, Mr. Hood, as you indicate on page 117 of his

presentation, he presents that equation W is equal to 3.01 cubed to the 0.57. What this equation allows Mr. Hjalmarson to do is to take stream flow data that, for example, the Charleston data which I just talked about or the data at the mouth of the San Pedro River and allows him to put that discharge data into this equation and out comes a width.

So it's important because once he knows what the width is and he knows what the discharge is, then he's one step closer to coming up with what the depth is.

So this equation is important, and quite a bit of time was spent on it this morning talking about it.

Q. It's also referred to as the Osterkamp equation?

A. Yes. In fact, he says on page 117 it's the equation from Osterkamp, 1980. And then he presents the proceedings on which this was presented.

I looked at this equation a little bit differently. I took it at face value, the equation, and assumed that Mr. Hjalmarson fairly looked at Osterkamp and picked out an equation that would be representative of the San Pedro River. But I wanted to check it against the San Pedro River to see if actual stream flow conditions in the San Pedro River in any way work with this. Does it make sense?

So we can do that exercise because in the Fuller

report and in the appendices of the Fuller report -- and I apologize in advance to the Commission because I don't believe Mr. Hood reproduced this monster, but this is the Fuller report which I think we've all been talking about repeatedly.

And in this Fuller report, 2004, and it's entitled Arizona Stream Navigability Study for the San Pedro River/Gila River Confluence to the Mexican Border. In appendix E of this report, the USGS compiled data. With the USGS, they actually went out and measured channel characteristics of the San Pedro River both at Charleston and at Redington. And they -- and I will just show, if it does not displease the Commission, if I could maybe walk up and just show you what these look like.

THE CHAIRMAN: Out of the witness protection program.

A. Okay. Unfortunately in this part of appendix E, there is not page numbers so I can only refer to these as -- I'll give you the title of them, but there's not a page number.

THE CHAIRMAN: This document is not part of the record?

MR. MEHNERT: It is. We have that.

MR. HOOD: It is. It is.

THE WITNESS: This is the so-called Fuller

report.

MR. HOOD: This is Exhibit 16 of the prior Brown proceedings.

A. Right. And what Fuller has done is they've taken discharge measurements actually measured by the USGS and related those to widths. You see all these little data points are all those different places where they did that.

And then they put a line through it to try to -- a regression line as Mr. Sparks talked about it this morning. It represents the average through all these data points.

And what you could see then is using this, you can then pick out an applicable discharge in the San Pedro River and come up and, using these actual field data -- these aren't synthesized. These are actual measurements -- come up with a width of the San Pedro River. This was at Charleston, and this is at Redington. Okay?

When you do that, an interesting conclusion comes up. And that is the San Pedro River based -- measured at those points, how does that compare to Mr. Hjalmarson's model? Well, what I did and what was shown as I walked and showed this to you, I picked 50 CFS, not an unusually high or low number for the San Pedro River. Probably more on the high side based on the historic accounts that I

looked at. And I put that into this equation -- or not this equation, these real data, and looked to see what the actual width was for those discharges.

And at Charleston, 50 CFS of flow based on actual field measurements relates to about 40 feet of stream width. And I need to make this point strongly because I'm going to get into this more in bit is one should not confuse stream width and channel width.

The surveyors that were out there were looking at the ordinary high water mark where the vegetation breaks. They were not looking at -- and if you look at the instructions that the surveyors used to map streams, they were not measuring the live stream. They were looking at the channel where the channel break is, the ordinary high water mark.

So this equation that Mr. Hjalmarson used is actual channel width; right? He's looking at how -- this parabolic channel and how wide it was and then how deep it was at its center.

So let's look at 50 CFS. You put 50 CFS into his model, and you get a width of 25 feet. So Mr. Hjalmarson on page 118 of his presentation plots this graph. And if you put 50 CFS into it, you get 25 feet as the width of the channel.

Well, how well does that hold up to actual stream

data from the USGS? Well, as I've showed you, we have those data. At Charleston, 50 CFS relates to a 40-foot channel. At Redington, 50 CFS relates to 35 feet. In both cases, actual data being used in Mr. Hjalmarson's equation results in a stream width that is more narrow than what is physically measured. Okay? And I'll just repeat that again.

Mr. Hjalmarson's model would suggest at 50 CFS that the width of the channel is 25 feet. If you look at the Charleston gage and you look at the Redington gage, 50 CF is either related to a 40-foot channel or a 35-foot, both substantially larger than the 25 feet that his model would predict.

Why is that relevant? If you're trying to force the same amount of water through a channel and the channel is narrower than it actually is, where has the extra water got to go? It's got to go in its depth.

So what Mr. Hjalmarson has done is he's used an equation -- and I understand why he used it, but I think more the question to the Commission, and I think Mr. McGinnis touched on this during his examination of Mr. Hjalmarson, how well does it hold up to real data, to empirical data?

And based on the data in the Fuller report, I don't believe it holds up very well. And more

importantly, it makes a prediction of the channel width that is narrower than actual data would suggest. And if it's narrower, you've got to force more water through a cross-section that is narrower this way. Where else is the water going to go? But you've got to have a deeper cross-section. What's the foundation of his conclusions are based on the depth of the channel at the base of this parabola.

So this is of concern to me, and I think it should be of concern to the Commission, that the equation that he used has not been calibrated in my opinion. Mr. Hjalmarson does, however, and I applaud his effort at least to compare how well this width equation holds up to other data. And what he does is he, on pages 120 and 121 of his report, he takes the general land office survey data from the late 1870s and he takes those data and says: Well, those surveyors were out there looking at channel widths. I have with my model an estimation of how discharge changes along the river. I'll put those discharges into my width-discharge relationship and come out with what my model says the widths are, and then I'll compare it to those surveyors. How well does it hold up?

And he presents that, Hey, its holds up pretty well. But there's a fundamental apples-to-oranges comparison that's being done here. If you become a

04:19:07 student of how those surveyors were instructed to survey
04:19:12 channels, they were not instructed to survey the actual
04:19:16 width of the live stream. They were instructed to survey
04:19:20 the width of the channel at the ordinary high water mark.
04:19:24 And if you don't believe me on that topic, I'll let you do
04:19:27 your own comparison.
04:19:30 If you take a look at another document that we've
04:19:32 talked about at length, and that is, this report, Ecology
04:19:41 and Conservation. We talked about this. This is another
04:19:45 Center submittal. And on page 234 -- and I believe the
04:19:48 Commission has this. So if you don't mind, I'm going to
04:19:51 have you guys refer to this, if you want.
04:19:53 On page 234 of this report, Hereford and
04:20:01 Benticort compiled all of the general land office survey
04:20:04 data along the San Pedro River in a very convenient map
04:20:09 where it shows the various points where the surveyors
04:20:12 crossed the San Pedro River at a section line and what the
04:20:16 channel widths were that they measure. When you look at
04:20:19 this, be very aware of the units. The units are meters.
04:20:24 And, please, at your leisure, look at these
04:20:27 values, and look at what the general land office survey
04:20:30 said the widths of the San Pedro River were in the 1870s
04:20:35 and other various dates. So you can look through here and
04:20:39 try to find the dates that are in the 1870s. There are
04:20:41 some in the 1880s. It goes right into the 1900s.

Typically, the San Pedro River in meters as recorded by these general land office surveyors was 10 to 15 meters. So multiply that by three roughly, and that will get you feet. The problem with that is now we're talking those widths are on the order of 30 to 45 feet.

But now I encourage the Commission to go back to my historic accounts from the 1950s -- or 1850s and 1860s. How wide were these explorers seeing the live stream, not 30 to 45 feet. 8 feet, 12 feet. "An active man can jump across it." I would encourage the best of olympic long jumpers to long jump a stream that is 35 or 40 feet wide. It isn't going to happen. So there's a disconnect.

Somehow these surveyors are measuring channel widths that are much, much broader than what these explorers saw. But when the explorers make these accounts, they're very clear. They say, "The stream is eight feet wide." They're not saying, "The banks of the stream are eight feet wide." They're saying, "How wide is the active live stream?"

So for Mr. Hjalmarson to use these historic surveys as a justification for his width-discharge relationship is, I believe, an apples-to-oranges comparison. Those surveyors were not out there measuring active channel stream widths. They were looking at widths at the ordinary high water mark.

Q. (By Mr. Hood) That brings us to the depth equation?

A. The depth equation, the --

Q. And just for anybody following along still, this is also referred to as equation 2, and it is discussed on slide 123 of Mr. Hjalmarson's Power Point.

A. And I apologize again. I suppose I tried to warn the Commission. But this, again, is where we get into lots of equations, and I appreciate your patience with me as I walk through this.

But this is an equation that Mr. Hjalmarson talked about at length in Bisbee and also again this morning. Another foundation of his model where he puts it all together, the width equation, the hydraulic equation, and comes up a relationship between width and discharge.

As Mr. Hjalmarson has readily admitted, this equation represents the channel of the San Pedro River as a smooth parabola. He has also admitted both in Bisbee and here that what his model predicts is what the depth of the channel would be at its deepest point at the lowest point of this parabola.

Similar to looking at his width equation to see how well it holds up to reality, I wanted to take a look at whether anyone had developed cross sections of the San Pedro River and what do those look like? I think Mr.

McGinnis touched on this this morning of, How well does that parabola represent reality?

So one of the things I looked at is going, again, back to the Fuller report. Fuller has a series of cross-sections also in Appendix E. These fortunately are numbered. And if I can again approach the committee members since we don't have a copy of this, what I'm going to show you are actual channel cross-sections that were prepared by Fuller in his report starting on pages 65 and going through 68. These cross-sections are from the Hereford bridge area down to the St. David diversion ditch.

And what these show, if again I can approach the Commissioners --

THE CHAIRMAN: Please do.

A. These show what the San Pedro River cross-section looks like. And I will just page through. This perhaps comes closest to a parabola. But you can take a look at the irregular nature of these cross-sections. And I'll go show this to the audience, if they're of any interest.

Q. (By Mr. Hood) Let's make sure it's on the record. For the record, it's pages 60 --

A. 65 through 68 of Appendix E of the Fuller report.

Q. Great.

A. I think the Commission can see that -- and as I

think what was alluded to by Mr. McGinnis this morning that the actual cross-section of the San Pedro River is certainly not a uniform cross-section. It's very irregular with not just one low point but several low points and a bottom that is all over the place.

There's a practical significance to that though. And that is if you're on a boat trying to commercially navigate down the San Pedro River, life would be much easier if the world was like Mr. Hjalmarson where the channel had a uniform cross-section where the deepest part was exactly in the middle because then what you could do is you could simply follow along the very center of the stream and you would always be in the deepest part.

But unfortunately reality is not so clean. Those cross-sections show a river -- and I should point out an argument might be made, Well, these cross-sections were made much more recently. But there is strong evidence that the San Pedro River has healed itself from its entrenchment. And those of us that have been down on the river, some of you who live in the area, know that it meanders. In a way, it is very similar to what was described historically.

These cross-sections then provide a glimpse of just how irregular the channel looks. And I would challenge anyone navigating with these cross-sections to

be able to figure out what the deepest part of the channel is as they're working their way down. It's all over the place.

But this is a foundation of Mr. Hjalmarson's model. He, again, assumes a smooth, clean channel with the deep -- his predictions, his depths are, again, for that deepest point. The point I'd like to drive home with the Commission though is that would be a wonderful circumstance if it was true because you could then follow down that centerline of the river and you always know that you're in the deepest spot. But it's simply not that way. It's very irregular. And anyone trying to successfully navigate would never really know where they're at. Are they in a little localized low? Are they in the deepest low, or are they going to run into a sand bar? It's all over the place.

Q. This, Mr. Burtell, this equation 2, which is the depth equation, it assumes a parabolic channel, and it's being applied to a river that you've just demonstrated is not parabolic.

Aside from the issue of identifying the deepest -- the invert, the deepest point of the cross-section as you're trying to navigate, is there a problem in using this equation and trying to accurately generate maximum depths in a nonparabolic situation?

A. Absolutely. It's -- it's a model that is being applied to the system. And I thought Mr. Hjalmarson did a fair job on redirect from Ms. Herr-Cardillo indicating that -- and I don't disagree that these are equations that have been developed and are used in the scientific community. I don't disagree with that.

But I think any good scientist will tell you, Don't use an equation to represent reality if there's not a good relationship between that reality and what the equation is trying to explain.

And it's the best he has, and I understand. And certainly I also understand and I'm the first to admit that how Mr. Hjalmarson approached this problem required that he make these assumptions. And it's a difficult thing that he was trying to do. I feel strongly, as I said earlier, I don't believe he needed to go down this path due to the historic data, both accounts and flow data, we have.

But he went down this path. And so now we are -- I don't want to say "stuck." That's too strong of a word. But we are left with his model. So it's our responsibility, and I think it's the Commission's responsibility to be -- to be aware of the weaknesses of those models. And when he makes the statements that his model in every case he picked the most conservative

assumption, I simply think is not supported.

Q. And we've already been through, again, this equation that builds upon what was done in equation 1, and there were problems with that. So, again, we have an issue about compounding problems here?

A. That's correct.

Q. The next topic you wanted to discuss was model output, and this comes down to, Are you able to calibrate the thing?

A. Yeah, I -- and, again, I will apologize for the fifth time to the Commission. Theoretically, you folks, you fellows could have not had to hear all of this up to this point. The proof's in the pudding. What's the final results in Mr. Hjalmarson's model? More importantly, how well does his model hold up to calibration? Has he made any attempts to see whether or not his model predictions are accurate?

The closest I saw that he came to that was what he did at Charleston with his graphing analysis, which I believe has issues with it. And then he also used the general land office survey data which, again, shows survey channel widths in the 1870s far wider than what just 20 years before explorers that went through the area measured live streams.

So I don't think he did a rigorous job of trying

to calibrate his model. What I -- I tried to though. Giving him the benefit of the doubt, I wanted to see how well his model holds up to the historic accounts. I feel strongly --

THE CHAIRMAN: We're going to take a short break.

THE WITNESS: Okay.

(A recess ensued from 4:31 p.m. until 4:31 p.m.)

THE CHAIRMAN: We appreciate that brief break, and we're back on the record.

MR. HOOD: Thank you, Mr. Chairman.

Q. (By Mr. Hood) Where we left off, Mr. Burtell, we were talking about the lack of calibration. And then we're going to move into a discussion about whether the stream was perennial or not.

Before we move there, have we finished up the calibration issue?

A. Again, two topics I think that are worth discussing regarding the last thing, the proof in the pudding. We talked a lot about model inputs. We talked about some foundational equations that Mr. Hjalmarson used for his model.

But at the end of the day, you crunch all these numbers, How well does it hold up? Is there any data that we can compare to Mr. Hjalmarson's predictions to show that the model that he used is reasonable, it's realistic?

A couple things that I've looked at. And I think the first is this table --

Q. Okay.

A. -- I've put together.

Q. Can we identify it, please, for the record.

A. It's a table that I put together. And it's entitled Comparison Between Historic Observations of the San Pedro River Stream Flow Conditions and Hjalmarson's Estimates of Predevelopment Flows.

And I'll let you pass that down the line. What I've done in this table -- what I've done in this table is, again, attempt to see how well Mr. Hjalmarson's flow predictions hold up to the historic accounts that were made and that I tabulated and discussed earlier.

So what this table does and what I'll do for the Commission's benefit is walk through this quickly. And I've read several of these accounts this morning. But what I did was I tabulated accounts that were made in four areas of the San Pedro River near Benson, above the narrows, at or above Aravaipa Creek, and near the Gila River confluence.

And what I tabulated was when the observers passed through the area, the date that they passed through, both month and the year, and what stream flow conditions they recorded when they passed through the

area. I read some of these accounts to you earlier this afternoon. But what I've done here for brevity is I've tabulated them.

And so we have folks on the river in the 1840s and 1850s making actual measurements of stream flow conditions, the width and the depth. And as I mentioned to you, this fellow Tevis, who wrote the letter back to his parents, he actually estimated the flow. That flow equates to a velocity of 2.2 feet per second. I think he said it was one and a half miles per hour, I think is what he said, but I converted it to feet per second, and then he made width and depth measurements.

What I did is I used these historic accounts -- this is actual data, empirical information -- and calculated what the discharge was that these fellows would have seen. Now you might ask yourself --

Q. Using Mr. Hjalmarson's equation?

A. I haven't even gotten to Mr. Hjalmarson's. What I tried to do first is calculate how much flow these explorers would have seen based on their speed conditions. Now only Tevis indicated what the stream flow was. So I'm missing one part of my equation, right? Discharge is equal to -- discharge upstream is equal to its width. It's average depth times the velocity, how quickly the water's passing through there.

So I'm missing, except for Tevis's account, what the velocity was of the water as it was passed through the area. But that data is available on the velocity. The USGS as indicated in Appendix E of their -- I'm sorry, Fuller in their report in Appendix E tabulates actual stream flow measurements that the USGS made where, again, they were out there with their flow meters and actually estimated -- or not estimated, measured what the average stream flow velocity was at these points.

And so what I did -- and I believe it's a range that even Mr. Hjalmarson would say is realistic. I put in a range of velocities of 1 to 3 cubic feet per second based on those USGS stream flow measurements of what the flow was in the river. It's a broad range.

Well, now I've got the one missing piece. So now I got a velocity for the stream. I've got actual width and depth measurements. The velocity is actual, that is, measured by the USGS. So now I can calculate what the discharge was that those explorers saw.

How much did they come up with? Well, not very much. Near Benson, the range goes from 18 to 54 CFS when Parke was there in 1854. When Hutton and Leach were above the narrows in September, it was dry. So the discharge was zero. And in March and April, I calculate 12 to 36 CFS. At or above Aravaipa Creek where Tevis left the San

Pedro to then head on over to Tucson, he actually, again, had a width of six feet, a depth of one foot. He has a -- he measured or he reports a velocity of 2.2 CFS. My range of 1 to 3 CFS, which covers his measurement of velocity, comes in at 6 to 18 CFS. And near the confluence with the Gila River, Emory, the fellow who said -- the fellow who was with him who said an active man could jump across the stream, the width was six feet wide, one foot depth. Multiply that by 1 to 3 CFS, and you get 6 to 18 CFS.

So for these historic accounts, we've got flow depths that are typically less than 20 to 30 CFS. Well, how well does that hold up to Mr. Hjalmarson's model? Now as you know, Mr. Hjalmarson discounted these historic accounts indicating that they were affected by man because there was entrenchment there in the area.

As I bored the Commission at length earlier, I feel very strongly that he has not provided any evidence that the entrenchment that was recorded during the time when these observers made these measurements was caused by man.

How well does his model then hold up to these historic accounts? Because we know the time of year that these explorers passed through the areas, we can relate -- and it's a confusing discussion. And Mr. Sparks and Mr. Hjalmarson discussed it. This is the flow duration curve

issue.

But the flow duration curve relates how often in a year the flow is less than or greater than a certain amount. Well, because we know what time of year these explorers went through the area, we then know whether the stream flow exceeded or didn't exceed a certain period of time. For example, in the April time period, the stream flows, which were the basis of his flow duration curve, are about 50 percent. That is, about half the time, the flows are less. About half the time, it's greater.

So you can use the month that these historic explorers passed through the area, pump it through Mr. Hjalmarson's flow duration curve, and you get discharges from his model. Well, how well does that hold up? Not so well.

And I remind the Commission again that Mr. Hjalmarson has repeatedly said that his model in every case underestimated actual depths. Well, it doesn't appear that that is the case. If you look at my calculated discharges based on actual historic accounts of stream channel conditions and you compare that to Mr. Hjalmarson's estimates of discharge, you will see without exception that his model overestimated what the stream flow discharges were.

Let me give you an example. For the area at or

above Aravaipa creek, we have Tevis who actually, again, gave us not only a width, a depth, and a velocity of the stream. Using that data and a range of flows of 1 to 3 CFS, that relates to 6 to 18 CFS that Mr. Tevis would have seen.

Mr. Hjalmarson's model comes in at 30 CFS. That's almost double. In fact, depending on the range, it's more than double. I don't believe Mr. Hjalmarson has made the case that his model consistently and in all cases underestimates the flow.

And because discharge relates to width, if his model is overestimating discharge, then by its nature it's also overestimating the width. Even if the parabolic channel is in fact accurate, which I don't believe it is, even if it were, if he's overestimating the discharge, then he's going to be overestimating what the widths are -- I'm sorry, the depths. So --

Q. Let's just clean that up because you said that a couple times.

A. Oh, I apologize.

Q. Underestimating width equals?

A. What I should be saying is when he overestimates the discharge, that means he will be overestimating what the depth is.

And in the last three columns of this table, I've

tried to address any concerns that Ms. Herr-Cardillo may express to me, "Well, Mr. Burtell, was there any possibility that there was diversions and it affected your historic accounts?"

So what I did, I broke it into the big three that most people consider grouping historic diversions, mines, irrigation, and cattle. These historic accounts that range from 1846 to 1858, there weren't any mines in the area. So diversions that could be caused by mines affecting these historic accounts simply didn't exist.

The area was largely abandoned. As was mentioned by these explorers, 49ers, military people, when they went through the area, outside of some cattle that they saw, the area was abandoned. The Apaches had developed a stronghold in the area. Thus, the need for the military camps.

I think Mr. McGinnis and Mr. Hjalmarson were talking during their discussion this morning about, Well, what evidence really is there of irrigation going on? And the best that I heard Mr. Hjalmarson say, "Well, you know, Native Americans might have been irrigating." The problem I see with that is that the Native Americans that were left in the area, the Apaches, were not known as a tribe that irrigated. They simply were not that.

They were a tribe that, as I understand, and Mr.

Sparks could probably clarify, did more raiding of existing settlements. They were not an agrarian tribe, as I understand. I just don't see any evidence that there was irrigation going on in any significance in the 1840s and '50s when these historic accounts --

And last, but not least, what's the other potential effect on these stream flows? Cows. And we talked, I think, at length, probably more than you folks on the Commission want to hear, about cows and how much water they drink on a warm summer day versus a cool winter day. Under the worst case scenario I think laid out by Mr. Hjalmarson, I don't think the cows could cause anymore -- and I don't believe his number. But even his worst case is a couple, 2 CFS.

So take my calculations of Q based on historic accounts and add 2 CFS to them. My 6 to 18 CFS turns into 8 to 20 CFS. His model, 30 CFS. So, again, I do not feel that Mr. Hjalmarson's model holds up well when you look at data, when you go at the end of the day to calibrate to see how well it holds up.

Q. Okay. The next topic is the discontinuous nature of the stream and more specifically, Mr. Hjalmarson's contention that it was instead perennial?

A. Mr. Hjalmarson has repeatedly mentioned the importance of this. And this is Hydrologic Atlas 664.

And I have an original copy of this. And what I will do for the Commission's benefit is approach. Without going into excruciating detail about this, and I believe counsel for the Gila River Indian Community talked to Mr. Hjalmarson about this in Bisbee, so I apologize if you've already heard this story. But let me say it again. And stop me if you get the point. And to the degree that I can do a Vanna White, I will hold this thing up. And this is --

MR. SPARKS: Not even close.

THE WITNESS: Yeah, I'm much more attractive. I know.

A. This is a -- this is sheet three of three, I believe, if I get that right, sheet three of three of the Hydrologic Atlas. And Mr. Hjalmarson has repeatedly said that he's used this and was conservative. It had some of the lowest estimates of predevelopment stream flow and thus it was an important source of data for his model.

The San Pedro River is here, starts down here at the border and comes on up before it joins the Gila River. And what you'll see is some pie charts. That might -- that should ring a bell from counsel for the GRIC mentioned, some pie charts.

And what these pie charts are is an accounting of the ground water in flow and ground water out flow at

various points along the San Pedro River. And those components are variable. Discharge, for example, ground water discharge includes base flow. It also includes evapotranspiration, and it also includes a term the USGS refers to as under flow. And that is shallow ground water that follows the stream course but is below subsurface.

The point that I want to drive home in this is that the pie chart for the narrows, which is about the center as well as near the mouth. What's important is this pie chart which represents the flow at the narrows and this pie chart which represents the flow components near the mouth -- here's Winkleman. Neither one of them show base flow. And that was a point that was made by the GRIC in Bisbee. The USGS's ground water predevelopment model represented by these pie charts for the middle and the lower San Pedro River do not include base flow as a component. Well, base flow is what feeds a perennial stream.

Mr. Hjalmarson has said repeatedly that the entire San Pedro River was perennial. But one of his data sources, in fact the key data source, doesn't even show base flow at the middle and lower parts of the river, which, again, leads me to wonder how accurate it is.

I mentioned to you earlier that I presented this to you -- and if you don't mind, I'll stand because this

probably helps. This was a figure that we gave you from Hendrickson and Minckley. And this figure on the left was prepared by Brown and Others.

Brown and Others, if you look at the references in the Hydrologic Atlas that I just held up, Brown and Others is one of the references. So what I've done is went to Brown and Others. And it's color, so it helps.

This is a reference in the same report that Mr. Hjalmarson used as foundational evidence that the San Pedro River was perennial in its entire course. And what Brown and Others do -- and this is a map that is widely referenced, again Hendrickson and Minckley among others. And what it shows is where the rivers in Arizona were perennial, currently and prior to divergence.

And you can figure that out by looking at the legend of Brown and Others. If you take a look at the legend of Brown and Others, see where the line is dotted? It's a blue dotted line. That says "the stream" was -- "is currently ephemeral, intermittent, or wastewater." And then it goes on to say, "Flow was perennial prior to diversion, impoundment, or decline in ground water levels."

And when you look at the San Pedro, you'll see that there's several areas where the line is dotted blue. You'll also see in the Charleston area to the south there

where the line is a solid blue, that indicates that the San Pedro River is currently perennial. But I ask the Commission to look at the breaks in the lower San Pedro River where there's no dotted line or no solid blue line.

What Brown and Others concluded was that in those areas, the stream was ephemeral at predevelopment time. That's an area where they indicated there was not evidence that there was flow prior to diversion. And I'll point out again that Brown and Others is a reference that was in the Hydrologic Atlas that Mr. Hjalmarson relied so heavily on.

The reason I'm pressing this point -- and, again, I appreciate the patience of the Commission -- Mr. Hjalmarson's final -- his finale is those series of flow duration curves that show how the flow and the depth of the San Pedro River changes. Every one of those shows some flow in the river. He doesn't ever show the river going dry in any of those graphs. He's said repeatedly that the San Pedro River in its entirety was perennial.

I would ask him then to explain why one of the foundational references in his Hydrologic Atlas shows areas of the San Pedro River without water. That Hydrologic Atlas shows pie charts with the ground water components including base flow, but there's no base flow component at the narrows and down near the confluence.

05:00:50 So I don't believe --

05:00:54 THE CHAIRMAN: Whoa, whoa, whoa, whoa. Help me out.

05:00:55 THE WITNESS: Sure.

05:00:55 THE CHAIRMAN: You say there's breaks in this line. Is that just because the dots are farther apart?

05:00:57 THE WITNESS: No.

05:01:00 THE CHAIRMAN: I'm missing the breaks.

05:01:01 THE WITNESS: Okay. I --

05:01:06 THE CHAIRMAN: Oh, okay. I found the breaks.

05:01:06 A. There is a -- for point of reference for the Commission, I -- I add a label that says San Pedro River. That's the only way I've really adulterated this figure. I pointed the label so you knew where the river was.

05:01:15 And then if you'd look, Chairman, shortly downstream of that, you see Cascabel -- it's a little hard to see. And then you see Redington. And there's a symbol which represents former wetland. And below that, the dotted line disappears. Then it comes back again where a channel comes in. Then it disappears again, comes back just a little bit before Mammoth, disappears yet again, and then comes back where Aravaipa Creek joins. And then from there down to the confluence, it's a dotted line.

05:01:54 So I don't believe, even though Mr. Hjalmarson has repeatedly said that all the evidence that he has

compiled indicates that the river is dry, I don't believe that that is supported by these --

Q. (By Mr. Hood) That it's --

A. -- statements.

Q. -- perennial?

A. That it's perennial. And I'd like to bring in the beavers again just because they're -- they've been on the stage a few times, but I'd like to bring them in one more time.

Mr. Hjalmarson, as I understood, was very adamant in Bisbee about the importance of beavers and Mr. Pattie's accounts as an indication that the river was perennial. He said, "Hey, there's beavers all up and down the river." One can conclude from that: "Hey, if there's beavers, that means it's perennial. They trapped all these beavers. That must mean that the whole river is perennial."

Well, I think that's a bit of a leap of faith. If you take a look at Pattie's document. And this is what Mr. Hjalmarson passed out to us in Bisbee. And you actually read what Pattie said about the San Pedro River. He never talks about the actual occurrence of water and flow in the river. He talks about the beaver. He doesn't talk about how often he saw water. I can read you some quotes.

"March 3rd, we trapped along down a small stream that empties into the Heelay," which is how he referred to it, "on the south side, having its head in the southwest direction. It being very remarkable for the number of its beavers, we gave it the name of Beaver River. At this place, we collected 200 skins and on the 10th continued to descend the Gila until the 20th when we turned back with as much furs as our beasts could pack."

I think it's interesting they weren't using the river to transport their furs. They had them on pack mules. But that's for another day perhaps. They do not talk about the occurrence of water on the river.

But I think what the real important thing to say on this topic is our good friend Tevis. Remember the guy I keep talking about who wrote the letter back to his parents about what he saw? Tevis also noted beaver going along the San Pedro River. But he, I think, directly challenges Mr. Hjalmarson's assumption that beaver equals full stream perennial flow.

And if I could once again read Tevis's account, I'd like you to think about what Tevis is saying regarding the relationship between beaver dams and flow conditions. Here's what Mr. Tevis says again. "The San Pedro River, as they call it, is a stream one foot deep, six feet wide, and runs a mile and a half an hour. And in ten minutes

fishing, we could catch as many fish as we could use. And about every five miles is a beaver dam. This is a great country for them, and we have went to the river and watered and it was running fine. And a half mile below the bed of the river would be as dry as the road. It sinks and rises again. And we went down as far as the Aravaipa, and eight miles below that the Pedro empties into the Gila River."

What Tevis is saying is: Wait a minute. He saw lots of beaver, but he also saw dry stream -- stretches of no flow.

Mr. Hjalmarson said: Wait a minute. Pattie says the river's got to be perennial because of all these beaver. But that directly is inconsistent with what Tevis is saying where Tevis saw both beaver, but he also saw the dry sections of the channel.

So I don't think that you can make a simple conclusion that the presence of beaver indicates that the whole reach of the San Pedro River is perennial. You simply can't do it unless you're going to explain to me why Tevis was seeing dry stretches and beavers at the same time. In a letter to his parents, where again I ask you how much bravado are you telling folks when you're saying a river is dry below a beaver dam. That doesn't seem very much like hyperbole to me.

Q. Mr. Burtell, The Ecology and Conservation of the San Pedro River, the report that we've referenced for several different topics, that also indicates that the flow was interrupted spatially and intermittent; is that correct?

A. Yes. And I'd like to -- and thanks for reminding me. There is a quote that I think would be of benefit to the Commission. And I promise I'm just about done reading things to you guys. You're probably very tired of hearing me talk. Hereford or Hereford, Hereford, I've been -- I have been told and corrected, and I appreciate it, that I've been mispronouncing Hereford. It's pronounced more like she, her, Hereford. Ironically this researcher, Hereford --

MR. SPARKS: Those are cattle, Hereford.

A. -- Hereford actually --

MR. SPARKS: Not sheep.

A. Just as a side note that I think the Commission might find entertaining is, Hereford, this researcher, is a descendant, as I understand the original people that settled the town of Hereford -- I can't even say it. I'm so used to saying it Hereford. So it is ironic that in his professional life he has become such a student and an expert in this area.

In this ecology report that was submitted by The

Center, on page -- their chapter is chapter 12. I would like to read you how they described the San Pedro River in their summary. I think even Mr. Hjalmarson would agree that Mr. -- Dr. Benticort and I think Mr. Hereford is also a doctor, although I'm not sure, are considered experts on the San Pedro River and certainly experts on geomorphology. Here is how they describe the San Pedro River.

THE CHAIRMAN: Page?

A. Page 249 of the document Ecology and Conservation, which again is a Center document. They say as follows:

"The historical records suggest that in the mid 19th century the San Pedro River was a continuously perennial stream from its source near Cananea to just beyond the narrows. Flow was interrupted, spatially intermittent in the lower reaches with the dry discontinuities outdistancing limited surface water flow from ground water outcroppings. Apparent discontinuous arroyos up to six meters deep at St. David, Tres Alamos, and below the narrows transitioned a short distance downstream into cienegas dammed by beaver. Mesquite thickets occupied dry and incised reaches while mostly treeless conditions characterize the unincised marshy floodplains particularly in the upper basin."

05:09:22 1 This is a document, again, submitted by The
05:09:25 2 Center by researchers in 2009 that, based on the
05:09:30 3 references and my understanding of that river system, have
05:09:34 4 spent a tremendous amount of time down there. They are
05:09:38 5 concluding that the San Pedro River was not perennial in
05:09:41 6 its entirety. And Mr. Hjalmarson's --
05:09:41 7 Q. (By Mr. Hood) And that conclusion underscores
05:09:44 8 that Mr. Hjalmarson's flow duration curves do not match
05:09:47 9 the reality as it existed in ordinary, natural conditions?
05:09:51 10 A. I'll repeat again. His premise in his flow
05:09:54 11 duration curves never show the San Pedro River running
05:09:57 12 dry. They assume that there is always flow from the
05:09:59 13 international border down to the confluence. These
05:10:03 14 various pieces of evidence, most which, if not all of
05:10:10 15 which, submitted by The Center contradict those
05:10:13 16 statements.
05:10:13 17 THE CHAIRMAN: Mr. Hood, help us out here.
05:10:15 18 MR. HOOD: We are down to our last topic. Mr.
05:10:19 19 Burtell, what do you think, ten minutes for the San Juan?
05:10:23 20 THE WITNESS: Yeah, that would be fine.
05:10:25 21 MR. HOOD: Probably have about ten minutes left.
05:10:26 22 So we're happy to go forward. Or do you want to stop? We
23 can pick it up first thing in the morning.
05:10:29 24 THE WITNESS: Right. Ten minutes is probably --
:29 25 I can do it in five.

THE CHAIRMAN: But he's not a lawyer.

MR. HOOD: I won't say anything, so we've got a shot.

THE CHAIRMAN: Let us proceed then. Is that all right?

THE WITNESS: I promise.

THE CHAIRMAN: Why does he get to go home with empty boxes?

MR. HOOD: I've got a lot of work ahead of me to get out of here.

A. One final thing I'd like the Commission to consider when it looks at the -- when it looks at the information that I've submitted, certainly the information that Mr. Hjalmarson has submitted, and as I understand information that Mr. Gookin will also be submitting, is other river systems in the western United States that have been deemed navigable or not navigable.

And what Mr. Hood is passing out to you now is a special master's report that was prepared in a case that I'm sure many of you are familiar with since it's, as I understand, it's a benchmark case related to the navigability issue that's referenced by counsel repeatedly. I'll just say again. You guys know it. I'm not an attorney, and I certainly didn't read this from the perspective of legal issues.

But what I did read it for was, Did the special master and ultimately the U.S. Supreme Court which approved the special master's findings, I believe, in their entirety, did he present factual information that can provide a guidepost, some guidelines for me as a hydrologist, as a scientist? Is there some information that the special master presents that can help me figure out, all right, hydrologist, you compiled all this technical data. Where does that lead us to the next step of a legal conclusion?

I'm not going to make a legal conclusion. It's not my place. But I certainly can benefit from the technical information that the special master used. This case U.S. versus Utah, as I understand it, which is the case, covered the three rivers in the state of Utah, the Grand River which is the portion of the current Colorado River above where it joins the Green River, covers that area. It covers the Green River. And it covers the San Juan River, all of which again are in the state of Utah.

And similar to what's here before us, the question was before the U.S. Supreme Court in this case was whether or not those river systems were navigable or not at the time of statehood. And Utah became a state earlier than us, but it provides some interesting parallels to our case where they looked at evidence of

navigation historically, stream flow conditions historically. What did they conclude?

So, again, I looked at this not so much for legal precedence but more to factual guidelines that could help me put my data from the San Pedro River and Mr. Hjalmarson's into context. What did they conclude?

They concluded that the Green River and the Grand River were navigable. When you look at -- and you have a copy of it -- the data that were compiled by the special master related to those rivers, he describes those rivers that he deemed were navigable had average flow depths on the order of three feet and greater over time. And the discharges are on the order of thousands of CFS. The San Juan River ironically was deemed not navigable.

And I say ironically because any of those of you that have been on the San Juan River would not -- would perhaps at least in comparison to the San Pedro River almost be surprised that we're having a conversation about the San Pedro River at least insofar as that the San Juan River was determined and approved by the U.S. Supreme Court as a non-navigable river that river is much broader, much deeper.

I am a big fan, thus the name of my company is called Plateau Resources. I love the Colorado Plateau. I go to the town of Moab a lot. Well, to get to the town of

Moab, what do you do? You drive up through and go through a little town called Mexican Hat. And just before you hit Mexican Hat, what do you do? You cross over the San Juan River. I've crossed over the San Juan River at all times of the year. Particularly, I've been there in the wintertime when it's cooler in Moab when there's no potential irrigation affecting the San Juan River. And you look down at that stream, and you say to yourself, Wow, for anyone to even try to compare the San Juan River to the San Pedro River is -- it doesn't seem like even a fair comparison.

It is a much deeper river. It's got much more CFS. The special master in this report talks about the physical conditions the San Juan River and how it led to the conclusion regarding navigability. And he talks about channel depths. And when I say channel depths, actual stream depths, on average being on the order of two and a half to three feet for more than half the time of the year is that the flow and those depths are greater than that. He deemed the river not navigable.

The discharges that the special master looked at in the San Juan River also typically more than 50 percent of the time the flows in the San Juan River are not tens or hundreds of CFS as we have in the San Pedro but thousands, between 1,000 and 2,000.

So we're talking about quite a difference, and that stream was deemed nonnavigable. So we can talk a lot about models. We can talk a lot about presumptions and whether data is good or not, et cetera. But I think it's valuable for the Commission to consider a case that went all the way up. Can't go up much higher, as I understand, to the U.S. Supreme Court where a river of the size, the discharge, the depth of the San Juan River was deemed non-navigable, I find it hard to assume based on those physical data that the special master determined that you could ever conclude that the San Pedro was. And that --

Q. (By Mr. Hood) We're done?

A. -- is what I have to say.

THE CHAIRMAN: Ms. Cardillo, you'll have tomorrow morning at 9:00.

MS. HERR-CARDILLO: Sounds great.

THE CHAIRMAN: Is there anybody who wants to prolong this? Let's go home.

(Hearing recessed at 5:18 p.m.)

STATE OF ARIZONA)
) ss.

COUNTY OF MARICOPA)

I, DEBORAH CLEARY, do hereby certify that the foregoing Transcript of Proceedings constitutes a true and accurate transcript of the proceedings held in the foregoing matter, all done to the best of my skill and ability.

DATED at Phoenix, Arizona, this 21st day of August, 2013.

Deborah Cleary, RPR/CR
Certified Reporter
Certificate No. 50663

San Pedro River Hearing Transcript August 2, 2013, Phoenix, Arizona

BEFORE THE ARIZONA NAVIGABLE STREAM

ADJUDICATION COMMISSION

In Re Determination of Navigability of the San Pedro River	)	No. 03-004-NAV

REPORTER'S TRANSCRIPT OF PROCEEDINGS

Phoenix, Arizona
August 2, 2013
9:00 a.m.

Reported by: Deborah Cleary, RPR/CR
Certified Reporter
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(ORIGINAL)

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** No exhibits were marked.

THE TRANSCRIPT OF PROCEEDINGS was taken on August 2, 2013, commencing at 9:00 a.m. at the Arizona State Capitol Building, 1700 W. Washington Street, Third Floor Conference Room, Phoenix, Arizona, before Deborah Cleary, RPR, CR, a Certified Reporter in the State of Arizona.

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08:38:51

08:38:51 P R O C E E D I N G S

08:59:32 THE CHAIRMAN: Good morning. We welcome you to the third day of testimony on the San Pedro River. The record will reflect the presence of all Commissioners, the attorney, Mr. Breedlove and George Mehnert. We are going to continue now with the cross-examination of Mr. Burtell by Ms. Herr-Cardillo.

09:00:10 MS. HERR-CARDILLO: Thank you, Mr. Chairman. With me today at the counsel table is Christopher Losi who is a practicing attorney in Arizona doing some volunteer work at the center. So he's got more of a science background. So you may see him pass me a few notes.

RICH BURTELL,

called as a expert herein was examined and testified as follows:

CROSS-EXAMINATION

BY MS. HERR-CARDILLO:

Q. Good morning, Mr. Burtell.

A. Good morning, Ms Herr-Cardillo. Am I pronouncing that correctly?

Q. Cardillo.

A. Cardillo. Herr-Cardillo.

Q. Well, it's actually Herr-Cardillo.

A. Herr, okay, like Hereford.

09:00:37 Q. Call me Joy.

09:00:39 A. That would be -- that would be wonderful. You can --

09:00:43 Q. I've spent 36 years trying to explain and spell that name. Doesn't get easier with time.

09:00:46 Okay. I wanted to talk with you about the declaration that you filed in this case and then also we'll get to your testimony yesterday.

09:00:50 First of all, I just want to clarify. I think I heard you correctly in your testimony. In preparing your declaration, you relied upon the Fuller report; correct?

09:00:55 A. That was one source that I looked at, yes.

09:01:00 Q. Okay. What other sources besides the Fuller report?

09:01:04 A. As I indicate in my declaration, I read the legal opinions, PPL Montana, and I read the Arizona Appeals decision, also read the Utah case, which we discussed yesterday.

09:01:07 And in addition to the Fuller report, I did other research, some of which came out of Mr. Hjalmarson's testimony, new references that I wasn't aware of before he presented his report, I think, shortly before the Bisbee hearing. So I looked at those references as well.

09:01:12 Q. And what references were those that you looked at as a result of Mr. Hjalmarson's report?

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A. I tried to look at -- with the time that I had, I believe that report came in about a week before the Bisbee hearing. So it didn't give me a lot of time to address everything he had in there. But I tried to look at most of his references.

And I think based on my testimony yesterday, as you could tell, many of his foundational references I looked at more closely and then had an opportunity to discuss with you folks yesterday.

Q. Okay. And between the time of the Bisbee hearing and when we reconvened yesterday, did you do any additional research?

A. Other than preparing based on the testimony that was presented in Bisbee, I'm finding with this case that the door never shuts. So as an expert, it's quite a challenge that the evidence just keeps coming in. And so at the Bisbee hearing, Mr. Hjalmarson, your expert, presented an additional document. I think Huckleberry was one that came into -- in mind. That wasn't one that was previously discussed, so I looked at that as well.

Q. What about historical research? Did you do any independent research into the history of the San Pedro?

A. I did. And I think yesterday was one example. Some of the references that were in Fuller, rather than just take the reference at face value, like your witness,

I went and actually got the books in which those references existed and was able to read them and put them into context, sometimes add dates. So, yes, I did independent historical research insofar as it helped to build on what Fuller already had. Fuller was a foundation --

Q. Okay.

A. -- for what I have.

Q. And did you -- did you find any historical documents that weren't already referenced in the Fuller report that you relied on?

A. Certainly one that was in my declaration that comes to mind was the Boundary Commission report, and I can refer to the page in my declaration --

Q. No. I --

A. -- if you insist.

Q. -- don't need --

A. But one of the things I looked at was above and beyond what Fuller had in the report, were there any other folks that passed through the area at the time that would have taken careful measurements and observations. And that Boundary Commission report was written in the mid 1890s. And so that, for example, is a piece of independent evidence that I looked at.

Q. Anything else that you can think of?

A. Can I look at my declaration to see --

Q. Of course.

A. -- if I'm -- if I'm overlooking anything? One thing in particular that comes to mind is the historic stream flow data, the USGS gage data. The Fuller report talked about that data, but I went back and looked at those records in more detail and was actually able to look at the notes that were related to those gauges and whether there were any diversions upstream.

Another example -- this happened to be, I believe, a reference that your witness also had -- was that map that I presented yesterday that showed the irrigation ditches that were mapped by the USGS in 1899.

Q. That's the Newell map?

A. Yes, the Newell map. I believe that was in the appendices of your expert report. Mr. Hjalmarson had that in his report.

Another -- another piece of information that I looked at were those military accounts. As I described in my declaration, and Fuller touches on the issues of how the military camps were supplied, but he didn't go into much detail. And so I found and I included in my declaration two attachments from books that were written on that subject. And you probably had an opportunity to look at those. There's a lot of history in those

documents.

Additional historical evidence would have been those maps that I looked at to rebut the claims made by the Senator regarding the San Pedro Lake. I might be forgetting a few others, but that certainly is a sampling of some of the additional work that I did above and beyond what was in the Fuller report.

Q. Okay. Did you do any modeling yourself?

A. No. No, I felt that it was not appropriate. Based on the amount of historic and other data that we had, I didn't feel it was necessary.

Q. You have expressed the opinion that the San Pedro was not navigable or susceptible to navigation. What is your definition of "navigable"?

A. My definition as a scientist or my definition as understanding what the case law says? I mean, it's a legal -- are you asking me what the legal definition is?

Q. I'm asking you what definition you're using when you offer the opinion that the San Pedro was not navigable?

A. I am -- I am giving the definition of navigability based on my reading of PPL Montana and the Arizona Appeals decision and which is in the Arizona Appeals decision and I could read it, if you would like, is the formal definition of what navigability is by

statute.

Q. And what is your understanding of the formal definition of what navigability is?

A. Can I read it?

Q. Do you have to read it?

A. Well, my understanding of the definition of navigability is it was whether or not the river was susceptible or actually used for commercial navigation at or prior to statehood under natural and ordinary conditions.

Q. So --

A. If I missed anything, please, I'm sure you'll correct me.

Q. Is it your understanding that the river in order to be navigable has to be susceptible of navigation year-round?

A. No, it does not have to be susceptible year-round.

Q. What percentage of the year is it your understanding the river has to be susceptible to navigation?

A. Based on my reading of the case law, I've never seen a percentage put out. And if you've seen a percentage, I would like to see it or I certainly would like to hear what that is.

I think what's more important is the definition says that the river would have to be susceptible to navigation commercially. And because commercially constitutes a business venture, then I suppose one could argue that the frequency of navigability somewhat depends on whether or not you could satisfactorily operate a commercial business.

Q. Is it your understanding that the entire river has to be navigable?

A. PPL Montana, I think, is clear on that issue regarding segmentation, that there are portions of the river that can be deemed navigable and portions that are deemed not navigable.

Q. What about obstacles? Is it your understanding that in order to be navigable, the river has to be free of all obstacles?

A. Certainly the case law is clear on that that some obstacles, if they don't overall defeat the purpose of meaningful navigation, then those obstacles can exist and it can still be navigable. But I think the key is is that if those obstacles as well as other factors in their entirety lend the river to being deemed not commercially viable and meaningful for navigation, then it's not.

Q. What is your understanding of "ordinary"?

A. The Arizona Appeals decision, as I recall, is

very specific as to the definition of what is both ordinary and what is natural. And unless I get them mixed up, I believe ordinary is absent droughts and flood events.

Q. And you know what's coming next. What's your understanding of "natural"?

A. Natural is absent -- and I'm paraphrasing of course, and I could read it if you wanted me to -- but absent manmade diversions.

Q. Just manmade diversions?

A. I believe so.

Q. Other impacts are not taken into account?

A. Well, natural conditions are absent impacts are affects by man. That's my understanding.

Q. Okay. So impacts as opposed to simply diversions?

A. Oh, I understand now your point. Yes, impacts. I would -- I would say that those impacts are primarily diversions as I read the Arizona Appeals decision.

Q. You've mentioned commercial travel --

A. Yes.

Q. -- a couple times. What's your understanding as to the requirement with respect to commercial travel?

A. Well, it's the definition of what commerce is. And my understanding based on reading the case law would

be that it would be an enterprise where you could make a living at it, that it's a business, that it's profitable.

Q. So is there any particular type of watercraft that is required to demonstrate commercial travel?

A. Well, certainly in the case law I looked at, a variety of watercraft could be used ultimately in a commercial practice.

Q. So could canoes be used for commercial purposes?

A. Well, I guess I would need to ask you a question in return is when you say a "canoe," are you talking about just a recreational canoe or are you talking about a canoe that's being used to transport goods and supplies in a commercial manner? So I guess you would need to tell me what type of canoe you're talking about.

Q. Well, I'm guess -- I'm asking if assuming a canoe is being used in a commercial venture, does that watercraft satisfy the criteria?

A. If it's being used in a commercial manner, yes.

Q. Okay.

A. That is true.

Q. What about --

A. Oh, and -- sorry to interrupt. And it would need to be a canoe being used in a commercial manner. And that canoe or that boat would need to be a type of boat that would be available for commerce on or before the time of

statehood.

Q. What about logs?

A. Logs as -- I don't unders -- I didn't understand your question.

Q. Would flotation of logs, in your opinion, be commercial use?

A. I've heard it referenced that logs have been considered in navigability cases, but I can't say whether or not the courts have deemed the transport of logs would or would not make a river navigable.

Q. You don't know of any instances of logs floating down the San Pedro, do you?

A. As I testified yesterday and I witnessed and I was there in August, I believe it was 2009, I saw some very large cottonwoods. I would however point out to you that those logs were not being transported in a commercial fashion. They were being transported in a flash flood.

Q. In your opinion, can recreational boating be considered a commercial activity?

A. That's an important topic, and I think PPL Montana was clear on that topic. PPL Montana talks about the use of recreational craft as to how it can potentially lead to navigability. One needs to look at that issue very carefully. And PPL Montana, I think, and as the Commission will also look at, is clear about what type of

boats are being used for recreation and whether those boats would even have been available at the time of statehood is an important consideration.

Q. But conceivably, assuming those other criteria were satisfied, could recreational boating be a commercial enterprise on a river?

A. Depending on the circumstances, that is a -- that is a possibility, yes.

Q. Is it your contention that the San Pedro was not in its natural condition in 1912 at the time and date of statehood for Arizona?

A. By the time of statehood in 1912 -- let me ask you, What part of the river are you referring to?

Q. At any -- any part of the river.

A. Based on the evidence that I presented in my declaration reported by the USGS, the upper portion of the San Pedro River, at least through the Charleston and Fairbanks area, there was minimal diversions in that area based on those records.

I contend that in those areas, the river was in its natural and ordinary condition. However, and as I presented in my testimony yesterday, that report that I presented from Walcott showed in 1899 a series of diversions starting at the St. David area and then going all the way down to Aravaipa. And obviously those are

manmade diversions. The USGS quantified how much water was being diverted. So in light of those diversions, I would say that at the St. David diversion and downstream at statehood that the river was not in its natural and ordinary condition.

Q. So let me just make sure I understand that.

A. Sure.

Q. At the St. David diversion and downstream at the time of statehood, it's your opinion it was not in its ordinary and natural condition?

A. Due to those diversions and my reading of the Arizona Appeals which include diversions as a potential impact from man, I would say that those diversions could be considered a impact from man that would perhaps be viewed by a court as indicating that it was not in its natural and ordinary condition.

Q. And upstream of St. David, your opinion is what?

A. Is that, as I just indicated, is that it was in its natural and ordinary condition in light of the fact that the diversions were minimal --

Q. Did you --

A. -- if that occurred at all.

Q. What diversions are you aware of upstream at the time of statehood?

A. Upstream of those -- of where?

09:16:58 Q. Well, you've said, I think, the breaking point
09:17:01 was the St. David diversion?
09:17:02 A. That's correct.
09:17:03 Q. So upstream of St. David.
09:17:05 A. My knowledge of the diversions upstream of St.
09:17:12 David at that time and before comes from the reports that
09:17:13 the USGS made regarding the diversions that were
09:17:18 potentially above those stream gauges.
09:17:21 And as I indicated yesterday, when the USGS
09:17:25 report stream flows, an important consideration for those
09:17:27 reviewing the records is whether those flows have any
09:17:30 effects from diversions upstream. And so the USGS reports
09:17:35 that in their notes that accompany their stream flow data.
09:17:38 Q. So did you make any effort -- do you know how --
09:17:43 what the quantity of upstream diversions were above the
09:17:47 St. David diversion?
09:17:48 A. What I -- the only thing that the USGS indicated
09:17:53 was the acreage. And based on my memory, and I can look
09:17:56 at my declaration, there was about 50 acres that they said
09:18:00 may have been irrigated above Charleston.
09:18:04 Q. And do you know how much water would be diverted
09:18:06 to irrigate 50 acres?
09:18:08 A. Well, you have to think then about 50 acres, what
09:18:12 type of crops were they growing? And I think it's
09:18:14 reasonable to assume that 4 acre feet per acre would not

be unrealistic. So you multiply the 50 by the 4 and you get about 200 acre feet. Then you have to think about the irrigation season. All that water isn't diverted over the same year or at the same time.

As Mr. Hjalmarson indicated, 720 acre feet is equal to 1 CFS. So if you've got a couple hundred acre feet that are being irrigated, that would be less than 1 CFS of water. So getting back to my numbers, similar to the cattle issue, if you take then my numbers and add 1 CFS, is that going to make a substantial difference in the navigability?

Q. And the 50 acres that were being irrigated that were leading to this diversion, do you know what those acres -- who was diverting that water? Do we know where it was being diverted?

A. No. And if it would help, I'll read you the quote which was in my table of what the USGS did say --

Q. Sure, if you want to.

A. -- about that, if that would benefit, if that would benefit you.

And it says, "Diversions above the station" -- and this was from the Charleston gage -- "reported in 1911 as" about 50 -- "about 50 acres irrigated."

Q. Okay.

A. So that's what they -- that's what they said.

09:19:42 Q. And do we know if that includes any irrigation
09:19:45 that might have been occurring in Mexico?
09:19:47 A. Regarding the issue of Mexico, it's good that you
09:19:51 asked that actually. In the notes for the Hereford
09:19:58 gage -- I think I pronounced it right that time -- they
09:20:01 actually address potential diversions in Mexico. And they
09:20:06 say, related to the Hereford gage, they say, "In 1931,
09:20:12 there were no diversions above the Palominas gage" -- now
09:20:15 the Palominas gage is even further upstream, as you know,
09:20:18 from the Hereford gage. It's closer to the border -- "in
09:20:21 Arizona and probably none in Mexico."
09:20:23 Q. So that was 1931?
09:20:24 A. That's in 1931, yes.
09:20:27 Q. So considerably past the time of statehood?
09:20:29 A. That's correct.
09:20:33 Q. And in fact, the 50 acres on the USGS note, what
09:20:40 date was that note made?
09:20:42 A. 1911. And I believe my flow records range from
09:20:48 19 -- let me see. I appreciate your patience with me
09:20:52 here. My memory isn't as good as it used to be. 1904
09:20:55 through 1912 were the gage data that I have for
09:20:59 Charleston. And in 1911, they reported that there was
09:21:02 none above -- that there was only 50 above in 1911.
09:21:05 Q. Okay. Did they report any diversions prior to
09:21:10 1911?

09:21:11 A. No. No, but one thing I would say that might
09:21:16 provide some further indication that there weren't any
09:21:19 substantial diversions upstream is Walcott's report, which
09:21:24 I just talked about, from 1899, which was earlier, didn't
09:21:28 have any diversions listed above St. David. And of course
09:21:32 St. David is downstream of Charleston. So there wasn't
09:21:35 any record of any diversions in 1899 above that period.
09:21:41 So when you put that together, I was not finding
09:21:45 in the evidence that I looked at any indication that there
09:21:47 was any substantial diversions. USGS reports and we have
09:21:50 the formal survey of diversion ditches along the San Pedro
09:21:54 in 1899 and nothing's above St. David.
09:21:58 Q. Okay.
09:21:58 A. If you're aware of any evidence that there was,
09:22:00 I'd certainly like to see it.
09:22:02 Q. You would have seen it by now, believe me. I
09:22:07 don't think there's a lack of evidence in this case.
09:22:09 A. No, but I mean if there's any evidence of
09:22:11 substantial diversions above those gages that you're aware
09:22:14 of or -- I don't believe Mr. Hjalmarson presented anything
09:22:17 on --
09:22:17 Q. No, I don't --
A. -- that topic.
09:22:18 Q. -- think he did.
09:22:19 A. So I would believe if he did and he would have

brought that to our attention since that would counter my evidence in my tables.

Q. Is there a time that you can identify when the entire San Pedro River was in its natural condition?

A. As indicated in my declaration and looking at several documents, many of which are documents that the center submitted, diversions of water from the San Pedro River for agricultural purposes started in earnest in the late 1860s and into the 1870s. And those diversions were largely to provide crops for the military bases that were there. And I discussed, as you know, at length yesterday about those military bases.

Q. So in answer to my question, is there a time period that you can identify where the San Pedro River was in its natural condition?

A. I apologize. I need to listen to your question more closely and answer it.

I would say that on or before 1870 would be a date where there was not substantial diversions. Now I will preface that by saying that it's not only before that time and all that period before that there was never any diversions from the river.

As we've talked about at length, the Spanish were in the area first and then followed by the Mexicans. And while they were there, they had ranches. And as I

understand, they were irrigating. So between the period when Fr. Kino first visited the area in the 1690s up to the 1820s and '30s when the Apache presence had become so strong in the area, it could be argued that during that period when the Mexican and Spanish had settled the area that there were diversions.

And I don't unders -- in all the records I've looked at -- and, again, I don't think Mr. Hjalmarson presented -- and Mr. McGinnis even asked him, I believe, Is there any record of how many acres were being irrigated during that period? And I don't believe he could report of any acreage. And I'm not aware of what that acreage is.

But the possibility exists that when the Spanish and Mexican settlers were there and they had their ranches that they were irrigating and they may have locally diverted water from the river that could have affected it.

But the point I think I would like to make is that later when the Apaches drove those settlers out and the area was largely abandoned it was just that, largely abandoned. And so there is that window when there wasn't diversions going on.

Q. And when is that window in your calculation?

A. The reports that I've read, including the documents that you've submitted, would suggest on the

order of the -- in the early 1800s that the Apaches had developed such a stronghold in the area. One of the reasons that I know the Apaches had established such a strong -- stronghold is the Indian villages that had been along the San Pedro River that Fr. Kino observed in 1690, those Indians fled to the Santa Cruz River. And I believe the date is in the 1760s that was in your ecological report.

So due to the Apache presence in that area, the Native Americans fled. And from what I understand, the Spanish fled thereafter. It was just too difficult for them to operate in the area. And that was observed by the American settlers that first passed through the area that observed these abandoned ranches and what was left of their cattle herds.

Q. You answer in one of my questions when I asked you if you could identify a natural condition, you said the diversions -- I think it was diversions. You might have said irrigation started in earnest. What -- can you quantify what you mean by "earnest"?

A. The only other -- and I reference this in my declaration. The only other irrigation that I was aware of in the 1800s was at the Tres Alamos area. It's in my -- it's in my table. And when the Mexican government had its Presidio in Tucson, because the Apache presence was so

strong in the area, they actually, as I understand the historic record, they had military troops from Tucson actually travel to Tres Alamos to protect the folks that were trying to irrigate in that area.

And obviously when the United States then got the territory from Mexico, the Presidio was removed. That military support was pulled out, and the area was left largely abandoned and then there was no longer any irrigation in that area. And I believe the reference -- and it was in Fuller and, in my declaration, was in the 1830s.

So I understand your question. And I apologize if it's a complicated answer. But you said, Well, when was it in its natural and ordinary condition. There's a lot of factors that need to be -- it's not a simple, Well, it was just a date. It depends on where you're at on the river, and it also depends on the time.

Q. So if I understand you correctly, when you're talking about -- I think it's -- did you include that information about the people being protected by the Presidio in your table 1?

A. Absolutely, yeah. Would you like me to refer to it?

Q. Yeah.

A. Sure.

Q. I just have to register a complaint on the font size here. I don't know who picked this font size. But for anybody who struggles with their eyesight, this was very --

A. Well, when I --

Q. -- difficult to read.

A. When I prepared the PDF of this, it is 11 by 17, so I guess --

Q. So blame the printer?

A. So I file a countercomplaint that you should have printed it out on a size where you could read it perhaps.

Q. I was provided this copy, but I did actually copy an enlarged version.

A. If you take a look at the middle San Pedro at Tres Alamos, you'll see this was, I believe, the only reference in this table which wasn't a direct quote from a historic explorer.

Q. Okay.

A. And I say that in my comments. And this is by officer who's a historian also referenced in Fuller. And I say in my comments, recent, 1980 description by officer of historic conditions at Tres Alamos.

And, again, he says: "Tucson settlers planted and harvested crops on the San Pedro at Tres Alamos. Because of the Apache menace, they were escorted to and

09:29:21 from their fields by Presidio soldiers." And that was
09:29:24 1830s.
09:29:26 Q. Okay. And when is it that you contend that
09:29:35 Indians left the area?
A. Well --
09:29:37 Q. The farming -- the farming Indians?
09:29:39 A. The farming Indians, the Sobaipuri. And if you
09:29:42 folks know how to pronounce that, please, somebody should
09:29:45 probably tell me if I'm pronouncing it wrong.
09:29:48 I believe in some research that I did -- and
09:29:51 don't have it in front of me, but I believe it was in the
09:29:55 1760s was when the Sobaipuri Indians fled the San Pedro
09:30:01 and went over into the Santa Cruz Valley due to the Apache
09:30:05 presence in the area.
09:30:09 Q. In the 1760s, you said?
09:30:11 A. 1760s, yes. Now after that period of time then,
09:30:14 the Spanish settled the area and developed their haciendas
09:30:19 and the ranches. And then from the Spanish, it went into
09:30:22 the Mexicans. And then from that period of time again up
09:30:25 through the 1830s at least, there was some irrigation.
09:30:27 But by the 1830s, as indicated, it took military people
09:30:32 from Tucson to protect the irrigation going on at Tres
09:30:37 Alamos. And then a decade later in the 1840s when the
09:30:41 first military folks started coming through, including
09:30:41 Cooke, they observed the area being abandoned.

09:30:46 Q. Did you make any attempt to measure the effects
09:30:53 that the diversions, the irrigation diversions, had on the
09:30:56 river at any point in time?
09:30:57 A. Fortunately I didn't have to because the historic
09:31:01 accounts that I used were in a time period when there
09:31:04 weren't diversions.
09:31:05 Q. So the answer is no?
09:31:06 A. That's correct.
Q. Did --
09:31:10 A. Sorry to interrupt. But I -- I -- just to
09:31:12 provide the Commission some explanation for your question,
09:31:15 the reason I did not was that there was not a need.
09:31:19 Q. Did you make any attempt to determine the effect
09:31:24 that the water use by the mines had on the river?
09:31:28 A. Well, I looked at a couple of things, one I
09:31:31 talked about yesterday, and that was -- a couple things I
09:31:35 mentioned yesterday was one of the documents that you
09:31:37 referenced, the biological report for the San Pedro,
09:31:42 talked about the Cananea mine.
09:31:45 And it talked about the fact that the diversions
09:31:49 of water to supply that mine largely came from the Rio
09:31:52 Sonora side with some possible diversions from the San
09:31:58 Pedro side. But the majority was from Cananea. So I
09:32:02 looked at that, and I think that was dispositive insofar
09:32:05 as the document that you referenced indicates that there

was little, if any, going on in the San Pedro.

But I think more importantly was the flow data that I presented yesterday and those base flows. And even though Mr. Hjalmarson implies that that possibility exists, that's frustrating for me as a scientist without actually presenting any data. It's easy to apply something, but is there any data to back that up?

And yesterday I heard from Mr. Hjalmarson based on several questions that he couldn't provide a quantification for what that was. And I'm sure if he could, he would have. I also could not find any reported data about how much the mines affected stream flows at that time.

I think a real proof in the pudding is those base flow data that I presented yesterday from the 1930s through 2003. And the reason I think those are important, Joy, is that because mining is a all year-round event, if mining was having an impact on the river and the Bisbee operations, for example, shut down in the '70s or '80s, there's no change in that base flow at Charleston which then lends the question of, If mining was having an impact on those base flows, where is the data to show it?

I'll just say as a last point to answer your question, Mr. Hjalmarson talked about the USGS's attempt with its flow models -- and as you know, there's been

numerous flow models that have been done in that area. And none of the researchers that I have seen have been able to calibrate and relate the pumping of water from those mines to the alluvial basin.

And believe me, with the attention that the San Pedro River and SPRNCA has had, they're trying to look at any possible impacts that could have occurred on those base flows. And they have been unable to relate that mining pumping to changes on base flow.

So I guess I turn it back over to you and to your expert. I haven't seen anything, and I'm not sure you folks have seen anything. And so to make an implication that there was is fine, but I just haven't seen any data.

Q. Did you request any data on how much water the mines were using from your client?

A. No. Well, because they aren't pumping anything now. Bisbee's abandoned, and my clients don't have any holdings in Tombstone, I don't believe. So -- and I don't think they own any property in Cananea, so...

Q. Do you recall seeing in Mr. Hjalmarson's Power Point slide 78 that showed where at the time the mining in Bisbee dropped off, the mining in Cananea increased?

A. Yes, sure.

Q. So --

A. In fact, he even talked about the fact that ore

was coming from Arizona and going into Mexico.

Q. So isn't it possible that the lack of an impact on the base flow as a result of the stoppage of mining in the Bisbee mine would have been offset by the increase, the simultaneous increase, of mining in --

A. But you're being --

Q. -- Cananea mine?

A. -- contradictory with your own expert's evidence because he talked at great length about the amount of mining that was occurring at Cananea starting in the 1890s, and he implied to the Commission that that was having an impact or could have had an impact on the river. But where was any of that impact from that earlier work at Cananea? There was no -- that base flow's been -- has been constant. So I'll just say again. Possibilities are good and should be discussed, but there's no -- there's no evidence of any change in base flow.

Q. I realize there's no evidence of any change in base flow. But there is evidence that actually at the same time the Bisbee mine decreased production, the Cananea mine exponentially increased production.

A. And that's -- and that's -- I don't disagree with you on that, but I'll get back to that document that you presented to the Commission indicating that the water source for the Cananea mine was largely coming from the

Rio Sonora side. So I would counter that by saying, Well, I could just as easily explain why there wasn't any effect in base flow because the water wasn't coming from the San Pedro basin to begin with.

Q. It wasn't entirely from the San Pedro basin is -- was the testimony; correct?

A. Right, it wasn't. And what I heard yesterday from your expert is he had no way of quantifying what, if any, effect was occurring in the San Pedro.

Q. Correct. But your suggestion that it would have no impact on the San Pedro is just as speculative; correct?

A. It's only as speculative as the fact that there is no flow data that shows it. And ultimately it's the base flow that would be the indication that there is an effect.

Q. But also because it's not clear where the water was coming from for the Cananea mine?

A. The document that you indicated indicated that the majority of it was coming from the Rio Sonora side, and I could -- I could read that if that would --

Q. But not en --

A. -- help.

Q. Not entirely?

A. They were not able to quantify it.

09:37:23 Q. To what extent did you consider the effects of
09:37:30 ground water pumping or ground water withdrawal on the San
09:37:34 Pedro River in your analysis?
09:37:35 A. It gets back to that base flow assessment. But
09:37:41 before I even get to that, I would say that the historic
09:37:46 accounts that I relied on from the 1840s and '50s were
09:37:50 before there were wells. In fact, some of the first wells
09:37:53 in Arizona were, as I discussed yesterday, were relate --
09:37:57 were a cause of that earthquake that caused springs to
09:38:02 bubble up in the St. David area.
09:38:04 And after those springs were seen bubbling up,
09:38:07 they started to drill artesian wells. And that was in the
09:38:13 1880s, I believe. So -- and that was downstream of my
09:38:16 Charleston gage data and my Fairbanks gage data. So
09:38:20 that's a long winded way of saying I didn't analyze it
09:38:24 because I didn't need to because the historic accounts
09:38:27 that I looked at were -- there were not wells at the time
09:38:30 in those areas.
09:38:31 Q. You talked about cattle yesterday and the feral
09:38:52 cattle?
A. Sure.
09:38:52 Q. And the fact that they died off. Can you refresh
09:38:56 my memory on the feral cattle?
09:38:58 A. I don't think I said that they died off.
09:39:02 Q. Okay.

A. What I did is I provided a quote from a fellow that led a group of cows from Texas over into California that went through the area in 1854, I believe, some eight years after Cooke went through the area and saw lots of cows, which I think was the basis of your expert's feeling that the area was overrun with cows.

In another one of the documents that you submitted, the Hendrickson and Minckley, they tried to explain, their words not mine, why the decrease in cattle observed by people passing through the area might have been -- might have occurred.

And I believe that document which you submitted said that it was either Apaches were rounding them up or they were rounded up and eaten by either the Mexican -- I'm sorry, the U.S. military folks going through or the 49ers as an explanation of why people weren't seeing these cattle when they went through after Cooke went through the area.

Q. Okay. So Cooke went through the area when?

A. 1846, as I recall.

Q. And he reported seeing the feral cattle?

A. Yes. And let me point out that it's not that there were no feral cattle in the 1850s and '60s, but the numbers, these vast herds, the 60,000 that I believe your expert referenced, Bell's words, not mine, "I did not see

the cattle that Cooke reported."

Q. Okay. And do you agree that cattle have an impact on a river?

A. When you say "impact," what do you mean by that?

Q. Impact, they --

A. No, no, no.

Q. -- impact the river.

A. Well, no, you -- affect how?

Q. Any way. In any way, shape, or form.

A. Well, as I described yesterday, they could impact the river in two ways. They could potentially increase the flow of the river if by grazing they cause more runoff to occur to enter into the river system. So in some regards, they could increase the flow of the river. Conversely, they could decrease the flow in the river by their direct consumption of water out of the river.

Q. So the impact of cattle isn't solely on water -- isn't solely water consumption?

A. It can be -- it could be either, sure.

Q. And in 1854, when Mr. Bell ran his herd up the San Pedro --

A. Sure.

Q. -- that was cattle on the river; right?

A. They passed through the river.

Q. Right.

A. Yeah, they passed through. I don't know how long they went along the river, sure.

Q. So they weren't feral cattle, but they were cows on the river?

A. Yeah, but he kept going. And so I see where you're going with this. And if you're trying to suggest, well, then my historic accounts wouldn't be accurate. Well, that would only be of concern, I guess, if the historic accounts were at the precise time when he was driving his cattle through the area and all of those cattle were immediately upstream of where a person is making a historic account.

Q. So is it your position that the presence of cows, if he ran cows up the river, that any impact that that herd had on the river would be completely transitory?

A. He went through the area in 1854. And if those cows, just like plants, are drinking water out of the river, when they've left, there's no longer a draw on the river. So the river returns to its natural course -- or returns to its natural flow, either base flow or runoff.

Q. Do the cattle eat the plants along the river, along the riparian areas?

A. They do. And actually that's another reason why cows can actually increase -- you could argue -- arguably increase the flow in the river because that vegetation

along the river is consuming water that otherwise feeds base flow. So if you've got herds of cows that are eating a lot of grass on base flow, enough to the point that it perhaps kills the grass and there's no longer transpiration occurring and that transpiration is occurring immediately adjacent to the river, I certainly wasn't going to argue this with Mr. Hjalmarson because even his worst estimate was only 2 CFS, but I could perhaps argue back the other way -- I'm not sure how easy it would to be to quantify -- that the potential loss of vegetation along the river due to cows grazing could have actually increased the flow.

Q. They would have impacted the river?

A. But in this case in a positive way. That is, there would have been more flow in the river leading to conclusions regarding the navigability that would have been -- that perhaps a river that wasn't natural or flowing in its natural and ordinary condition, there's actually more flow.

Q. But the river, once it's denuded by the cows, would no longer be in its natural condition; correct?

A. Well, I will think the point that needs to be made here is that the amount of potential impacts that the cows could have was never quantified by your expert in any way. None of the historic accounts that I looked at

09:44:24 talked about substantial herds of cows.

09:44:28 If you take those historic accounts and you add
09:44:31 onto those what potential impacts even your expert's
09:44:34 60,000 cows would have to increase the flows by a CFS
09:44:40 simply does not change any of the conclusions that those
09:44:43 experts came as to what they saw in the river.

09:44:46 Q. Was Mr. Bell the only one running cattle through
09:44:49 the San Pedro in 1854?

09:44:51 A. I'm not aware of --and I'm sure you're going to
09:44:58 tell me here in a second. I'm not aware of anyone else
09:44:59 that did that wrote a log about what they saw. The
09:45:02 possibility certainly exists. If there was a commercial
09:45:07 need to get cattle to California, it's not -- it wouldn't
09:45:10 be unreasonable to assume that maybe somebody else did
09:45:13 that as well. But I don't have any records of that, and
09:45:16 I'm not -- I don't -- haven't seen anything submitted.

09:45:19 Q. If you could look at Table 1 --

09:45:22 A. Sure.

09:45:23 Q. -- is it your position that at the time of all of
09:45:42 these observations that you've documented in Table 1 that
09:45:46 there were no diversions on the river at that time?

09:45:50 A. When you say diversions, can you clarify what you
09:45:58 mean by the word "diversion."

09:45:59 Q. Anybody taking water out of the river.

09:46:02 A. Anybody?

Q. Correct.

A. Meaning a human?

Q. Human impacts, no human diversions.

A. No human diversions. Well, I talked about the diversions that occurred at the time that the Presidio in Tucson was in operation in the 1830s. And my understanding of looking at these accounts is that there was no diversions, human diversions, occurring at the time that these accounts were made.

And in fact, Joy, I -- I was -- as you know, having read the Fuller report, there are many other historic accounts of flow conditions along the San Pedro River. And I purposely chose accounts from the time period when diversions were not occurring or that there was no record of any diversions occurring so one could indicate there wasn't any impacts.

Q. So your opinion that there were no diversions occurring at that time is based on the absence of any record of diversions?

A. Not just the absence of the records, but I think more importantly the accounts of the explorers that went through the area that indicated that they saw the area abandoned. That, to me, is the key is these very people that made these accounts talk about the fact that the area was abandoned. That, to me, was the driver.

09:47:36 And I would point out one final thing is the fact
09:47:39 that the military starting just before the civil war and
09:47:43 then thereafter established these military bases, that, to
09:47:46 me, Joy is even more evidence because the area was not
09:47:51 settleable because of the Apache presence in the area.
09:47:54 Q. If we could take a minute and turn to your
09:48:01 declaration, I think this was clear from your testimony.
09:48:20 But just to be clear, the work that you did for ADWR in
09:48:23 the adjudication section, did you ever do work related to
09:48:28 the ANSAC proceedings?
09:48:29 A. No. In fact, the only -- my only involvement
09:48:32 with ANSAC when I was at ADWR was -- that's when I first
09:48:37 got to know who George was and learned of the various
09:48:42 ANSAC reports, the Fuller reports, that had been prepared.
09:48:46 And because in my role in the adjudications and dealing
09:48:49 with water right issues which, as you know, are a little
09:48:52 different than adjudication of navigability, the Fuller
09:48:56 report, the many reports for those major water courses
09:48:59 have important information on -- on the history of the
09:49:02 rivers. And so I contacted Mr. Mehnert and got copies of
09:49:09 the various ANSAC reports. But as you know, ADWR had no
09:49:15 or has no role in the adjudication of navigability issues.
09:49:20 It's adjudication of water rights, a very distinct and
09:49:24 separate issue.
09:49:24 Q. Okay. In paragraph 10 of your declaration, you

state that State v ANSAC does not preclude the use of more recent evidence to assess the river's navigability. What evidence are you referring to there? What more recent evidence are you relying on?

A. The reason we -- I put that in there is that I present in Table 1, I believe -- Table 2 is less of a issue as to date because my latest stream flow date is 1912 and we became a state in February. So insofar as I have a few months of data in Table 2 post February statehood, that's of issue.

But Table 3 is data from the Hereford gage. And that data ranges from 1930 through 1922. So because I felt that that data was -- demonstrates non-navigability in the Hereford area, then it was important for me to remind the Commission that just because data is post statehood that you don't necessarily have to ignore it, that if it is of value to the Commission, then it should be presented, and that's why I did.

Q. Okay. In paragraph 11 of your declaration, you talk about dividing the river into three roughly equal reaches to organize your historic accounts?

A. Yeah.

Q. And you say: "Note that these reaches were selected for ease of discussion and are not an effort to divide the river into distinct hydrologic segments."

Do you believe the river should be divided into distinct hydrologic sections?

A. I think if you go to my very next paragraph I state that hopefully clearly. I say, In a June 8th, 2012 legal memorandum, the Arizona State Land Department recommends that the San Pedro River not be segmented for purposes of determining its navigability. I agree with that recommendation --

Q. Oh.

A. -- which is right in the very next paragraph.

Q. Yeah, yeah. Thank you. Sorry. So as far as you're concerned, the navigability of the San Pedro, it's all or nothing?

A. I wouldn't characterize it as, quote, "all or nothing." I would say based on my reading of PPL Montana, there is no need to segment the river as described in that U.S. Supreme Court case.

Q. In paragraph 13, are you suggesting that the beaver dams were responsible for intermittent and discontinuous flow conditions?

A. If you don't mind, let me read that to see why one might come to that conclusion.

Q. Okay.

A. No. Joy, what I'm saying -- and I apologize for any confusion it may have caused you or the Commission. I

was -- my first statement is a standalone statement regarding the beaver dams being an obstacle. The next sentence is not related to the beaver dams but another statement about a impediment to navigability related to the intermittent and discontinuous flows.

I would, however, point out to you that the account of Tevis that we talked about yesterday did discuss the fact that there were beaver dams and also intermittent reaches along the lower San Pedro. So having both is certainly reasonable and was observed.

Q. In your Table 2, you reference this in paragraph 15, you talk about the USGS essentially including data about diversions. Is it your contention that every diversion on the river has been accounted for by USGS in this data?

A. Yeah, I know we talked about this earlier, so I apologize if I'm repeating myself. But as I indicated, the -- when the USGS reports their stream flow data, they report diversions that they -- that they feel could affect their stream flow data. And that's what's presented here.

And as I mentioned earlier this morning, the map that I presented yesterday related to the diversion ditches, that the USGS maps start in 1899, including their diversions. The first diversion they had was at St. David. They did not map anything upstream.

09:54:52 So there's no evidence that I've seen, and I
09:54:55 don't believe that your experts presented unless I missed
09:54:58 it, that there were any diversions upstream that have been
09:55:00 reported.
09:55:00 Q. What about ground water pumping, any -- any
09:55:04 attempt in this table or by the USGS to account for ground
09:55:09 water pumping?
09:55:10 A. This gets back to the issue of the first wells in
09:55:13 the area were in the St. David area. And the USGS did not
09:55:19 discuss in here whether there was any wells that were
09:55:22 pumping. I'm not aware of and I'm not sure I've seen any
09:55:26 evidence of any wells that were operational upstream of
09:55:32 Charleston during this time period.
09:55:52 And if I could -- apologize for kind of adding
09:55:56 too much at times, but I'll go back again to particularly
09:55:59 the Hereford gage which was in the, right up through 1922,
09:56:06 the base flow data that I presented yesterday started in
09:56:10 1930 and went up through 2002. And, again, there was no
09:56:15 indication that that pumping was having any effect on the
09:56:20 river based on that constant base flow.
09:56:24 Q. In -- I'll find it here. In paragraph 22, you
09:56:42 talk about that you -- in your opinion, median flows
09:56:46 better reflect ordinary conditions than average flow
09:56:49 rates. Do you have any authoritative text or treatise
09:56:55 that supports that contention?

09:56:57 A. As I referenced in here, I referenced the State's
09:57:02 expert, which was Fuller. And Fuller made it clear -- in
09:57:11 fact, I believe if you take a look, if I could ask you
09:57:18 actually to look back on page 3 in my note number 16,
Fuller -- and these are Fuller's words, the State's expert
09:57:32 says: "According to Fuller, median flow rates are
09:57:32 probably best representative of typical flow conditions.
09:57:38 Floods with high peaks tend to skew the average."
09:57:38 Q. So that's the basis of -- you agree with Fuller,
09:57:40 and that's the basis of your opinion?
09:57:44 A. I don't disagree with -- as a hydrologist, I
09:57:46 certainly agree with his statement. And he was considered
09:57:50 an expert on behalf of the State. So I agree with his
09:57:54 opinion, and he feels that, and he is a respected
09:57:57 hydrologist.
09:57:58 Q. You talked about entrenchment a fair amount
09:58:05 yesterday. Is it your opinion that entrenchment on the
09:58:09 San Pedro was due entirely to natural causes?
09:58:12 A. Oh, I'd like to be very clear with you on this,
09:58:12 and I -- and I think it might even benefit, if possible,
09:58:20 to, if we have to, to reread what one of the documents
09:58:22 that you submitted where people have spent, I would argue,
09:58:26 their careers studying this issue.
09:58:31 The fellow Huckleberry that was a key valued
09:58:34 source for your expert made it clear that it is difficult

to relate human impacts to the entrenchment of the river and because entrenchment is a natural occurrence that that does not say that the possibility does not exist.

But what Huckleberry said very clearly -- and, again, this was somebody that your expert felt very strongly was a reputable source -- said that it is difficult to make any relationship between man's impacts and entrenchment.

Q. So my --

A. So I'll just get back to other questions that were posed by Mr. Hjalmarson. Speculation, again, I think, is valuable for people to explore topics so we make sure we don't forget any. But this issue about entrenchment, I believe very strongly, is a bit of a red herring. Mr. Hjalmarson, your expert, has continually contended that any entrenchment of the river is only a manmade process. And because of that, all these data that were collected have to be thrown out.

Unfortunately, the very scientist that he relies on to draw that conclusion cannot definitively state and says how difficult it is to try to relate impacts from man on the entrenchment.

Q. What is your opinion? Is the entrenchment on the San Pedro due entirely to natural causes?

A. I would say -- now when you say "entrenchment,"

what era of entrenchment are you referring to?

Q. In the mid 1800s.

A. In the mid 1800s, the 1850 period, my opinion very strongly is that there is no scientific evidence that I have read that would lead one to conclude that that entrenchment was anything other than natural.

Q. So your opinion is that it was entirely due to natural causes?

A. In the 1850s, yes.

Q. What about modern time entrenchment, more recent entrenchment?

A. I would rely on experts that have studied the issue. And I have not studied the issue as they have. Like your expert, I have to rely on other folks that have focused their attention on these issues.

I agree with Huckleberry's conclusion in 2009 in that document that The Center submitted that it is difficult to draw any direct relationship between man's impacts and the entrenchment that occurred in the late 1800s and the early 1900s and that I will also in addition say another chapter in that book that The Center submitted talked about the potential effect of the earthquake and that I'll then throw out a speculation as well that even though Mr. Hjalmarson, your expert, discounted that possibility out of -- just indicated that the earthquake

couldn't have had any effect, experts unlike he and myself that have spent quite a bit of time studying the area, they disagree that the earthquake could have had an effect. The earthquake is a natural condition.

Q. Does entrenchment affect navigability of a river?

A. Natural entrenchment?

Q. Any entrenchment, natural, unnatural.

A. Well, if -- if entrenchment is a natural condition of the river, I'm not sure why it would matter.

Q. On Table 2, we talked about it, but I just want to be clear. Is it your position that those gage readings on Table 2 represent flows of the San Pedro in the ordinary and natural condition?

A. Yes.

Q. Yesterday, you talked about a map, a USGS map, that was done by Brown and Others. And you criticized Mr. Hjalmarson for not relying upon the map by Brown and Others; correct?

A. I don't know if I would characterize it as criticizing. What I found interesting was that one of his major sources of data for his predevelopment model was Hydrologic Atlas 664. And one of the references in that Hydrologic Atlas 664 was the Brown and Others map.

And then I further said to the Commission that this is a piece of evidence that shows that the

calibration of Mr. Hjalmarson's model is not a good one. His flow duration curves indicate that the entire San Pedro River from the international border to the mouth was perennial at all times. A map that was referenced in one of his major data sources shows that it was not.

Q. Were you aware that the map prepared by Brown and Others predated the report you referred to? I'm going to refer to it as the Anderson-Freethey map that it was referenced in obviously. Brown predated it.

A. I don't know how you could write a document that has something referenced that hasn't been written yet.

Q. So the Brown and -- map done by Brown and Others --

A. Sure.

Q. -- was done by USGS; correct?

A. No. No. In fact, it was done by the Arizona Game and Fish Department. Brown was with Arizona Game and Fish.

Now it's Brown, Turner and Others. So if you look at the different authors, Brown was Arizona Game and Fish. I believe Turner was USGS, but it's not a USGS publication. And in fact I could check for you, but in the Hydrologic Atlas 664 where it's referenced --

Q. That hydrologic ass -- whatever that is, that 664, let's just refer to it as the Freethey,

Anderson-Freethey map. Okay?

A. Freethey and Anderson but yeah.

Q. Freethey -- is Freethey's name on it first?

A. Yes. I think Mr. Hjalmarson said it the other way around. But my understanding --

Q. I get it mixed up.

A. -- it's Freethey and Anderson.

Q. Okay. I'm better with names than numbers.

A. And that's 1986 as opposed --

Q. Right.

A. -- to the Brown and Others which was 1981.

Q. Okay. Were you aware that the Freethey-Anderson map was intended as a revision of the earlier Brown, that early -- the map done by Brown and Others?

A. I do not recall reading that in -- and, please, I would love to hear where you learned that because when I read the text that goes with the Hydrologic Atlas, there's four -- there's three sheets. And the third sheet is what has the San Pedro, but the first sheet has text. And it describes what reference sources they used to generate their map.

Nowhere in there did it say that the map was an update of Freethey and -- of Brown and Others.

Q. As to -- I should clarify. Just as to the San Pedro?

A. As to the San Pedro, yeah. It wasn't indicated in their Hydrologic Atlas that that was the case.

Q. Have you ever spoken with either Anderson or Freethey?

A. I believe Freethey has passed away, and Anderson used to work at the USGS in Tucson, but he's no longer here. So, no, I have not reached out to them and asked them.

Q. You had some criticisms of the modeling that was done by Mr. Hjalmarson. And one of the things that you said yesterday is you accused him of double counting 10 CFSes --

A. Cubic feet per second.

Q. Yeah, yeah.

A. CFS, yeah.

Q. CFS. I'm trying to figure out how to make that plural, but I guess it already is -- at the Charleston gage? And you base that criticism, as I understand it, on USGS gage readings at the Charleston gage; is that correct?

A. That's right.

Q. So you were looking at records that showed flow at the Charleston gage from 1930 to 2004; correct?

A. That's right. And the USGS, the data that your expert, Mr. Hjalmarson, used for the 10 CFS was

predevelopment stream flows. And he has a table, and he picked what he said was the lowest number.

As was discussed at length, those numbers came from ground water models. And the USGS considered 1940 to predevelopment flow. So that graph that I showed yesterday from the USGS was 1930 through 2003 or 4. So it actually had a period prior to the time period that the USGS said predevelopment stream flow conditions started.

Q. Okay. So if I recall your testimony, you said, looking at these gages, the water's still there.

A. Oh, no, I was -- well, I need to be very clear on this point. I said that during the winter months of January, February, March and April, the flow was 10 or 11 CFS. So the double counting -- I was very clear. The double counting occurred in those months when -- when the CFS currently, from 1930 all the way to 2004 or 5, was no different than the 10 CFS that was assumed during predevelopment.

I then went on to say that later in the year, starting in, if you look at those graphs -- and I can pull it back up -- starting in May and going into May, June, July, and the monsoon hits, those base flows decrease. And if you look at that USGS professional paper, they explain those decreases in flow due to vegetation, which I believe is a natural condition.

So if the vegetation is causing the flows to go down, that's a natural condition and shouldn't be something that one would have to correct for. But where the double counting occurs is the fact that Mr. Hjalmarson added the 10 CFS on top of the long-term average flow from that gage for its full period of records.

So when you add 10 CFS on top of the average for the full period of record, you're assuming that that 10 CFS is gone. And my point is it's not gone. That same 10 CFS is there in January, in February, in March, in April.

And when it starts to go down, USGS explanation for why it's going down is not pumpage. It's vegetation, which is a natural condition. So that's why I indicated that for those months when there wasn't any decrease in base flow, it's double counting.

And one further thing I'd like to point out that I didn't mention yesterday in my testimony is Krug, which was relied on by your expert, he adjusted the various stream gages for diversions when he did his analysis. He never adjusted the Charleston gage data. And it's in the Krug report. You'll see the Charleston gage data. He never adjusted it.

And so I would like to ask your expert, and maybe ask you, why the USGS would not have adjusted the Charleston gage data when they adjusted other gages. But

they adjusted the Charleston gage when they were specifically trying to adjust for diversions.

Q. You're aware, aren't you, that the San Pedro went dry in 2005 at the Charleston gage?

A. Absolutely. When I was at DWR, I worked on a white paper with the Upper San Pedro Partnership on that issue.

Q. And it ever since 2005 has really gone close to dry every year since?

A. Now, see, you've got to be very careful what you say there. And what I would like to point out is the "very close to dry" versus "dry," USGS and what we concluded in that study for the Upper San Pedro Partnership was the reason why it was going dry in June was due to the riparian vegetation. And this gets back to the issue of if there was pumping impacts on the river, why when the plants aren't transpiring water does the CFS go back up to 10 CFS? And if you're a student of the SPRNCA area, which I am, the agricultural pumping along the river is largely gone because now SPRNCA pretty much covers from the border all the way up to nearly St. David. So the base flows in the wintertime are flat. So if there was any pumping effects on the river, we're not seeing those.

Q. The base flows in the winter are flat, you're

saying?

A. Right.

Q. At 10 CFS?

A. From 1930 prior to the predevelopment period that was assumed by the USGS ground water modelers all the way up through 2004 or 5.

Q. So it's your position that ground water pumping has had no impact on the San Pedro?

A. I do not believe that the data that has been compiled to date shows that the pumping outside of the river corridor has had any effect. I certainly agree with the U.S. Geological Survey that before SPRNCA was obtained by the U.S. Government, there was a series of wells in that area that were owned by Tedaco, and those were irrigation wells. And during the summertime to irrigate those fields, they pumped.

And the USGS talks about in their report that during the summertime, the riparian vegetation has caused the decrease but earlier when the agricultural pumping in SPRNCA was occurring that some of the decreases in the summertime was caused by that agricultural pumping.

But then that agricultural pumping stopped since SPRNCA was established. And my concern about the double accounting is occurring at the times of year, the months when there's no agricul -- there was no historic

agricultural pumping along the San Pedro River. So he's double counting in my opinion for months like January, February, March, and April because there was no agricultural pumping occurring that would cause any flows in the river.

But he assumes that the base flow has disappeared because the 10 CFS is the predevelopment estimate by the USGS of base flow. So he continually and I'm hearing you say, "Well, how about the flow disappearing in June?" But it only disappears in the month of June. Joy, you have to look at all those other months of the year --

Q. So it's --

A. -- when there's not --

Q. Is it your position that the base flow of the San Pedro today is identical to what it was predevelopment?

A. I believe that the base flow in the San Pedro River has decreased as indicated in that USGS study. As to the cause of that decrease, the USGS feels that, and I would agree, that the increase in vegetation along the San Pedro River is the primary cause for that decrease in flow.

So I'm not saying that the base flow has not decreased in the San Pedro. I said it hasn't decreased in the months when the plants aren't transpiring. And that's clearly shown when you look at the data from 1930 to 2002

where you do not see a decrease in base flow. It's flat.

Q. So what is the difference today in the base flow in the San Pedro from predevelopment times?

A. If you look at that graph in that professional paper, I think the USGS has done a good job of trying to show since 1930, which was in their minds predevelopment, what those changes have occurred.

And I'll say again for the winter months starting in January and heading through April, I believe, is what they said, they have not seen any significant change in base flow. Starting in May and then going from May, June in particular when the vegetation starts to transpire, they have noted a change in base flow. They account for that base flow to two factors, vegetation increases along the San Pedro and, for the period in the '50s and '60s probably up through the '70s and early '80s before BLM obtained SPRNCA when there was a lot of irrigation going on, these Tedaco wells in the SPRNCA area.

They explained summer decreases in base flow due to that pumping. That pumping has since stopped. However, the base flow continued to decline. And the USGS has concluded that the continued decline of summer base flows is due to the continued increase in the vegetation.

So I'm not saying that base flow hasn't decreased. I'm saying it's not disappeared. Your expert

has assumed that it has disappeared because he added the full 10 CFS on top of his long-term record for the San Pedro. So I'm saying it has simply decreased in the summer months. But to assume that it has not only decreased but disappeared for the full 12 months out of the year is wrong. And that means in those months when it hasn't changed, he's double counting. He's adding base flow onto a system where the base flow hadn't already declined.

Q. Okay. You also took issue with the calculation that Mr. Hjalmarson used for the mouth, the 113 CFS?

A. Yes.

Q. Is it your contention that he should not have included data for all of the water that flows into the lower basin?

A. No. No, not at all. What I suggest is that for some reason, he chose to deal with the mouth differently than he chose to deal with the Charleston gage. The Charleston gage, as we've just been talking about, he took the long-term period of record for the Charleston gage, the 52 CFS. He added on top of that the 10 CFS which he said was base flow, and he assumed that that was the predevelopment flow at Charleston.

For some reason at the mouth, the USGS in that Krug report, they did the exercise for him. There is a

gage at the mouth. In that Krug report, they actually had their period of record and what the runoff was. And the USGS adjusted it for diversions as indicated in the notes to that table. But Mr. Hjalmarson ignored that. I don't understand why he ignored it. But the USGS has a gage that's no less than one mile from the mouth of the river.

His predevelopment model was based on Charleston at the narrows and at the mouth. So he ignored a gage whose flow data had already been adjusted by the USGS. And why it's significant or why at least I think Mr. Hjalmarson should have looked at it is the USGS adjusted flow at the mouth, adjusted for those diversions based on the area upstream of it, is 62 CFS. He, on the other hand, assumed at the mouth it was 113 CFS.

And he repeatedly told us and the Commission that every assumption in his model was conservative. I don't understand why he did not choose to use -- just like he did at Charleston, he took Charleston gage data and adjusted it there. Why would he not have taken the USGS's gage data from the mouth and used their adjusted data there? I just don't understand why --

Q. What is the basis for your contention that he didn't use the USGS data?

A. What he did is he explained to us what he did. He took the runoff from the cataloging unit upstream of

it, added it to the runoff from the cataloging stream below it which includes Winkleman down there, added it up and assumed that that was the runoff at the mouth. And my point is, Why not do it similar to how he did it at the Charleston? I'm not saying that he ignored the mouth data, but he ignored the corrected mouth gage data similar to how he used the Charleston. It's kind of like he's picking and choosing what he wants to do.

The Charleston gage data was also included in Krug unadjusted. He chose not to assume, like the USGS, that you didn't need to adjust it. So he went ahead and added 10 CFS onto it. And then when he gets down to the mouth, he ignores -- just like Charleston, he's got a gage with an adjusted flow data, but he chooses to not use it.

And I simply don't understand, Joy, why he chose to not use the specific gage data because he's trying in his predevelopment model to figure out what flow was at points in the river. And his most downstream point is the mouth of the river. And we've got a gage that's one mile upstream of that mouth where gage data has actually been measured by the USGS. And more importantly, they've adjusted that for diversions. And he did not use that gage data.

Q. So when he described in slides 85 through 87 of his Power Point where he --

10:21:02 A. Okay. Would you mind if I turned to those because otherwise I have --

10:21:03 Q. That'll be fine. That would be good.

10:21:04 A. -- I mean, I have a really hard time knowing what you're talking about. Thank you. Pages?

10:21:05 Q. 80 -- slides 85 and 87, so it'll probably --

10:21:18 A. Yes.

10:21:22 Q. -- be about half.

10:21:22 A. I'm there. Thank you.

10:21:23 Q. Okay. So he took the gage data or the data for the upper basin and adjusted for evotrans --

10:21:29 A. Evapotranspiration.

10:21:34 Q. -- evapotranspiration and then added that into the data for the lower portion of the basin. And you're saying that was incorrect for him to do that?

10:21:36 A. What I'm saying is that he did that exercise to ultimately come up with the flow at the mouth of the San Pedro River. His flow duration curve has a Charleston, the join area, and it says -- I believe his graphs say "the mouth."

10:21:44 My point is we have a USGS gage recording hard gage data one mile upstream of the mouth. Not only do we have that, but the USGS in Krug's report adjusts that data for the diversions. But even with all that said, he chooses not to use that. But he chooses to add runoff

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from an upper basin into a lower basin and then make an adjustment. I don't know why he needed to do any of that exercise when an adjusted gage was located one mile upstream from the mouth and his model wanted a predevelopment flow number at the mouth. And it was right in front of him.

I don't want to speculate as to why he didn't use that, but I will say that the adjusted runoff one mile upstream of the mouth is nearly half of what he assumed in his model, 62 CFS versus 113.

Q. You testified --

THE CHAIRMAN: Joy?

MS. HERR-CARDILLO: Yeah?

THE CHAIRMAN: Would this be an appropriate time to take a break?

MS. HERR-CARDILLO: Sure. Yeah.

THE CHAIRMAN: Thank you. We'll take 15 minutes. I'm sure you'll stretch it to 20.

(A recess ensued from 10:23 a.m. until 10:41 a.m.)

THE CHAIRMAN: We are ready to go again. The record will reflect the presence of all Commissioners, Mr. Breedlove, and Mr. Mehnert.

Joy, please proceed.

MS. HERR-CARDILLO: Okay.

Q. (By Ms. Herr-Cardillo) Mr. Burtell, at the outset of my questions, I asked you if you had done any modeling. And you said, no, because you didn't think it was necessary given the historic information that was available.

If there had not been historic data, would you have done modeling to attempt to determine the ordinary and natural condition of the San Pedro?

A. You know, I didn't -- I didn't consider it because there was the data.

Q. And you can't answer the hypothetical of what you would do in the absence of data?

A. Well, in the absence of data, probably the approach that one would take in a river system where there are diversions is that you would look at the current flow data that's available and add those diversions on. I would not have done it in the same manner that Mr. Hjalmarson did in his what I think is a somewhat convoluted model.

But I would focus more on stream flow gages where you have cross-sections. And if you have cross-sections there and you have stream flow data and you're aware that there is diversions upstream of any significance, then you could add those stream flow data onto the existing record and see if it results in conditions of navigability.

10:43:30 And I need to point out that the observations of
10:43:34 stream flow depth, which is ultimately what comes out of
10:43:37 Mr. Hjalmarson's model, out of all that he does, at the
10:43:40 end of the day, he's simply looking at depths as an
10:43:43 indication of navigability. And I think there's an error
10:43:47 in that -- and this is hopefully responding to your
10:43:53 question. I don't think depths are the only issue. I
10:43:57 think depths are an important issue, but there's other
10:44:01 factors that need to be taken into account. And his model
10:44:04 was focused on the depths.

10:44:05 I think that there are other techniques that you
10:44:07 can do hydrologically or hydrographically to try to figure
10:44:12 out what those depths were if you're aware of diversions.
10:44:17 But I'll just say again, the depths are one of many
10:44:20 factors that need to be looked at. And fortunately for, I
10:44:24 think, most of Arizona that there are -- there are
10:44:29 historic accounts all the way going back to Kino of river
10:44:34 conditions on the Gila, the Salt, the Verde. And Fuller
10:44:40 in his various reports had compiled that.

10:44:42 So I think the approach that needs to be taken is
10:44:45 that you carefully look at all of the data. But unlike
10:44:47 your expert, I think you have to be very careful about
10:44:51 just throwing data out because you make broad assumptions
10:44:55 that none of it is appropriate because it was affected by
10:45:02 man and not natural and ordinary.

Q. When you talk about depth, what is, in your opinion, the minimum depth to support a canoe in the river?

A. Well, I have to ask you when you mean by a canoe. Is this a canoe that is being used for recreational purposes? Is it a recent canoe? Is it an older canoe? Would it have been used on or before statehood for a commercial -- what -- I don't know --

Q. Canoe on or --

A. -- what you're asking.

Q. -- before statehood.

A. A canoe on or before. And for what purpose?

Q. To transport people, travel.

A. Well, apologize asking you. I know you're the attorney. You're supposed to ask me. But I just wanted to make sure I'm answering your question. Is that boat being used for commercial purposes?

Q. It's irrelevant --

A. No --

Q. -- for my question. For my question, it's irrelevant. What is the minimum amount of water? What's the draft for a canoe in your opinion?

A. Well, depending on -- if it is a -- according to Mr. Hjalmarson, if the canoe, if it's a recreational canoe, certainly more recent documents indicate that the

draft in his opinion is one foot. He referenced some federal documents that indicate a foot or a foot and a half might be suitable for floating a recreational boat. And that's a current recreational boat.

I don't believe that your expert presented any evidence of how much water a canoe would need at or before statehood. His references were all based on more recent documents. So to answer your question, I would turn to documents like the Utah case where the special master in that case looked at a variety of different boats on the river. And it was, as I discussed yesterday, the Grand, the Green, and the San Juan. And what they determined there, at least for the Grand and the Colorado, was that at least three feet of water was needed for commercial practices on those rivers.

And I think, as I indicated yesterday, I'm not a lawyer and I did not read this case law from a legal perspective. I looked at it from a perspective of guidelines on the factual information. And in that case, the San Juan River which typically has flows in the two and a half up to three was deemed not navigable. So in light of the boats that were available to people in Utah at the time, I would answer your question by saying probably on the order, and since that case was approved by the Supreme Court, I would say that probably on the order

of three feet and greater.

And I appreciate you letting me elaborate. I'll just say one further thing. The Colorado river, which was used for commercial navigation on or before statehood in Arizona, has that, those type of depths. The other streams in Arizona, my understanding, since there was not commercial navigation occurring on those, that it's unlikely that three feet of water was typical in those other rivers.

Q. How is it -- how do you distinguish between a canoe being used for recreation or commercial?

A. As I indicated -- and I think you asked me a similar question this morning. You asked me, Well, what constitutes commercial use? I think you're asking me the same question, and I'll try to respond as I did earlier this morning is commercial indicates that it's being used in a business setting, that whoever is operating the boat is using it to make some profit.

And I think that's an important distinction between a commercial enterprise and commercial navigation. And simply putting a canoe in some shallow backwater and fishing, I don't think that constitutes a commercial enterprise. I think a commercial enterprise has to be for the purpose of making a profit.

Q. What difference would the commercial nature of

the use -- what difference would it make in terms of the amount of water necessary to float a canoe?

A. I don't understand your question.

Q. Well, when I asked you -- I'm just following up because of the way this question was suggested to me by your answer.

A. Okay.

Q. I asked you how much water needs to be in a river for it to support a canoe in your opinion as of 1912. And you asked me commercial or recreational? What is the use? And I'm asking you, Why does that make a difference? You seem to think it made a difference.

A. Well, I think it makes a difference here because the issue before the Commission is the navigability. And you asked me, I think at the beginning of my testimony, what the definition of navigability is.

And commercial boat travel is a foundational and fundamental part of that definition. So we're kind of getting off, in my opinion at least, into hypotheticals about what it takes to float a canoe. It seems to me since the issue before the Commission is -- is commercial boat travel, that you need to, I think, ask me a question related to how much water does a commercial, a boat, a canoe, or some other boat need to practice commercial navigation.

Q. And your answer to that is?

A. Based at least on the case in Utah, in that case, the San Juan River which was determined to have typical flow depths of on the order of two and a half feet was deemed not navigable. The Green and the Colorado River, which typically have flows greater than three feet, was deemed navigable.

So insofar as depth is one, but not the only criteria necessary to ultimately conclude navigability, I understand the importance of depth as a criteria because certainly if you have a puddle of water just a few inches of water, I don't think any reasonable person could conclude under any circumstances that you could float any boat, let alone a boat used for commercial enterprises.

So I certainly understand the importance of depth. I certainly understand why your expert spent so much time on depth. But I think what's important is to not focus on the depth as much as what type of commercial boat travel are you practicing with the water that's available in your stream. So it's not a one or the other. It's not just, well, if there's a foot of water and you can float a boat on it that that means it's navigable.

I think, and I think you know, the issue is more complicated than that and it's more nuanced than that. And so my point is is if you're asking me how much water a

commercial boat needed to practice navigation on or before statehood in Arizona, I have to rely on due to this case law that's been before me -- and neither PPL Montana nor the Arizona Appeals gives us a number. Unless I missed it when I read the appeals decision, there's no depth that they say if there's that much water, then it's navigable. They understand, and I believe you understand, that it's a more complicated issue.

If you're just going to focus on depth though, I'll use a case where they looked at one factor which was depth. And, again, the San Juan River, two and a half feet of water, not navigable.

Q. I still -- I'm sorry. I --

A. Okay.

Q. -- promised I would try to get done before lunch. But I --

A. Sure.

Q. -- still didn't hear an answer to my question which is --

A. Okay.

Q. -- what is it about a commercial enterprise that influences how much draft a canoe would take?

A. Oh, well, I'm sorry if I -- if I -- I'm not trying to be evasive. When you are using a boat in a commercial purpose, then certainly there needs to be a

reliability of flow. If you're trying to make a business out of using a boat and, for example, in the San Pedro River where there are sections of river which have no flow, there are sections of the river where there are continued obstacles that would need to be overcome, then those factors do have an effect on whether or not the enterprise could be deemed commercial or not.

Q. Still didn't hear --

A. Okay. Please --

Q. Why is the boat heavier if it's being used for commercial purposes?

A. Well, certainly if -- certainly if you are trying to transport goods or supplies using a boat for commercial purposes, then certainly the load of the boat will likely be larger. And if you're doing this in a commercial practice, then whatever you're transporting, either the goods or the people, need to be done in an efficient manner so you can make some money on it.

So having the ability to maneuver that boat along a stream course and not lose whatever the load of your boat is, whether that load of the boat is people or goods, certainly is a factor.

Q. So it's not your contention that a commercial use of a boat has to involve carrying goods?

A. As I understand, it can be the transport of goods

and people.

Q. So if the commercial purpose is transporting people, there really wouldn't be a difference between a canoe being used commercially or a canoe being used recreationally in that instance; right? You're just going to have people in it?

A. I'm not sure how you can -- I'm not sure how -- can you restate that. I'm not sure how you can conclude that a boat that's being used for personal recreation purpose is the same as a boat that's being used for commercial purpose.

Q. In terms of draft?

A. In terms of draft? If draft is the only factor that you're considering, there might not be a difference.

Q. You've mentioned numerous times that you read PPL Montana and the Utah case and the Winkleman case.

A. I'm sorry. What was the last one?

Q. Winkleman, State v ANSAC?

A. Oh, I'm sorry. The appeals decision?

Q. Right. Right.

A. Okay.

Q. And I think you also mentioned Defenders versus Hall. Did you read Defenders versus Hall?

A. I did not.

Q. Any other cases that you've read?

A. No. I focused on those three cases.

Q. Going back to your testimony yesterday, you talked about how you attempted to test the validity of Mr. Hjalmarson's model?

A. Sure.

Q. And one of the ways that you described testing it was kind of comparing the model to data that you found in Appendix E, I believe, of the Fuller report; correct?

A. That's right, sure.

Q. Okay. And that data in Appendix E, when was that data obtained?

A. I can look. I believe it was 18 -- or 1980s and 1990s.

Q. And that data was extracted or -- is that the right word? Maybe not "extracted" -- deduced or whatever from the river in the 18 like 9 -- not 18. 1900s, right, because I think it starts in 1930. There's a range of -- but everything is before 1900 in Appendix E. If you need to check it, you can look.

A. No, no. Maybe I misspoke. No, I said that the data was from the 1980s and the 1990s, that stream flow data that was -- well, and --

Q. The stream flow data, and then there was also the channel --

A. Yes.

Q. -- cross-section?

A. Those channel cross-sections was 1980s and 1990s. I can give you the precise date --

Q. That's fine.

A. -- if you want.

Q. That's fine. So we're in the range? It's '80s and '90s is the --

A. 1980s, yes.

Q. 1980s --

A. Sure.

Q. -- and 1990s?

A. Sure.

Q. So essentially Mr. Hjalmarson's model which is attempting to predict what a river in a natural and ordinary condition, the San Pedro in its natural and ordinary condition, to test that model, you compared it to a river no longer in its natural and ordinary condition?

A. Oh, I want to be very clear as to what I did. I used among other things data from the Fuller's report regarding the cross-sections. Natural and ordinary conditions is related to, as we've talked about and you asked me, was related to diversions.

I did not use those cross-sections in the Fuller report for diversions. I used them for hard empirical

evidence of what the cross-section of the channel is regardless of how much diversions are occurring. So I was not using the data from the Fuller report from a flow perspective. And flow perspective is what relates to natural and ordinary condition, not the cross-section.

Q. But channel shape is affected by diversions; correct?

A. Could you explain to me how that is?

Q. Do you disagree?

A. I don't understand how diversions would change the geometry of a channel.

Q. So you are suggesting that all channels are uniform regardless of flow and diversions in a river --

A. I --

Q. -- over time?

A. No. I -- you've got to re -- have to restate that. I'm very confused --

Q. Okay. So the --

A. -- about what you're asking.

Q. -- cross-sections of the channel --

A. Yes.

Q. -- that are in Appendix E?

A. Yes.

Q. -- are of a modern channel of the San Pedro?

A. Right.

Q. Okay. And that river, that modern river, has been impacted by diversions and other human impacts; correct?

A. Well, the only impacts that I'm aware of that can be definitively affect -- or related to man is the diversions, the amount of water diverted out of the river. But I'm not -- I don't understand how actual diversions of water out of the river would change the channel cross-section.

What those cross-sections showed was the flow at various levels in the trail of cross-section. But I wasn't -- I didn't have any interest or concern about what the flow levels were and the amount of water diverted. I was more focused on the physical geometry of the channels and to show that the physical geometry of those channels are in no way the nice parabola that your expert used in his analysis.

Q. So the river, the channelized river in those cross-sections --

A. Yes.

Q. -- did not match what Mr. Hjalmarson predicted a river in its ordinary and natural conditions channel would look like?

A. I don't think, based on what I heard Mr. Hjalmarson say yesterday, he ever testified what the river

looked like cross-section wise in an ordinary and natural condition. All he said was that he used -- I mean, he was asked repeatedly that question. And all he said was that the channel cross-section that he assumed parabolic, he thought, is a good representation. But he was repeatedly asked on what evidence he was able to compare that cross-section to any data, and he indicated that he didn't have any data.

And so what I thought is a further check of his model is take a look at the channel the way it looks now. And you might argue, Well, entrenchment caused a change in the channel, and that entrenchment was caused my man. But I strongly would contend that I don't believe The Center nor your expert has in any way demonstrated that man was the only reason the river was entrenched because the entrenchment is a natural condition.

So if entrenchment is a natural condition, then it seemed to me that I should be able to use a cross-section the way it looks now or it did in the 18 -- 1980s and 1990s as a check against your expert's cross-section.

Q. You also checked against historic accounts that you've relied on; correct?

A. That's right.

Q. Now if those historic accounts were actually

11:01:54 describing a river that was not in its natural condition,
11:01:58 it wouldn't surprise you then that they would not be
11:02:01 consistent with Mr. Hjalmarson's model that attempted to
11:02:05 predict what the river would look like in its ordinary and
11:02:08 natural condition?
11:02:09 A. If that was the case. But as you might recall,
11:02:11 in my table, I specifically tried to evaluate the
11:02:14 potential impacts that occurred at that time and relate
11:02:23 those impacts and quantify those impacts and relate those
11:02:26 to those numbers. So I was very cognizant of the fact
11:02:29 that if I'm going to do that comparison, I need to make
11:02:31 sure that there isn't any substantial diversions that
11:02:34 would have affected those estimates.
11:02:36 Q. Okay. You talked about surveyors, and you
11:02:41 indicated that the surveyors actually measured high water
11:02:46 mark to high water mark?
11:02:49 A. That's right.
11:02:50 Q. Did you actually read the surveys?
11:02:52 A. I did. I've read -- unlike your expert, which
11:02:56 I'm not sure why he didn't do this, but you can go down to
11:02:59 the BLM office and they have those survey notes available
11:03:02 on microfiche and you can look through those.
11:03:06 Q. And did you see where it described measuring from
11:03:09 the left bank to the right bank?
11:03:11 A. What the survey notes -- the survey notes don't

say "ordinary high water mark." But what I did -- and I should have brought the reference with me, and I can provide it to my counsel to provide to you -- is studies that have been done on how the streams have been surveyed. The general land office surveyed streams over the years.

And there's been several survey manuals and guidelines that were used to give instruction to the surveyors as to how they're supposed to measure when they come across a stream. And what those documents indicate is that when the surveyors reached a stream, they were not measuring the wet water. They were measuring the water from bank to bank, the channel width.

And I believe, Joy, as a further indication that that's what they were doing is when I had -- when I tabulated these accounts, these -- these explorers that went through the area were very specific that the river was eight feet wide and so many inches or feet deep.

And I mentioned this yesterday. When you take those accounts of 8 feet wide and 12 feet wide and then compare them to what the surveyor channel widths were in the 1870s, and that's what your expert did, you find that they're talking in meters and their widths in meters are substantially larger than these widths in feet. So there's a disconnect going on.

Why is it that people that were along the river

no less than 20 years before the surveyors were out there and before major entrenchment occurred in the late 1890s and they're observing a stream that's only eight feet wide and the surveyors go out there 20 years later and they see that the stream also 30 or 40 feet wide, there's a disconnect going on here.

Q. So what is the timing on the surveys that you're referring to --

A. In the document --

Q. -- in meters?

A. In the document that you submitted in evidence -- and if I can pull that out, I can direct you to which I'm referring to. It's the Ecology and Conservation Report. And on page 234, Hereford and Betancourt -- it's getting easier for me to say it -- have a compilation of all of the channel widths in meters along the river. And what they did is it's an excellent summary because they have the different ages -- the different dates, I should say, that the surveyors crossed the river when they were doing their section surveys. And they have both the width and the depth of these channels.

And that's something else, Joy, that you should focus on is these depths. If you're going to believe this then -- I'll just give you an example. 15.8 we have as the width in meters and the depth is 4.6? So is The

Center suggesting that the depth of the water in the river is 4.6 meters? No. It's the depth of the channel and the width of the channel, not the active water in the channel. So that's the difference.

It's what these explorers were actually reporting as width of a live stream versus channel measurements, which is what the surveyors. And so what I said is that your expert was doing an apples-to-oranges comparison because he was trying to compare his stream depths to channel depths which are not comparable.

Q. And I think my question that you just answered or didn't answer is, When did those surveys occur --

A. Oh, I apologize.

Q. -- that you're referring to?

A. I apologize. I got all roped up. As I indicated, there is a range of dates starting, oh, the earliest I see here is in 1873. And then extending on up into early 1900s, and what Mr. Hjalmarson did, as I understand, in one of his slides I could try to find is he just selected the survey data from the 1870s and used that as a way of checking his width-discharge relationship.

Q. Did you read that survey, the one that he relied on?

A. Well, he relied on several, so I didn't look at every single one. So I wouldn't know if one of -- and he

didn't -- he would have to provide me more information because his graph just shows a series of points. So he's not telling me which survey it is. So if you could provide that to me, maybe I could check to see.

Q. Okay. I think you testified yesterday -- correct me if I'm wrong -- that the San Pedro had begun healing itself?

A. Yes, I -- I read, I believe that it was in this Ecology and Conservation Report, or maybe it's something else I had heard that the river has started to heal itself from that natural entrenchment that occurred in the late 1890s into the 1900s, that the river down cut due to that entrenchment, but since that time the meanders have resumed. Anyone -- and I'm sure you've probably spent some time on the San Pedro River, or if you haven't and you look at aerial photos, the meanders have returned.

And the talk about the original entrenchment cutting this deep trough, if you will, and all the water being funneled through that. Look at the San Pedro now, and it's meandering again. And that was another reason why I didn't think it was inappropriate to use those cross-sections from the 1980s and 1990s. They're not necessarily unrepresentative of the river.

Q. So is it your position that in its ordinary and natural condition, the San Pedro is a meandering river?

A. I think that's the danger that folks and Mr. Hjalmarson in particular have -- it's a trap that they have fallen into that the river is easily characterized as just meandering or otherwise. And as Hereford and Betancourt talk about, it's a much more complex system. There are areas naturally in their opinion, which I agree, which are meandering. There are areas which are entrenched under natural and ordinary conditions. But to broad brush and just say that the entire river is meandering is, I think, too simplistic.

Q. This is a kind of out-the-blue question, but I forgot to ask it.

A. Sure.

Q. When we were talking about the farmers in the early 1830s or early 1800s that had abandoned or, I guess, farmers or maybe it was Mexican farmers, Indian farmers that had abandoned their farms, do you know if the diversions were destroyed or if the diversions were left behind in place?

A. Well, the best evidence we have of that is the lack of any description of fields being irrigated when those explorers came through. So when those explorers came through the area in the 1840s and '50s and '60s, they talked about abandoned ranch houses, but they don't talk about any fields with crops that had been irrigated or

otherwise could be harvested. Now certainly folks that are traveling up the area that are looking for sources of food, I would have to speculate that if there was any fields that had any harvestable crops, they would have mentioned that, but I don't recall seeing anything about that.

Q. I'm not necessarily suggesting there were crops. But were diversion ditches still in place diverting water off the river? Were any, you know, things left behind if they -- you know, you're clearing out --

A. Sure. Sure.

Q. -- you know, there could be ditches.

A. Yeah, any -- any records that I have read about folks that irrigated along the San Pedro River starting in the 1870s, they all talk about, and even in modern days, people talk about how much maintenance is needed for irrigation ditches. And because of the floods, the summer floods that -- that -- the monsoonal floods that blow through the San Pedro, what's going to happen, and this is commonly reported by current irrigators, is the amount of cleanup work they have to do to get their irrigation ditches working again.

This was a time when there weren't concrete irrigation ditches and concrete head gates. So you would get large summer storms that are going to flood through

that area and likely destroy the head gate area and requiring them to go back and clean it out and rebuild it. If there's nobody there to do that, then there's not going to be water that's going to get diverted into these ditches.

Q. But you don't know one way or the other whether -- what the condition of the irrigation ditches were for these abandoned farms, if they even existed at all?

A. Based on what I've read and on what your expert presented, there is no hard evidence of any operating ditches at that time.

Q. When we were talking about the base flow of the San Pedro today --

A. Yes.

Q. -- and you indicated that the -- let me see if I'm saying this correctly. But it was vegetation that was causing a reduction in the base flow?

A. I said that was one of two factors.

Q. Okay. Has the vegetation changed over the course of history, the vegetation that's along the San Pedro?

A. Oh, undoubtedly. There is a book I didn't bring called "The Ribbon of Green" which is kind of considered the bible, if you will, on this topic about historic changes in vegetation, and it goes into great discussion about how vegetation has naturally changed along river

courses.

Q. So the vegetation that's impacting the base flow here today is most likely different from what vegetation would have occurred at the time, say, of statehood?

A. Yes. Certainly, the photograph -- there is photographic evidence that shows the San Pedro River with much less vegetation certainly within the SPRNCA area than there is now.

And it's discussed in this Ecology and Conservation document in some more detail in, I believe, other chapters which you didn't include that this is a natural progression that has followed the entrenchment of the river. The river became entrenched. And when it became entrenched, it lowered the water table locally and allowed vegetation like cottonwoods and willows to get a foothold and proliferate.

And certainly anyone who's been in the SPRNCA area knows just how prolific the vegetation has become. But it has definitely changed over time, and it's a natural changing of the system. It's -- the San Pedro River, again, I think there's a danger in people putting its conditions in a box and say, well, it's always this meandering river. It changes with time. It's dynamic. Or to use Mr. Hjalmarson's words, it's variable.

Q. You're a registered geologist?

A. That's correct.

Q. And do you have a professional seal?

A. I do.

Q. Why did you not put a seal on your declaration?

A. When you seal documents as a registered geologist, it has to be -- or it's required when you are discussing topics related to geology. And my focus of my report is hydrology, not geology. I don't discuss anything below the ground surface.

MS. HERR-CARDILLO: That's all I have.

THE CHAIRMAN: Thank you. Are there others who might wish to ask questions of the witness?

Do the Commissioners have any questions? Oh, Mr. Hood is stepping up.

MR. HOOD: I'll have just a very little redirect. Why don't you go first then.

THE CHAIRMAN: Please.

MR. MURPHY: I just have a few questions.

THE CHAIRMAN: Name on the record, please.

MR. MURPHY: Tom Murphy.

THE CHAIRMAN: For?

MR. MURPHY: Gila River Indian Community.

THE CHAIRMAN: There you go.

MR. BURTELL: And, Tom, I will just apologize that I referred to you as the Gila attorney probably about

20 times. And my poor memory with names is just rearing its ugly head. But I remember you were present in Bisbee and I should know better. So always should know what counsel's name are for better, for worse. So...

MR. MURPHY: I appreciate it.

CROSS-EXAMINATION

BY MR. MURPHY:

Q. I just want to ask you a few, I think, more general questions about research methodology.

A. Okay.

Q. Joy referred to modeling, but what we are really talking about with regard to what Mr. Hjalmarson attempted to do is developing a research methodology; right?

A. I think what he did is, even though he used bits and pieces of -- of research, ultimately his model was a pretty novel thing. Now I understand that he's used this in other areas for navigability purposes. In my professional practice, I have not come across how he used all those pieces together. So it seemed like a new approach to me. And quite frankly, it took me some time to figure out what he did. And the Bisbee hearing was critical because I was able to further understand some of those references.

Q. And I think as you indicated to the Commission,

11:17:06 the mathematical model in his presentation only gives depth; right?

A. He had two mathical -- two mathical -- mathematical models, excuse me, that I recall. One was a relationship between discharge and width. And then results of that got put into a broader equation, the so-called Manning's equation. The former equation was known as the Osterkamp equation. The latter equation is the so-called Manning's equation. And, again, both those are used in other settings. I had not seen it used in this setting.

Q. Okay.

A. So...

Q. And then the outcome of the second equation was to provide depth?

A. I'm sorry, Tom, yes, you're -- yes, ultimately the result of his model was to provide the Commission with his estimate of the frequency of depth at various points along the river.

Q. Now would it be fair to say that one principle of research methodology is validity?

A. I think it's important when you are trying to use a model which, again, is a means of simulating reality to always check to see how close that model is predicting reality. Calibration, I think, is critical.

Q. Sure. And you're kind of ahead of me, which is probably good, but if we were to -- if I said, let's develop an ideal methodology for determining the susceptibility of the San Pedro River to navigation, the ideal methodology would take into account flow rate; right? Is that accurate?

A. And, Tom, I apologize for asking. But just so I don't misunderstand subsequent questions, are we just talking about a model developed to look at flow depth or is this a more general model that might be used to --

Q. I'm talking more general --

A. -- try to figure out whether a stream is navigable or not?

Q. I'm talking more general.

A. A more general model would need to certainly consider flow and have that as one portion. And I think that's where Mr. Hjalmarson has focused his efforts was on depths. Of course, he's looking at maximum depth in this hypothetical channel. I hope I've done a fairly good job, but I'll let the Commission decide, of bringing to their attention, as others have, several other factors that you need to consider --

Q. Yes.

A. -- for navigability.

Q. And, again, I think you're getting ahead of me,

but I was going --

A. Sorry.

Q. -- list off some of the other factors that you might want to consider.

A. Okay. I should just shut up and let you -- all right.

Q. So that would include things like the slope of the river?

A. Yes.

Q. The shape of the river?

A. (Witness nods head.)

THE COURT REPORTER: Yes?

Q. (By Mr. Murphy) Is that a yes?

A. Oh, I'm sorry. You're asking me questions. I need to respond. Yes.

Q. The composition of the river bed?

A. Yes.

Q. The meanders?

A. Yes.

Q. Obstacles like the cienegas?

A. Yes. Oh, and if I can just say regarding the slope, in particular, as slope may cause rapids to form. But keep going with your list if you want.

Q. Beaver dams?

A. Beaver dams definitely would be something that

should be considered in any model.

Q. So if we're talking about just a, like I say, more general methodology on determining navigation, you would want to take all of those and maybe other factors into consideration?

A. And I think the best indication that all those other factors need to be considered is when I looked at the Utah case, the special master in that case did look at other factors. Depth was not the only criteria. But I'll say, as I've said to Ms. Herr-Cardillo, that certainly depth is an important consideration at the outset. If you only have a few inches of water, probably not.

And I think, if I'm not correct, please, Commissioners, tell me I'm wrong, but several stream courses in Arizona were quickly discarded as potential consideration for navigation due to, among other things, that there just wasn't enough water typically in the river to even consider it. So it's an important first step, but there's a lot that's got to be considered since -- or after that, so...

Q. Sure. Now the other thing, too, if you're developing a research methodology, ideally once you develop numbers from a model, you want to go out and field test; right?

A. I think any modeler is going to face severe

criticism if he or she develops a model that is only hypothetical and has no check to real data. I just think that that's a critical and important thing for people to do.

Some people develop models simply from a -- for a hypothetical almost thought exercise. This case is different. This model had a very -- that Mr. Hjalmarson developed -- had a very, very clear purpose, as I understand it. And that was to convince the Commissioners of the depth of the water in the river typically. And so when you're trying to use a model to come up with a very precise conclusion about something, to not try to calibrate it in a rigorous fashion casts a doubt over whether the model is valid.

Q. And ideally, I mean, that's the whole idea of making certain the model that you're using is measuring what you want it to measure?

A. Absolutely.

Q. And -- and from a theoretical standpoint here, I mean, it's -- it's, you know, for what the Court wants in State versus ANSAC is essentially for a decision to be based on a time when you would expect there to be no data; right?

A. Not necessarily. And I think certainly what my report shows is that you can look at existing data and

find periods of time in the San Pedro and I believe these other water courses that are before the Commission when the amount of diversion either was -- there was either no diversion or it was of such a minor amount that it would not have had an effect on the natural and ordinary conditions of flow, and thus you could use it.

Q. And as I understand what you did is you took the best available data and made comparisons of that data to what Mr. Hjalmarson found in his model?

A. I tried to -- and I'll let you and the Commissioners and others decide if I did a fair job. But I tried to look at all of the factors that could potentially affect navigability and try to lay those out, warts and all, good and bad, and let the Commission decide whether that -- and this is a legal term, but I've heard you guys use "preponderance of evidence." But is there -- when all that data is added together, does it lead to a conclusion that the river was, with any reasonable scientific certainty, was it navigable or not? So I hope that I provided some value to the Commission in that regard.

Q. Now if -- if -- you were just a few moments ago asked questions about the fact that some of the data you compared to were in more recent years?

A. Sure.

Q. If a comparison can't be made between, let's say, some data in Mr. Hjalmarson's model, I mean, is that really an indictment of what you did or is it just the incompleteness of his methodology?

A. I think it's more an incompleteness of his model. I -- I would have -- I would have had more confidence in Mr. Hjalmarson's model if he tried to use what existing data was available and checked that data against his model.

In the few cases where he did try to check, like width, the channel widths versus the stream widths, I feel strongly that it was an apples-to-oranges comparison. And so his quasi attempt to calibrate the model I don't even think was done in a rigorous way.

MR. MURPHY: Okay. Thank you.

THE WITNESS: Okay.

THE CHAIRMAN: Anyone other than Mr. Hood? Mr. Hood.

MR. HOOD: Thank you, Mr. Chairman. Sean Hood on behalf of Freeport McMoran.

REDIRECT EXAMINATION

BY MR. HOOD:

Q. I have just got a few follow-up questions for you, Mr. Burtell, and you'll be done for the day.

A. Thank you. Looking forward to being done.

Q. Every time I say anything about us getting done, I hear a lot of chuckles.

A. From that side of the room in particular.

Q. First thing, I'm going to try and just go down sort of chronologically the way that Ms. Herr-Cardillo went with you to try and keep some semblance of order.

A. Okay.

Q. The first, one of the first topics that she discussed with you was sort of the independent research that you did and some of the independent documents that you pulled together that supported your analysis in this case. Do you remember that discussion?

A. I do.

Q. And you mentioned several things. One of the things I didn't hear you mention, you did mention the 1899 diversion map. I didn't hear you mention the 1690s diversion map. Did someone else put this --

A. No. And I --

Q. -- in record previously?

A. And, you know, my memory isn't as good as it should be. But that was a piece of evidence that I had provided that I did not see in the Fuller report or anywhere in Mr. Hjalmarson's documents. Haven't looked at all of Mr. Gookin's documents. So whether or not he has

something like that, I'll find out when he gets his topics out here.

Q. Another document that I don't think --

THE CHAIRMAN: Mr. Hood, that document is part of your report?

THE WITNESS: No, it was sub -- I'll let you --

Q. (By Mr. Hood) You can answer.

A. It was not part of my declaration. It was submitted, I believe, into evidence into George during my testimony yesterday.

MR. HOOD: Right, and let me -- and thank you, Mr. Chairman, for correcting me. I should have been a little more clear on the title. It is "Indian Villages Identified Along the San Pedro River During the 1690s by Fr. Kino and Associates." And this was discussed at some length yesterday during Mr. Burtell's direct examination, and it is part of the record now.

THE CHAIRMAN: Okay. Thank you.

MR. HOOD: Thank you.

Q. (By Mr. Hood) There were some -- There were some questions and answers about ground water wells along the San Pedro and the earthquake that happened in the 1880s, I believe?

A. 1887.

Q. 1887?

A. Yeah.

Q. Now did those wells go in after the earthquake?

A. Yeah. And I apologize to the Commission if I was unclear. The earthquake, among its other effects, has caused fissures and caused these springs to bubble up in the St. David area. And the St. David area at that time was already in 1887 irrigating for -- to provide crops to Fort Huachuca. They saw all this water bubbling up from the ground. Knowing that water wasn't a terribly always certain thing to have down there, they thought to themselves, "Hey, there's probably some subterranean water sources," and they subsequently drilled wells. So the wells that I referred to were drilled after the earthquake.

Q. Okay.

A. Certainly not before.

Q. I think I misheard you somewhere along the way. And I thought I heard a causation discussion, and obviously that's not the case if the wells came in after the earthquake?

A. The earthquake insofar as it gave of the settlers of St. David a glimpse that there was a subterranean water source that they might want to tap into.

Q. I want to move next to this issue about the Freethey and Anderson plates which have also been referred

to several times as the USGS HHA 664 atlas --

A. Yeah.

Q. -- and its relationship to the Brown and Others 1979 map. Both of these sets of maps are in the record. Sheet 3 -- well, let me start first. You talked a little bit about the relationship between Brown and Others and Freethey and Anderson. Brown and Others preceded Freethey and Anderson?

A. Preceded, yes. It was -- there was a 1978 Brown and Carmody -- or Brown and Others. It's Brown, Carmody and Turner, I believe, are the three authors. There's a 1978 map and then a 1981 map. This Hydrologic Atlas is 1986. So the Brown and Others maps was referenced in the Freethey and Anderson map.

Q. And Ms. Herr-Cardillo asked you if it was your understanding that the Freethey and Anderson was an update of Brown and Others, and you said the notes don't reflect that?

A. In plate 1 of 3, which I have a copy if the Commission would like to see, and I read it carefully trying to understand how they were able to draw the lines that they did on the map. They specifically say that among the data sources that they used was the Brown and Others map. But they don't indicate, at least in their document, that that was any updating of -- at least in

this document. And I haven't seen it written anywhere else. Ms. Herr-Cardillo ref -- or indicated that might be the case, but I hadn't seen that.

Q. So am I -- so then if I understand you correctly, what is very clear is that Freethey and Anderson used Brown and Others as one of its foundational sources?

A. Yeah. And if I -- believe me, I will be quick. But I will just read into the record what they say. This is plate 1 of the Hydrologic Atlas. They're talking now about the ground water contours in the map.

And they say: "The contours were based on water level data obtained from reports and data files of the USGS and other agencies. Recent water level data were used for basins where development is minor and negligible. Data from the early 1900s to about 1940, which precedes the period of greatest development, were used for highly developed bases. In places water level contours were based on the location and altitude of perennial streams."

And then they reference, Brown and Others, 1981.

Q. Okay. And Brown and Others indicates that the San Pedro River is not a perennial stream?

A. It shows that it's a perennial stream in portions and not perennial in others prior --

Q. Discontinuous, portions that's intermittent?

A. Yes. Portions of it are intermittent.

Q. And then let's assume just for purposes of discussion that Freethey and Anderson was in fact an update of Brown and Others and that Freethey and Anderson maybe intended to change some things that are indicated in Brown and Others. Does Freethey and Anderson in any way support the notion that the San Pedro River was perennial throughout its entire reach?

A. What's confusing to me and was discussed yesterday and also down in Bisbee is that they have again these pie charts that represent the ground water inflow and outflow components. And base flow is one of the ground water outflow components. And when you look at the pie chart, if you will, which is the flow -- ground water flow components at the narrows area and near the mouth, there is no indication in those of any base flow.

So they, at least for those areas, indicate that there's no base flow in their ground water budget, if you will.

Q. If you don't have contribution from base flow, it's awfully hard to have a perennial stream?

A. In Arizona, that certainly is the case, yes.

Q. Let's turn also -- and just for the record, are you referring to plate 3 --

A. Now I'm refer --

Q. -- sheet 3?

A. Yeah, the pie charts I was referring to. Now I'm referring to plate 3.

Q. Okay. And sheet 3 or plate 3 also has -- and it depicts the San Pedro River. It has some markings here that are ground water contours; right?

A. Right. Those are the black lines.

Q. Okay. And Mr. Murphy covered this a little bit with Mr. Hjalmarson back in Bisbee, but I just want to make sure that everybody's clear. These are ground water contours. They are in no way an indication of an actual live stream?

A. The blue line is -- is -- is depicted as a perennial stream. But then, again, you look at these pie charts, and that's where the evidence of whether or not there's any base flow is presented.

Q. But the contours themselves --

A. No.

Q. -- those just relate to subterranean waters?

A. To ground waters, that's correct.

Q. So in your mind, are Brown and Others and Freethey and Anderson consistent in that they both reflect a stream that is not perennial throughout its entire reach?

A. Yes. And I would add onto that one more reference, and that was a document again that was prepared

by the -- prepared by a group and submitted by The Center, and that is Hereford and Betancourt -- Hereford described a river discontinuous flow prior to development that is consistent with the map that's in Brown and Others.

Q. Want to turn now briefly to the discussion of the gage data in Krug and the data that was, you said, I think you said, picked and choosed from among by Mr. Hjalmarson --

A. Yes.

Q. -- as he picked his data. You said it several times correctly. And so I think my next question is probably a reflection of my bad hearing in the back of the room. I thought at one time you clearly said that Krug did not adjust for the diversions at the Charleston gage. You said that several times?

A. That's correct.

Q. I thought one time maybe there was a double negative or a missing "not." So I just want to make sure the record's clear on that.

Was the stream flow gage data for Charleston in the Krug report, did they deem it necessary to make a change for diversions?

A. They determined that no correction was needed. And the way one can see that is by looking at the codes that were listed in Krug next to the numbers.

Q. There was after that, you and Ms. Herr-Cardillo discussed -- had a series of questions and answers relating to base flow, the base flow contribution to the stream.

And specifically in connection with the Charleston gage and this Trends in Stream Flow of the San Pedro River Southeastern Arizona and Regional Trends in Precipitation and Stream Flow in Southeastern Arizona and Southwestern New Mexico document which is professional page 1712, do you remember that line of discussion?

A. I do.

Q. Okay. And I just want to make sure that I understood what you were talking about. You were talking -- when you were talking about this document and the base flow and that during several months of the year it was 10, 11 CFS contribution to the stream, you were talking specifically about the Charleston gage and the upstream areas?

A. Absolutely. One should not infer that other areas of the San Pedro River certainly downstream of Charleston haven't gone through either vegetation increases and/or pumping that they have gone dry. But the focus of my discussion and the value, I believe, of that is how it describes the historic base flow at the Charleston gage and just to the Charleston gage.

11:36:56 Q. Towards the end of Ms. Herr-Cardillo's
11:37:04 cross-examination, she discussed your check of Mr.
11:37:13 Hjalmarson's equations against the real empirical data in
11:37:18 the Fuller report?
11:37:18 A. Yes.
11:37:19 Q. Okay. And what you did is you looked at examples
11:37:24 where we have actual width, discharge, and depth figures,
11:37:30 and you checked to see that these equations matched the
11:37:33 river?
11:37:33 A. Yes.
11:37:33 Q. Okay. Does the -- and Ms. Herr-Cardillo pointed
11:37:37 out that those data were from a period in the 20th
11:37:42 century, in the late 20th century?
11:37:43 A. That's correct.
11:37:45 Q. Does it matter for purposes of evaluating the
11:37:49 relationship between and among width, discharge, and depth
11:37:52 whether you're talking about a stream that's impacted by
11:37:55 diversions or not?
11:37:56 A. No. And in fact, the other thing that was
11:37:58 confusing to me with that line of questioning was that
11:38:02 nowhere did Mr. Hjalmarson indicate whether or not that --
11:38:06 in fact, he said several times that the equation was
11:38:08 accurate for different stream conditions and that that
11:38:12 width-discharge relationship is appropriate to use and
11:38:16 it's rigorous.

And yet when it's checked against some real data from the San Pedro River, it doesn't hold up very well. And so it just -- what he's trying to do is very difficult. And those equations result in generalized results that unfortunately don't match up very well with actual data from the field.

Q. If you pick a period of time, say, 1850, say, 1200 AD, a time when there's no active diversions, do you believe that the San Pedro River was a smooth parabola continuously down a stream -- down a stretch?

A. No. I -- and as I think as I responded to Ms. Herr-Cardillo's question, I think that's a real fallacy that maybe some people have regarding the San Pedro River is that over time or even spatially, so both spatially and temporally that it's a uniform system. It's a very complex system, and it's very dynamic and it changes with time. And among other things, that would pose challenge to commercial boat travel.

MR. HOOD: Mr. Chairman, that's all I have pending additional follow up --

THE CHAIRMAN: Yes.

MR. HOOD: -- if necessary.

THE CHAIRMAN: Joy, do you have any additional questions?

MS. HERR-CARDILLO: I'm done.

MR. HOOD: Then I'm done.

THE CHAIRMAN: You're leaving? Are you going?

MR. HENNESS: Be right back.

THE CHAIRMAN: You can go ahead and sit down. Do the Commissioners have any questions for Mr. Burtell? How about Mr. Breedlove?

MR. BREEDLOVE: No.

THE CHAIRMAN: I've got a couple of questions.

EXAMINATION

BY THE CHAIRMAN:

Q. Are you aware of evidence of travel on the waters of the San Pedro River in its ordinary condition?

A. No.

Q. That was a good quick answer.

A. Which is unusual for me. I know the attorneys are shaking their heads saying, For once he said one word in response.

Q. Are you aware of evidence of travel on the waters of the San Pedro River in its natural condition?

A. No.

Q. In your opinion --

A. And you said in its natural condition?

Q. Yes.

A. The only thing I have seen -- now are you saying

commercial boat travel or any travel, because Mr. Hjalmarson did have a picture as I recall of man in a canoe reportedly in the Charleston area floating down the river during a monsoon.

So there was a boat during the middle of a monsoonal flood. So that's the only thing that I've seen of anyone trying to float a boat down the San Pedro River under any circumstances, and that was a flood. So...

Q. And my question specifically excluded the term "commercial," did not include it.

A. Okay. All right. And actually your term also referred to natural and ordinary, and a flood would not be considered necessarily a natural or ordinary condition.

Q. And in your opinion, was the San Pedro River susceptible to travel in its ordinary condition at statehood?

A. No. I think there are several factors that suggest that it was not just actually but also not susceptible to navigation in its ordinary condition.

Q. And do you have the same opinion as to the San Pedro River with regards to its natural condition?

A. In its natural condition, I would have that same conclusion.

MR. BREEDLOVE: At statehood?

THE WITNESS: At or before statehood.

11:41:55 THE CHAIRMAN: For the record, that was Mr. Breedlove suggesting that. He's finally on the record.

11:42:04 Q. (By The Chairman) Have your opinions been based on distinguishing between ordinary and natural conditions on the San Pedro River?

11:42:22 A. Mr. Chairman, I didn't feel it necessary to distinguish but to consider both. My reading, and I think it's quite clear in the Arizona Appeals decision, is that you have to look at both. You have to look at both the navigability potential under natural and navigability possibility under ordinary. So it's a combined standard as I understand it. So I looked at both, which is probably all you really wanted as a response and whether I did or didn't. But I looked at both.

11:43:01 Q. Did you consider the terms "ordinary" and the term "natural" to be synonymous?

11:43:05 A. No. And I made that distinction following the definition that was provided in the appeals decision where they parenthetically after the words "ordinary" and parenthetically after "natural," they have several conditions or things that they use to further describe or define what "ordinary" and "natural" is.

11:43:29 Q. In doing your research and preparing your conclusions and coming to your opinions, did you refer to both the difference between "ordinary" and "natural"?

A. Yes, I looked at both conditions and the fact that they are different things. Maybe that's really what the question you're asking is. Ordinary conditions and natural conditions are different things. And I looked at them at different -- I looked at both of them separately to make my conclusions.

THE CHAIRMAN: Any other additional follow-up questions from anyone? If not, Mr. Burtell, you are excused.

THE WITNESS: Thank you.

THE CHAIRMAN: I believe we'll take our lunch break at this time in order to allow Mr. Gookin to set up.

Now it is the Chair's proposal that we reconvene at 12:30. That's 45 minutes, but I don't think we're traveling far. Those of you who were headed up to Macayo's, you're just not going to make it. Macayo's, you're just not going to make it. We are adjourned -- or we are recessed.

(A lunch recess ensued from 11:44 a.m. until 12:32 p.m.)

THE CHAIRMAN: Let the record reflect the presence of the Commissioners, Mr. Breedlove, and Mr. Mehnert.

Mr. Murphy, please take care of the necessary preliminaries for your witness.

ALLEN GOOKIN,

called as an expert herein was examined and testified as follows:

MR. MURPHY: Thank you, Mr. Chairman. Tom Murphy on behalf of the Gila River Indian Community. And I am introducing Allen Gookin on behalf of the Gila River Indian Community. And I believe he will be presenting more in the same manner as Mr. Hjalmarson did. So I'll just turn it over to...

MR. GOOKIN: What is on the screen is from Exhibit X008 called the Gookin Power Point Report, and it is slide 1. My name is Allen Gookin. I have qualifications. They are listed in Appendix C of my disclosure, so you can amuse yourself with them when you want.

The whole issue deals almost totally around two phrases. I'm sure you've seen them, "navigable in fact or susceptible of navigability" and "ordinary and natural as of the date of statehood."

THE CHAIRMAN: Thank you. Mr. Gookin, let me interrupt because I'm about to assign Mr. Murphy to make sure that the record shows which slides he is discussing each time.

MR. MURPHY: I will do that.

THE CHAIRMAN: Thank you.

MR. GOOKIN: Thank you. That was 2. Slide 3, first issue is "navigable in fact." There is only one historical instance that I could find where a boat was used on the San Pedro, and that was the Pattie beaver trapping. We don't know for a fact it was the San Pedro, but it reads like it probably was. He made a canoe. The reason they made a canoe was because they'd already lost one man who was on horseback who was swept away and drowned by the river. Based on that and the definitions of ordinary, that means the river was very, very high. It was at flood stage or very near to it. And so it would not be considered ordinary.

Slide 4, the Utah case suggests that if you didn't need boats and the fact you didn't use them is not a demonstration that it was not navigable. Mr. Burtell talked about the military requirements. I didn't think of that, but I looked at the mines. And the mines needed equipment and the ability to get the water -- or the ore out of Arizona so they could sell it. And they were using herculean efforts with 20 mule teams just like the borax commercial and so forth.

Their development was pretty limited until, slide 5, the railroad arrived. And the fact that they had at that point a good and reliable source of transportation is what really caused the increase in development in the San

Pedro region.

Slide 6, the second part of that test is, Was it susceptible of navigability? And that really leads us into the ordinary and natural as of the date of statehood.

As best I read the cases, "ordinary" primarily relates to flow. And it means it shouldn't be at flood flow. It shouldn't be in exceptional drought.

"Natural" I interpret as meaning I am the first human who's walked in the area on February 14th, 1912. What did it look like? What was the channel like? What was the vegetation and everything else?

Slide 7, I already talked about that. Going on to ordinary at slide 8, there is what's called the Freethey and Anderson map. This, Mr. Hjalmarson bragged about in Bisbee, was recognized by the Arizona Department of Water Resources as being a very important and accurate map. I just want to tell the rest of the story.

After they said that, there was a hearing by Special Master Shade who is the special master in the subflow adjudication. And on the screen is what he said about that map. Now it wasn't just that map. There was also a Fish and Wildlife Service and I think a third map. But they have limitations is my point. Freethey and Anderson is the basis for determining that it's perennial. Other sources disagree.

MR. MURPHY: Slide 9?

MR. GOOKIN: Slide 9. The Nature Conservancy District prepared slide 9. If you look at it, the blue represents areas that are now navigable. These areas right in here -- can you see the pointer? Okay. And over in here that are almost look like they were erased, they're shaded almost white, that's where the river was historically perennial. If you look in this area in the lower San Pedro and another couple areas in the lower San Pedro, you'll see there are reaches that were not perennial.

One of the reasons that there's the discrepancy that Mr. Hjalmarson talked about yesterday between some of the accounts, the railroad was coming in the upper San Pedro. The Butterfield stage coach that had observations was coming through near Tombstone, not at Tombstone, but pretty near it. The Boundary Commission, of course, was that down near the boundary. They didn't bother to walk 100 miles to the other end of the river to see what it was like there. That wasn't part of their job.

The other point I would just like to make in passing, the Charleston Tombstone gages are near where the Babocomari comes in, and there was very little development upstream of that in early history. The major development occurred between the Babocomari and what's called the

narrows in this area, (indicating). There was also some development in the lower San Pedro.

Slide 10, this has already been discussed. This is the map from Henderson (sic) and Minckley. I took the liberty of where he said it was ephemeral of highlighting it in red because it's very hard to see.

The ephemeral stream, I have to explain Henderson and Minckley call a river perennial or ephemeral. They had no categorization for intermittent. So maybe they really were ephemeral in that they only flowed a few days out of the year. I think it was more likely that they were intermittent, that they flowed seasonally. But we don't really know.

The reason I tend to believe these maps rather than the Freethey and Anderson map is first that the historic accounts support it.

MR. MURPHY: Slide 11.

MR. GOOKIN: Slide 11. Mr. Hjalmarson in 1988 wrote an article that -- in which he had an attachment. And he talked about what the flow of the river was, and there is the quote. There were several other observations and they are, again, in Appendix A where I had the quotes under the title Intermittent Flows.

Slide 12, this is a slide that caused a lot of problems during cross-examination by Joe, Mr. Sparks. I

was taught "average" means mean average, median average, mode average, geometric mean average, and probably some other things that I don't understand.

In the English common discussion when people say "average," they usually mean "mean." So I will try to use the term "mean average," but I'm bad. And if I say "average," I mean the mean. Median average and all this has been discussed at length. I won't go into it now.

Base flow is another issue that we will be talking about. And finally the base flow itself, which is an ill-defined term, is affected by where you measure it. And that's why the concept of where river gages are placed and why they were placed there become important.

Slide 13, base flow is the essence in answer to the question, "Why does a river flow when the snow is not melting and there's no runoff coming off the streams to the side from rainfall or anything?"

Most people never ask themselves that. The answer is the ground water comes up into the stream. They call it a seethe. Pimas call it a shone. Sometimes you'll also have springs coming in from the side. But it's all ground water.

The Tombstone report by Kennedy and Gungle, which distressed base flow as of Tombstone, provided numerous definitions. And that's why I say it's an ill-defined

term. Interestingly enough, Q90, which I've never heard used before, is not one of them in the USGS report. So I don't know where that term came from as a definition of base flow.

What I intend to talk about primarily, I think, will just be called low flow. And that is what's there on a normal day. Now a couple things on base flow. One is that if farming has occurred, the farming itself will increase the base flow. Yes, they divert some of it. But they create recharge through the fields. They often call it leaching, down into the ground water, which comes out as base flow assuming you don't have ground water wells.

Slide 14. Freethey and Anderson tell you that their map is not accurate or is not precise, I should say. It's a conceptual model. And the diagrams are there to estimate the magnitude. It's real good for telling you if it's 5,000 or 50,000 acre feet. It's not so good for 6,000 versus 5,000 acre feet.

This is the Freethey and Anderson map on slide 15. And in addition to what Mr. Bartell was talking about, I have a couple of other problems with it.

The graphs do have a slice, the pie charts, for stream base flow, but they also have one for perennial stream losses to the aquifer, which would mean base flow going into the ground because some base flow does go down.

It may or may not come up again depending on whether a plant or a ground water pumper catches it. The ground water pumper, of course, is not natural conditions.

At slide 16, if you look at this pie chart, there is none of that dark purple. That tells me that Mr. Freethey and Anderson, Messrs. Freethey and Anderson, believed there was zero base flow coming across the Mexican boundary. I don't think that is correct. I think that is inaccurate. But that is what the report would tend to be interpreted as. That is somewhat contradictory with the solid blue line which says there is base flow there. Generally speaking, I have found a bunch of problems and, as Shade pointed out, there are inaccuracies, inconsistencies, and other problems in this document.

The second one on slide 17 is the lower San Pedro. These pie charts and the numbers that are associated with it can be used to tell you the base flow, assuming it's accurate, at the boundary where the boundary of that basin crosses the river. The boundary is shown as kind of a pink thick line. Follow it around and you get to the mouth of the San Pedro.

The pink line, the inflow, is coming from the Gila River. It's coming down the San Pedro. It's coming from Mineral Creek. And the point of outflow on the

Freethey and Anderson map which is represented by the pie chart is at Kelvin on the Gila River. This map does not provide data sufficient to estimate the base flow at Winkelman or the mouth without some other source to break up those three rivers' contribution. I went through and made my own calculations, slide 18.

As I said, at Palominas, it was zero. Mr. Hjalmarson chose to ignore that report and pick his own. Now the way this base flow works is if it's base flow in one basin, you subtract the perennial recharge and then the rest continues on in the pie charts.

If you do this and put a new base flow in, it changes all your answers that follow. So I came up with 9 CFS in Charleston instead of 10. I have a mistake here. There's an asterisk from a different source. I got confused, and I just realized it yesterday. He has a -- Mr. Hjalmarson has a table from the Kennedy and Gungle report. He entered a number on a line opposite a different source, put an asterisk on it, and then references the Freethey and Anderson map in the asterisk. I got fooled, and I made a mistake. This number 10 is from his interpretation of the Freethey and Anderson map. At the mouth, of course, I can't come up with a number and I cannot see how he reasonably did.

Slide 19. In talking about base flow, and we're

talking about low flow, a study was made near the Tombstone gage, which is also fairly close to the Charleston gage, by the United States Geological Survey by Kennedy and Gungle.

And what they did is they had a methodology, and they determined how many days out of the year there was base flow and how much it was and other items. Blowing up the summary at the bottom, you can see that the number of days of base flow per year on the median -- in other words, 50 percent of the years had more days. 50 percent less. You'll get tired of hearing that -- is 207 days out of the year.

THE CHAIRMAN: Slide 19.

MR. GOOKIN: Thank you. The river also was dry 14.6 percent of the days out of the year. Finally, he makes -- they make a comment about the 25 percentile flow. What Kennedy and Gungle learned was that if you look at all the graphs of flow, at the 25 percentile, and you remember the floor duration, there's Q90. Q50 would be the median. Q25 is further to the left or, from where you're sitting, this way on the graph. That's where actual non-base flow runoff begins most of the time.

The values shown under the base flow show that the base flow varies from 3,860 to 5,400 acre feet per year. That's 5.4 CFS to 7.6. That is a depleted flow.

12:52:04 According to the chart contained in this report that Mr. Hjalmarson showed, the depletions at Tombstone were -- it depended on who you looked at -- but were about 4 CFS. That means the base flow varied from 9.4 to 11.6. And I'm giving more accuracy by these decimal points than is warranted by the data.

Slide 20. The big revelation is that the median and the base flow are the same thing on this river. That seems counterintuitive, the reason, most rivers, even in Arizona, have no melt. Snow melt is a slow discharge and it goes on usually for several months, and that helps to raise the median flow.

The San Pedro has virtually no snow melt. It's very far south, and the mountains aren't that high. The most significant flows are in response to direct precipitation. I went through all of the years and I picked a median year. I think you've heard what that means. It's the typical year. If you look at the graph, you can see -- I'm on slide --

MR. MURPHY: 21?

MR. GOOKIN: -- 21 -- that for most of the time, you can't tell the flow is there because of the scale of the graph in order to handle the one daily peak of 3,500. During the summer, you have about two months where there's some stream flow of varying degrees.

12:54:03 On slide 22, I blew that graph up so that the top
12:54:08 of the scale is only 50 CFS. You can see where the graph,
12:54:14 the tall monsoonal events go off the scale in the summer
12:54:21 for about a month and a half and briefly in late February
12:54:27 or early March. But most of the flow is below 10 CFS.
12:54:37 Now according to the Bureau of Reclamation, the depletion
12:54:44 at that period of time was probably on the order of 1 CFS.
12:54:48 So you'd want to add 1 CFS to what you're seeing. It's
12:54:53 not very much water.

12:54:58 Slide 23. This is the worst year of record,
12:55:07 2009. The depletion, again, according to Kennedy and
12:55:12 Gungle, was around 4 CFS at that point in time. As you
12:55:16 can see, even with 4 CFS added, there's only one day that
12:55:22 you get more than 20 CFS. This kind of event does have
12:55:27 implications in the ability of somebody to run a
12:55:30 commercial enterprise. If they were depending on any
12:55:34 flows, say, over 19 CFS, they're going to have to take the
12:55:42 year off, and most people cannot afford to do that.

12:55:48 Slide 24. I mentioned the gages. Now, first,
12:55:55 this map is backwards. It's how it was printed, but it
12:56:06 was very confusing to me. North is to the left. I'm used
12:56:09 to it either being up or to the right. So you've got to
12:56:12 reverse that in your mind. The -- this cross-section is
12:56:22 along the San Pedro, not explicitly, but generally along
12:56:26 the plane.

12:56:28 THE CHAIRMAN: Mr. Gookin, what's the source of this map?

12:56:30 MR. GOOKIN: This, the map source is from Dickinson, et al. at page 17.

12:56:32 THE CHAIRMAN: Thank you.

12:56:36 MR. GOOKIN: I might add on the source -- on the sources, if you look in my disclosure, below the Power Point slide I've tried to always list the source so that you can go look it up later.

12:56:46 The point on this map is that you have these rocks that come up near the surface. I call them rocks. They're bedrock. They're granite or schist or I don't know what. What one well driller called it was damn hard rock. And they force any ground water that is flowing down the river to come up to the surface. And that's base flow. But once you get past this barrier underground so that the water comes up, it can then start going down again. And so your base flow away from the gages will usually be less than the base flow at the gages. So the gages pretty much represent the best case scenario for base flow.

12:57:47 The reason they do that is because they can get more accurate measurements if there's less variability in how the channel bed moves and the geology tends to stabilize.

Slide 25. The second issue is, How do you get the mean average flow? Well, Mr. Hjalmarson used the Krug report, and that's been discussed somewhat. I didn't like it for several reasons. First, it deals with '51 to '80, 1951 to 1980. There was a lot of development there. There was ground water pumping. There were farms. There was -- cities were getting bigger. And as you can see, as you will see, we have a source that is closer in time to the period we're interested in.

The other problem was they tried to compute the virgin flow or undepleted flow at almost 6,000 stations. On 3,000 of those stations, they had to extrapolate and compute what the flow was for years when there was or there were no records. And they had about five years to do it. That's about six gaging stations per workday. That, by necessity, forced them to do this in a very cursory manner.

Slide 26. I chose instead to use the Bureau of Reclamation White Book. And excuse me. Let me jump back to talking about slide 25.

The other problem I had with it is I couldn't replicate the numbers that Mr. Hjalmarson came up with. I kept coming up with 63 CFS at Charleston, and I couldn't understand how it went up to 100 something at the mouth when they're almost the same place. I think you've heard

01:00:04 a lot about that.

01:00:05 The Bureau of Reclamation, and I'm back on slide
01:00:12 26, chose the period 1914 to '45. Well, that's a lot
01:00:17 closer to statehood. Also ground water pumping was very
01:00:22 small in that period. There was ground water development.
01:00:26 It was almost exclusively artesian flow. The San Pedro
01:00:36 River was very famous for a large artesian aquifer.

01:00:41 The vegetative changes that have occurred over
01:00:44 time on the rivers was not as extensive. I've mentioned
01:00:50 fewer human uses. And people back in the early '50s, late
01:00:56 '40s had more access to reports that had been destroyed by
01:01:01 today because we all know we get too much paper after a
01:01:06 while. And a lot of it goes -- used to be in the garbage
01:01:11 can, now in the shredder. They spent over 1,000,000 hours
01:01:16 in producing this book.

01:01:18 The Bureau of Reclamation, and I call it the
01:01:21 White Book because I have it in blue cover. It was
01:01:25 actually originally published in a white cover. And my
01:01:30 father who assisted on it always called it the White Book.
01:01:36 It accounts for the replacement of native vegetation.

01:01:41 Now what that means is if I go out on, say,
01:01:44 grassland and I tear it up and I start growing a crop,
01:01:48 that grassland used some water before. So the increase or
01:01:55 the depletion that I'm causing is the difference between
01:02:00 what I'm using now and what nature used before I started

my farming. And they took into account -- they computed how much the farmer is using and then subtracted from it the replacement of native vegetation. They also accounted for human-induced riparian vegetation change. And particularly what they were dealing with was the intrusion of salt cedar and other exotic plants on the rivers, and they accounted for that. They accounted for municipal and industrial use to the extent they deemed it appropriate. And they looked at the irrigated acreage on a year-by-year basis.

Now maybe because I was raised by an ex-Bureau of Reclamation employee instead of a USGS employee, I have more faith in those acreage data than I do the USGS. They're not in the business of computing irrigated acreage, and I found their values to not be as accurate as the Bureau of Reclamation was.

Now Mr. Hjalmarson pointed out that I got higher numbers with the White Book than he did. At several gages, that's true. The real reason for that was the period 1914 to about 1930 was moderately wet. There was a huge flood in 1941. If you jump to the 1950 period and on to '80, you're dealing with one of the worst droughts that we've ever had in the '50s. It's because I worried about that. I plotted against them each other, and I went, Why? It's because it was wetter in my period than it was in his

period because it rained more. Has nothing to do with development. The primary thing I was concerned about was their accounting for depletions so I could add it back in.

Slide 28 shows my conclusions. At Palominas, which is in essence the Mexican border, it's about 1.5 CFS. At Charleston, 1.4. At Mammoth, which is just upstream from where the Aravaipa joins the San Pedro River, it was up to 17.4 CFS. And by Winkleman, they said it was 21.8. And that's a cumulative number for the whole river.

The Winkleman unfortunately had no gage from 1914 to '45. They had developed those data, added them to other data to get the virgin flow at Kelvin on the Gila River. But I did have data for the three gages. Now in the case of Charleston and Palominas, allocating one point something CFS is very easy and has a trivial effect on these curves. You can't see it. The Palominas was tougher, and that's this graph in gray at the bottom. I'm on slide 29, if I haven't mentioned it.

You'll see that there's kind of a -- I'm sorry. Delete what I just said. It is slide 29.

It was Mammoth I had the problems, and that's in green. You can see a stairstep effect. When I looked at the historic records without depletion, I found that in the months of January and December when it's very unusual

that any would have been diverted, it was dry 27 percent of the time. In those two months, the flow was less than 5 CFS an additional 32 -- CF, percent of the time. So 59 percent of the time you're below 5 CFS. You were below 10 an additional 14. You were only over 10 27 percent of the time.

At first, I said, Let's just add that flat across, the 17.4. And I looked at it, and I frankly -- I didn't believe it. So I figured you wouldn't believe it.

What I did was I took the evapotranspiration data from a agricultural experimental station near the San Pedro River that was referenced. And I can't remember. I should have put a source. I did not. I'll have to provide that.

But it was, I believe -- I'm sorry. I just can't remember. It provided how much water a grass crop would use in each month. And I used that to proportion the loss because I figured whether it's grass or whatever it is, the vegetation is going to change in response to the climate. And that's what the grass crop was telling me is how the climate varied. And that's why you see this kind of stairstep. The various months create this.

I'm very confident of the gray and the blue charts. I'm less confident of the lower. And I think it probably had more of a slope like Charleston did. But

that's a feel, not a professional opinion.

Slide 30. Once we know what the flow duration is, we know what the flow is. The flow in hydrology is called Q. I never know why, but it is normally called Q. Equation 2 is from Mr. Hjalmarson's report. It's a variation on what's called the Manning's equation, very commonly, probably the most commonly used equation in surface hydrology.

This is a weird derivation of it. And the real odd part, it's accurate but it's kind of odd because you see this 0.67d? The 0.67 gets us back to the parabolic curve or channel. The parabolic channel is the basis that was used to derive that factor. The same source that Mr. Hjalmarson used to get 0.67 says it should be 1.0 if the channel is rectangular. That makes a big difference in the depth. I'm sure many of you were stuck taking algebra, and I'm sure many of you way back when had the experience of sitting there and deriving and calculating and computing and ending up proving 1 equaled 1 or, worse, 1 equals 2.

Well, I kind of did that with this equation, and then I finally realized, no, that's stupid. If this variable changes to 1 and everything else stays the same, d would have to go to 0.67 because these two terms together, if you're saying the depth is one foot, has to

01:10:24 equal 0.67. And that gives you an idea of how much impact
01:10:29 it makes.
01:10:31 Where Mr. Hjalmarson said a river was one and a
01:10:34 half feet deep at a certain point over a certain flow, in
01:10:41 reality, if it was a rectangular channel, which I intend
01:10:47 to show, it would only be one foot deep because the
01:10:50 rectangular channel is got more cross-sectional area for a
01:10:58 given depth.
01:10:59 As a result of this equation, we have to learn
01:11:05 three things to use it. One is the soils and the
01:11:09 vegetation that are in the channel. And that is called N
01:11:11 or Manning's N.
THE COURT REPORTER: Or what?
01:11:19 MR. GOOKIN: Manning's, M-a-n-n-i-n-g, apostrophe
01:11:21 s, N.
01:11:24 The second thing is the slope of the channel.
01:11:27 And the third thing, which I've already talked about some,
01:11:30 but you'll hear a lot more about, is the shape of the
01:11:33 channel.
01:11:37 Slide 31. First, let's start with the soils. As
01:11:51 you know, Mr. Hjalmarson assumed it was medium silty clay.
01:11:52 He had no basis for that, no soil surveys, no field
01:11:56 investigations. He just said it's ordinary and natural.
01:12:02 Therefore, that's what all streams have in ordinary and
01:12:05 natural conditions.

He did comment in Bisbee that geomorphology or the ground left behind records that we could look at. Many here have heard of the subflow trials. This document was prepared by the Arizona Geological Survey and included in the ADWR 2009 report and was the subject of a lot of discussion in those trials.

The Arizona Geological Survey did a whole bunch of field work and came up with this generic cross-section to show the surface geology. The pre-entrenchment alluvium, what was left over from where the river used to run, after it entrenched, it left some of the old alluvium. And that they termed QY2R.

In addition, in 1924, shortly after statehood, there was a soils survey done in the Benson area by the United -- or the Bureau of Soils. And the Bureau of Soils called these pre-entrenchment soils fine sandy loam, silt loam, fine sand, and silty.

MR. MURPHY: And you're on slide 32?

MR. GOOKIN: I'm on slide 32.

MR. MURPHY: Thank you.

MR. GOOKIN: These were explained as being the soils adjacent to the entrenchment channel. So they'd be the leftovers from the pre-entrenchment period. The Arizona Geological Survey basically said, You're going to have a whole bunch of stuff. But you notice clay does not

appear in any of this, and there's a reason for this.

This area is also called the saturated floodplain Holocene alluvium. And the courts have already ruled that this saturated floodplain Holocene alluvium is the subflow zone. We're still fighting on a whole bunch of details, and that trial is going, if possible, slower than your hearings. The --

This area was picked because it has very high well yields. People who drill in this area get high well yields and it connects with the stream very rapidly. This is because this area has been washed, rewashed, and rewashed by nature over the last 10, 12,000 years. And so it's got a high permeability, ability to transmit water.

If you have clay in it, that acts like a glue and it's kind of like you take a glass of ice and you pour glue in it, let it set and said: Go ahead. Have a drink. You're not going to get much.

So we know from the findings of the courts under Goodfarb and the Arizona Supreme Court and others that this saturated floodplain Holocene alluvium has very little clay. Now certainly there will be lenses of it and there's the cienega areas. But the water moves primarily in response to the open areas which exist throughout.

After the entrenchment, well, the Arizona Geological Survey called that QY3R, slide 33 for the

record, QY4R and QYCR. That they described as sand, gravels, cobbles, and boulders which is a long ways from silty clay.

At slide 34, this is a picture of what the ground looked like in 1964. And you can see -- where's my cursor -- the sand and the rocks that existed at that time. As I will be testifying, this is all natural channel. I agree with Mr. Burtell. The entrenchment and everything that followed was the result of natural processes, not human processes.

They did a cropping sample. They took the soil, and they put it in sieves and they got a distribution. According to Mr. Osterkamp in his 1980 report, which created the equations that Hjalmarson used, the majority or at least 31 percent of the soil must be above 0.062 millimeters. I don't know why that got picked, but that's what the soil scientists have picked. That would be right about here. Now --

Q. You're on slide 36?

A. I'm on slide 36, yes. At the bottom end of the curve, it's clearly less than 10 percent. So this cross-section at least did not meet the assumed basis for the equation.

Slide 37. The USGS went out and they took samples and drew cross-sect -- or cross-sectional data for

three sets of 18 cross-sections. And this one, they really plotted all the stuff up real neat, so I didn't have to do the work. So that's the one I picked to display. Part of what they did was they sieved the soil to see how it broke up. Now they have boulders, cobbles, pebbles, gravels, sand. I'm assuming the silt included the clay because if you're doing it with sieves, they both will fall through that sieve.

If you look at these, you can see they are radically different. Yet these six different sets of soils occurred in a distance of 400 meters which is roughly one quarter of a mile. You had that kind of variety in one-fourth of a mile.

The other way to look at this, on slide 38, what did people out there see in the early times? Well, you go back to 1849, they saw it running over rocks. 1854, you had sand, sand, sand, sand, sand, going all the way up to 1901, which is when I stopped. There's lots of sand.

So that tells me both from the soils report, the Arizona Geological Survey, the cross-sections that were taken by the USGS and historic observations that it was not silty clay and has not been silty clay for as far back as we can find.

Slide 39, slope. Mr. Hjalmarson assumed two slopes, one for the upper basin, one for the lower basin.

And they were, if I remember, 0.0021 and 0.0024. And that's from memory. I could be off a little, but they were very similar.

As you can see, in reality, the slopes vary a lot more. That's going to make your answers vary a lot more. Some will be shallower. Some will be steeper.

One of the reasons for this, slide 40, was that Mr. Hjalmarson assumed that the sinuosity was 1.5. Sinuosity, as you look at the record, and it snakes all over. You measure along the river, and you divide it by the distance it covered as the crow flies, so to speak.

Now we have one piece of historic testimony I could find, and it said 2.0 is the sinuosity. It's not a scientific study. It's just an observation. But if it was 1.5, Mr. Leopold, who created the channel geometry method, explained that the sinuosity is the boundary between a mean -- got a typo. It should be between the meandering and the braided, I believe. Which would put it on the edge right here. It should be on this slide. Yet if you see --

MR. MURPHY: And that's slide 41?

MR. GOOKIN: 41. I was working it into the sentence eventually.

On slide 41, that he has the information down there. You should be consistent in developing your

information. And the fact that it's on the boundary for braided to meandering, if he is correct, that means that definitely some of the river would have been braided because no river holds an exact sinuosity all the way. This was proved on slide 42 when Leenhouts measured the sinuosities -- and this is in the second column. And they varied from a low of 1.13 to a high of 1.65.

And one theme I'm just going to have throughout this. The concept that one cross-section can define a river is wrong, just flat wrong. I don't care what the cross-section is. The San Pedro is 140 miles long. You saw the variety in soils in one quarter of a mile. This slope occurred -- or is just for a portion of the San Pedro in the riparian national conservation area. It's not the entire San Pedro. That means you're going to have different conditions throughout the San Pedro.

There is another thing in regard to slopes. The values I've told you are general kind of more average slopes. But rivers have something called riffles, and riffles have rocks.

Riffles are very common. Mr. Hjalmarson tried to say that in the ordinary and natural condition, there might a few little riffles here and there, but they're no big deal. Well, riffles occur throughout the world and are associated with meandering streams and straight

streams. The only streams that don't have riffles are braided streams or what I call superbraided. They're called -- and I can't even pronounce it, anatocid or something like that. They're really crazy braided streams and not too relevant here.

The riffles have dramatically different slopes, and they have different soil structures. It's called the pool-riffle system, and it's very, very common.

THE CHAIRMAN: The slide we just left is?

MR. GOOKIN: 44 -- 3 and I'm moving to 44. These are -- and Mr. Hjalmarson is correct. They're illustrations, cartoons, if you prefer. But they show the concept of the pool-riffle system. A river will have a steep slope, and it will usually be very rough. Some cases, it's called rapids. It depends a lot on how much water is going through it. Then you'll have a very flat area where it's fairly deep, fairly tranquil, and very easy to navigate. And then you're going to have another riffle. This is, I thought, a better illustration.

MR. MURPHY: Slide 45?

MR. GOOKIN: I'm on slide 45 -- that this is, excuse me, a step which is a subpart of a riffle. You have a lot of rocks at a riffle. And what happens is those rocks perform natural veget -- or natural processes of oxygenating and a whole bunch of things that are useful

for rivers, but they're hard to traverse. And in order to get down them, you're going to need a lot of water to cover those rocks up.

Slide 47 -- 6, 46 shows an example. The study that was done at three sets of cross-sections or three groups of cross-sections by Beaulieu -- and I'm probably mispronouncing that -- they did one plot to show the slopes which is the channel bottom down on the bottom and then they also measured the water surface.

In a whole bunch of places, they found riffles. And this is probably the most extreme. This is the most extreme on this set of six. They didn't graph the others, and I thought this would suffice. They did a total of 54 cross-sections in three groups of 18, one at Hereford or near Hereford, one near Highway 90, and one near Charleston.

In the Hereford area, they found eight cross-sections that were riffles out of 18. In the Highway 90 area, they found seven cross-sections that were riffles out of 18. In the Charleston area, they found nine section -- cross-sections that were riffles out of 18.

In fairness, they made an effort for every -- should go back. They'd take, let's say, Hereford or Charleston or whatever, and they would do three sets of

six very close together near that gage. They tried to place those sets of six so there would be a change between a pool and riffle. So they're trying to make sure there was at least one. So it is a distorted sample, but it tells us there are a lot of them. Yes, this is more modern, but as Mr. Burtell says, and I agree, this is a natural channel. The water in it may be different, but it's a natural channel.

Slide 47 is a picture that I found of a riffle. I don't know if it's the same riffle as what I showed you on the cross -- on the graph, but it is a riffle. And you can picture trying to go down that in a canoe. And it creates quite a challenge. And it creates a need for a considerable amount of water to get through it.

Finally there's channel --

THE CHAIRMAN: Mr. Gookin, I think -- are you almost done?

MR. GOOKIN: I wish I were. I'm halfway.

THE CHAIRMAN: Okay. We're going to take a five-minute break.

MR. GOOKIN: Okay.

(A recess ensued from 1:29 p.m. until 1:37 p.m.)

THE CHAIRMAN: For the record, all Commissioners are present. Mr. Breedlove is present, and so is Mr. Mehnert.

Mr. Gookin, please continue.

MR. GOOKIN: Thank you. I'm jumping back to slide 9 just to correct one apparent misstatement. I refer to some of these reaches as navigable. I meant perennial. And if you look at the legend, that is what the legend says.

THE CHAIRMAN: We accept your apology.

MR. GOOKIN: Thank you. Also at the subtle urging of my attorney, I'm jumping to slide 53.

MR. MURPHY: Subtle.

THE CHAIRMAN: Only take three stitches.

MR. GOOKIN: You've heard about the entrenchment. I want to talk about five time periods -- I'm sorry. Yeah, 53 -- as shown on slide 53.

The first is prehistoric. This is a chart that was.

MR. MURPHY: This is slide 54.

A. You are correct. I'm sorry. Slide 54. If you look at these yellow lines on this chart, they show when entrenchments and channel cutting occurred in the last 12,000 years. This was by Mr. Waters. It's to demonstrate that channel cutting is a natural phenomenon.

Also other studies, which are referenced in my appendix, talk about how they have determined these cuts occurred during wet periods which indicates that it was

01:39:29 due to floods, not other characteristics.

01:39:32 Going to the very early period, 1700 to 1845.

01:39:40 MR. MURPHY: This is slide 55.

01:39:41 MR. GOOKIN: Rumor has it that 100,000 cattle
01:39:44 entered this area. I don't know if that's correct. It
01:39:50 seems large. But the important aspect, there were a lot
01:39:54 of cattle. And yet despite all that, there was no record
01:39:58 of entrenchment or there was no sign of destroying the
01:40:03 watershed, overgrazing.

01:40:08 Slide 80 -- or 56. In addition, in this
01:40:11 pre-entrenchment stage, there were obstacles to navigation
01:40:22 that are not really flow related. First, without the
01:40:27 trapping, beaver dams would have been prevalent. There
01:40:31 were cienegas, and you've already heard about riffles.

01:40:35 Pretty picture of a beaver damn, and then we're
01:40:39 jumping to slide 58. I don't know if Mr. Hjalmarson meant
01:40:46 that 500 dams on the river. But if he -- even if he
01:40:50 didn't, I think he was pretty close. I found two sources
01:40:55 of average densities of dams in the United States, and
01:41:00 they pretty much bracket that number. So that's a lot of
01:41:05 times you have to port.

01:41:08 Also canoes back as of statehood were made of
01:41:11 birch bark, cedar, which was a very soft wood, or canvas.
01:41:20 They couldn't take a lot of damage as a modern canoe does
01:41:25 by just shooting over the beaver dam and hoping that they

make it.

Slide 59, these are some cienegas. This one is Arivaca. It's southwest of Tucson. Slide 60 is the Canelo Hills cienega. I probab -- Canelo, C-a-n-e-l-o. And it is also west of the San Pedro basin. You can see there's a lot of grass. This one's an unusual cienega called the Bingham cienega. It's slide 61, and it was located near Redington. And finally there's the St. David which is south of Charleston, not on the San Pedro River, but in the valley. Most of the cienegas were on the San Pedro River. They had to be. That's where they got their water to create these huge fields of grass and marsh-like conditions that are talked about. These few cienegas are near other sources of water such as springs.

Slide 63, which you have already seen, these wide areas are marshy areas according to Hendrickson and Minckley, and probably some of them were cienegas. Cienega is a type of marshy area.

Slide 64, the period 1846 to 1870, we've heard a lot of debate about was that without human influence. Well, it's about as good a scenario as you can get. Many sources talk about how wonderful the grasses are, and they are in my appendix. Bartlett and -- or Lumelli -- Mr. -- go back. Mr. Hjalmarson quoted Lumelli who quoted Bartlett to say there were 60,000 cattle in this period.

If you go to Mr. Lumelli's chart, you'll find that he thought that Bartlett had said there were 40 and then he just added onto it. If you go to Mr. Bartlett's record, he saw a -- some deserted rancheros. And later he found out that somebody told him that those rancheros had had 40,000 cattle on them. It's not really a great source. But however it happened, the grass stayed really good, which means it wasn't overgrazed or significantly affected and the cattle did go away.

65, in addition, the river had its own braided sections before entrenchment. It was not unique to entrenchment.

The next period I want to talk about is the 1880s. And according to the records, the grassland was still good, but they were upping the number of cattle coming in. But it was a wet period, so the grass kept growing to feed them. There was still some --

THE CHAIRMAN: What slide did we just leave?

MR. MURPHY: 66.

MR. GOOKIN: 66. Thank you. There were some floods on slide 67, and there was some additional entrenchment. But the real entrenchment occurs at slide 68, and it was called the great flood of 1890. There were several monsoonal events who hit close together, and massive amounts of entrenchment occurred. And not only

entrenchment, the river didn't go just down, the stream widened. It cut those vertical banks and made the river wider. But, again, the river is a long river. It didn't happen everywhere. Some of it had already entrenched, and some of it didn't entrench, particularly then in the Redington-Mammoth area.

Slide 69 talks about how wonderful or how extensive the entrenchment was. Slide 70 talks about it wasn't everywhere, that there was some areas that weren't.

Slide 71. Now this slide is a very important one. In 1890, the winter of '90-'91, the grass was still doing good, and grass is critical on cattle impacts. It's the roots of the grass that get into the dirt and hold it in place and affect the runoff and affect the sediment.

In the summer of '91, the watershed was stripped bare. That's when the impact of overgrazing occurred. We entered a horrible drought period. The Pimas call it the starving decade, and that's when the watershed was effectively destroyed.

Slide 72. Many people have agreed that the floods were the cause of the entrenchment. Primarily, Mr. Hjalmarson in 1988 made that statement. Others who agreed included Huckleberry. You've heard a lot about that and other well known sources on the topic.

Mr. Hjalmarson also indicated that recovery would

01:47:38 occur -- this is slide 73 -- in a very short period.
01:47:43 Well, there were several problems. One, there was flood
01:47:45 after flood after flood. It was a very wet period as far
01:47:51 as the San Pedro went with some short dry periods in
01:47:55 between. Particularly '96 to 1900 was awful.
01:48:03 In 1906, they had a tremendous flood. It was
01:48:09 greater than the 1926 flood, which the USGS says was
01:48:13 100,000 CFS, over twice the 100-year flood.
01:48:19 Now Mr. Bartell talked about 4,000 CFS made him
01:48:25 humble. He wouldn't have stayed on the bridge with this
01:48:28 flood. He would be running and running and running. It
01:48:31 would be terrifying.
01:48:33 The other point is the experts that Mr.
01:48:38 Hjalmarson has said and others going out in the semiarid
01:48:42 southwest, once a stream is torn apart by a massive flood,
01:48:51 it takes decades to recover.
01:48:53 For example, on slide 74, you can see the gage
01:48:56 near Palominas, what the river was in 1930 and what it was
01:49:01 in 1981. Now remember this has almost no depletion. The
01:49:02 only thing really going on upstream is a little bit of
01:49:10 mining and -- or excuse me, a little bit of irrigation and
01:49:12 some mining.
01:49:16 Mining back around 1900 was not a very high use
01:49:22 enterprise. Nowadays they have to capture all of their
01:49:22 water and evaporate it or otherwise dispose of it so it

doesn't pollute the rivers. Back then, they didn't care. They just put it back in the river. So that wouldn't have been a significant depletion.

My conclusion is as of 1912 it was mostly braided. It was mostly entrenched. The cienegas due to the entrenchment were mostly gone. The beaver dams were probably gone, but that was a manmade impact. So in natural conditions as of 1912, the beaver dams probably would still have been there.

THE CHAIRMAN: Mr. Gookin, is that slide 79?

MR. GOOKIN: No, that's --

MR. MURPHY: 75.

MR. GOOKIN: -- slide 75. And the San Pedro still had some pre-entrenchment reaches. So it was a mixture of a whole bunch of things.

These are a series of slides starting with 76 that show as close as photographs can get to 1912 what the channel was. And, again, that is the natural condition for the channel. Charleston, which was before the 1926 flood, is 76. Palominas, now you drove by this going to Bisbee. That was that sand channel that you went over on the bridge that was dry with the trees growing up all around it. It looked a lot different in '39.

Slide 78 was at the Charleston bridge. Slide 79 is at Charleston. Slide 80, Palominas. Slide 81,

Charleston flow -- or, excuse me, Charleston. The flow was 13 CFS.

Slide 83 --

MR. MURPHY: 82 should be your next.

MR. GOOKIN: Oh, I'm coming to slide 83. Sorry. I'm sorry. You're right. 82. I was ahead of "What if I'm wrong?" Well, the floods occurred. There's no doubting that. And even if they had not trenched it, they would have braided it. That's a natural phenomena. The beavers and cienegas would still have been there without the entrenchment, and we'd still have riffles.

Slide 83. So --

THE CHAIRMAN: Could we go back to that previous slide?

MR. GOOKIN: Yes, sir.

THE CHAIRMAN: Thank you.

MR. GOOKIN: Well, there are two ways to get the depth of the water which is a critical element. I'm on slide 83.

First, I've just listed what people saw. Mr. Hjalmarson found one source that said it was two and a half feet deep. My recollection of that source is true that it was two and a half feet deep, but that was shortly after rains had occurred. And they commented later in the same quote. Most of them, or these are the ones I found,

you're talking about a foot for a reliable flow.

The second is the channel geometry method, slide 84. And this is just to refresh your memory of what it was.

Slide 85 talks about the limitations of this method. The big thing about this method is it was derived so if you go pick the width at the right kind of point on a stream, you can determine how much the average flow was. But we're doing it backwards. According to the USGS, you pick this cross-section here at the point bar, and that will tell you what the average flow was. By taking the average flow and computing the width --

MR. MURPHY: And you're on slide 86?

MR. GOOKIN: Yes -- that would give you the -- assuming the equation correctly predicts what it's supposed to, it would give you this width right here at the point bar. It would not give you the width downstream where the stream opens out some or upstream. So it's given you one cross-section and one depth at the point bars.

Slide 87. This equation by Osterkamp was developed in 1980. And it's the equation Mr. Hjalmarson used. Osterkamp didn't stop his work. He kept trying to find a way to get it to work better. And in 1983, he came up with this equation on slide 87 that shows the equation

for a braided stream. Braided stream has really wide river bed and the water kind of sloshes through it winding a lot like a snake looks.

Now the 1980 method that Mr. Hjalmarson used --

MR. MURPHY: And you're on slide 88?

MR. GOOKIN: Yes -- assumed a lot of clay, which we've talked about, and this uniform parabolic cross-section. I've already talked about the historic accounts say it was rectangular, and that makes a big difference in the answer.

And also at slide 89 -- or excuse me. Moving forward, you need to know the slope when you get into the Manning's equation. And it's shown here. The slopes really can vary -- I'm at slide 89. If you get on a riffle, the one riffle that we had a pretty chart for had a slope of 2.4 percent instead of 0.21 or 0.28, 10 times the slope. The procedure also ignores riffles, dams, and cienegas.

Slide 91. The green line is the approach used by Mr. Hjalmarson that I recreated and I compared it to his depth flow chart and it looked the same. I considered three scenarios: One, a riffle using that one riffle that I had data for near Charleston; two, a sand channel -- a sand and rect -- I should say rectangular channel which is what the people back in the 1840s, '50s, '60s saw; and

01:57:00 then, three, what was prevalent at statehood, a braided
01:57:05 channel. And that's in blue. Here's my cursor.
01:57:10 The up-down axis is the depth of water, and on
01:57:15 the bottom axis is the flow. It makes a huge difference
01:57:22 on which cross-section you pick as to whether or not you
01:57:26 get to one foot of depth.
01:57:28 Slide 92. State of Washington, Mr. Hjalmarson
01:57:37 said this was not a valid comparison because the state of
01:57:43 Washington rivers are developed. But it tells us the kind
01:57:51 of error that you can expect using this method.
01:57:54 And the other thing I want to point out is the
01:57:59 channel geometry method was developed for developed
01:58:04 streams. It wasn't developed for predevelopment streams.
01:58:09 And the reason I know this is they did it based on stream
01:58:14 gage data. Stream gages come after people enter the
01:58:18 watershed, not before. We find out what a stream flows
01:58:24 because we have a reason to. So saying that this method
01:58:31 is good for predevelopment but not post development is
01:58:36 backwards, and it should be good for all cases if it's
01:58:39 going to be.
01:58:40 Slide 93, Navigability Criteria. Mr. Hjalmarson
01:58:48 used two techniques, and they both talk about modern
01:58:52 recreation. I think the Montana case addressed that, but
01:58:58 let's talk about it factually and then go to what I could
01:59:02 find for commercial navigation.

01:59:05 THE CHAIRMAN: Slide number was?

MR. MURPHY: 93.

01:59:07 MR. GOOKIN: 93. This is 94. First, he cited to the Bureau of Outdoor Recreation, and he showed a chart 01:59:11 which you'll see in a minute on 95. Let me just go there. 01:59:14

01:59:19 So you can recognize this, my slide 95, his slide 01:59:24 94. That chart is for white water rapids. But the source 01:59:32 also talks about using it for tranquil water, and I put 01:59:37 "tranquil" in quotes because to an engineer that has a 01:59:41 specific meaning that is not a common meaning. I'm just 01:59:47 using "tranquil" as nice, pretty, smooth water.

01:59:51 The first thing is if you're going to do a canoe 01:59:57 which seems to be the lowest depth you can really get away 02:00:01 with, you need two feet, according to this source, if 02:00:04 you're going to be able to paddle it. Otherwise, you need 02:00:08 to stand in the canoe, get a long pole, and try to pole it 02:00:14 down the river. This could be detrimental for the health 02:00:20 of your passengers or property because you've raised your 02:00:24 center of gravity and could overturn very easily.

02:00:28 The second important thing is that it says you 02:00:32 need a width of 25 feet for the channel for a canoe. Now 02:00:38 these are modern canoes, so I figure the old canoes needed 02:00:42 at least that much because they don't have all the 02:00:44 advantages of current day canoes. 25 feet of width is 41 02:00:52 CFS according to the Hjalmarson model. It's a lot more

according to my models.

The two feet of depth so you can paddle it is 191 CFS according to Hjalmarson. Both of those are way above what the normal, ordinary, median base flow, whatever you want to call it is anything but a major rainfall event.

Now if you look at this graph, you notice that they stop, the lines stop, before they get to the bottom. And what made me beg my attorney to find this, which he did, was I couldn't understand because according to this graph, he plotted where the San Pedro was, but he says if you have zero CFS and a gradient of, say, 10 feet per mile, it's class 1 and it's navigable. Well, the problem is this graph was for white water.

Q. Now talking slide 95?

A. Slide 95, his slide one 40. Slide 96. Sorry. I'm getting wound up, forgetting the numbers. This is the actual original graph. Now if you look at 96 -- I'm blowing it up -- you can see it only went down to 500 CFS. So everything below 500 CFS is his own extrapolation, not the source's. And it only went down to 5 feet per mile, not zero feet per mile as his graph showed on 95.

Now let's go to 97. You've seen this before. If you take the slope between transect 3 and transect 2, it's 125 feet per mile. If you put 125 feet per mile on the gradient of Mr. Hjalmarson's graph 140, which is shown

again on slide 98, it's kind of off the computer, and it's really class 5 water, which is defined by his source at slide 99, very difficult, rapids long and very violent, following each other almost without interruption. And it goes on. Not suitable for commercial uses, I would suggest.

The second source at slide --

MR. MURPHY: 100.

MR. GOOKIN: -- 100. The Cooperative Instream Flow Service Group. First, it's for recreational -- modern recreational boating, not commercial. But, second, it assumes that you have picked a single cross-section that was your worst case scenario, the shallowest depth in the river, not your average depth, not your median depth, not what you think it usually is, but the worst case. So if it really is only one foot normally, as Mr. Hjalmarson solved it for, then it doesn't meet this criteria.

The other thing I had a problem with is, as I pointed out, in the state of Washington, they had huge amounts of error. He ignored all that error. And in fairness when I did my graph, I ignored them also. But if you're going to apply it to the chart like Mr. Hjalmarson did and go down to that one foot line and say that's the magic number, you really need to have some buffer of error because what he's really saying, when he solves for one

foot, ignoring all my other criticisms, he's saying half the time you'll enter the flow --

THE CHAIRMAN: George, do we need to stop?

MR. MEHNERT: No.

THE CHAIRMAN: Keep going.

MR. GOOKIN: Okay.

MR. MEHNERT: I had to drop something.

THE CHAIRMAN: Oh, I thought you were changing.

MR. GOOKIN: Half the time, it'll be above 100 and about half the time -- or 1 CFS. And half the time, it'll be below. You have to include the margin of error. That's a simple engineering principle.

Slide 101. I found a report written in 1914 about canoeing, and it talked about recreational uses. But it also talked about using what he called a freight canoe and that if you're going to have any weight in your canoe it takes more water, sinks further. And he said, it would take 19 inches for the draft. The Army Corps of Engineers said you should only use 75 percent of the depth because you've got to leave room for the water to go under the boat. So that comes out to 25 inches and a fraction.

Slide 102 -- no -- yes, 102. This is the state of Washington criteria. These are modern criteria. But you'll notice they indicate you need two feet minimum and really should have three and a half. They determine that

the width has to be at least 24.

Now Mr. Hjalmarson's source said the width had to be at least 25. I'm not going to argue the point. It indicates that you need a width for the canoe to work. The rest of the criteria, I think, are self-explanatory.

Slide 103. For those of you who suffered through the lower hearing, which went almost as long as this thing did, Mr. Hjalmarson used the Langbein method. I'm probably mispronouncing it.

He didn't use it this time. He was asked, and he said it just didn't work. Well, he's right. It was the method he chose to prove that the lower Gila could be navigated. Basically, you plot the velocity versus the depth. If your line from the San Pedro River, and these are using his values, is below 0.0002, in other words, falls in this whole right quadrant, right lower quadrant, it's not navigable. If it flows actually between 0.001 and 0.002, it's maybe navigable for ferries in short reaches, which I don't believe meets the legal definition, but that's irrelevant for this river because we're way down here. So Langbein, his own previous method, says it's not irrigable -- I'm sorry.

Q. Navigable?

A. Navigable. Slide 20 -- or 104. I wondered about looking at the Army Corps of Engineers. It, after all, is

02:08:55 the federal agency designated by Congress as the entity
02:08:58 for maintaining commercial navigation on what I would call
02:09:07 real rivers.

THE COURT REPORTER: What rivers?

MR. GOOKIN: Real.

02:09:11 As you can see, the Congress has continually been
02:09:14 increasing the depths that were required back then. And
02:09:18 as of statehood, you're looking at something in the
02:09:21 neighborhood of six to nine feet for commercial
02:09:27 navigation.

02:09:27 The other thing that the Army Corps brought up --
02:09:34 and Mr. Burtell's testimony made me want to point it
02:09:37 out -- they have a low flow requirement. It has to be
02:09:46 navigable more than -- well, it has to be navigable 350
02:09:48 days out of the year. That's their standard. It could be
02:09:52 too dry 15 days out of the year.

02:09:56 If you have a business, you have to have
02:09:59 reliability. You can't just count on half the time or 10
02:10:04 percent of the time. The Army Corps, right or wrong, came
02:10:08 up with 15 days out of the year as being the threshold
02:10:12 value for reliability.

02:10:12 Finally, the very end, slide 105, I took my three
02:10:23 charts, and I took Mr. Hjalmarson's chart, and I looked at
02:10:32 the issues of depth for various levels and how many CFS he
02:10:37 and I came up with to meet that requirement.

Now I have ranges because I had the same rectangular channel, I had the riffles, and I had the braiding. And those all require more. And I believe that all of those existed simultaneously on the river. In fact, there probably were a few spots that had a parabolic channel, but I doubt that it was very prevalent. Also, the width of 25 feet, that ended up requiring about 41 CFS, depending.

I am ready for cross-examination or salvage, the damage control, by my attorney.

MR. MURPHY: Actually, I just wanted for the Commission's information to let you know that on what was submitted by the community following Mr. Gookin's Power Point presentation, Appendix A were some supporting quotations or documentations for its report. Appendix B was a list of the references that were cited in the report. And for the convenience of the Commission and hopefully not damaging too many trees, for those reports that were available on the internet, the PDF we submitted is hyperlinked so that those originals could be located easier. And then we attempted to excerpt the remaining amount of the reference materials in his report.

THE CHAIRMAN: Thank you, Mr. Murphy. Do you have anything further from Mr. Gookin?

MR. MURPHY: Not at this time, Mr. Chairman.

THE CHAIRMAN: Is there anyone who wishes to question Mr. Gookin?

Yes, Ms. Herr-Cardillo.

02:12:27 MS. HERR-CARDILLO: Got a hodge podge of notes. 02:12:29 I've got some handwritten notes and things on my iPad, but I'll try to move through things pretty quickly.

CROSS-EXAMINATION

BY MS. HERR-CARDILLO:

02:12:43 Q. Mr. Gookin, I think I -- I think I know the 02:12:45 answer, but I'd just like to just start by asking you 02:12:49 when -- what your opinion is as to when the San Pedro was 02:12:55 in its natural condition?

02:12:56 A. Well, during the Holocene period from 12,000 BC 02:13:01 to today.

02:13:04 Q. So you say even today it's in its natural 02:13:09 condition?

02:13:10 A. Yes. The channel has reacted to natural forces, 02:13:11 so the channel is in the natural condition.

02:13:16 Q. And is it your position that there have been no 02:13:19 human impacts on the river?

02:13:22 A. There have been some human impacts on the 02:13:23 watershed, and there's a lot of argument as to whether 02:13:28 that caused impacts on the river. The watershed occurred 02:13:32 in 1891. So if you assume those impacted the river, 1891

would be the proper date.

Q. Have you read the State v ANSAC decision?

A. Yes.

MS. HERR-CARDILLO: Sorry. I'm skipping. This is good when I'm quiet.

THE CHAIRMAN: Take all the time you need. Trying to keep from waking Mark up.

MS. HERR-CARDILLO: Okay. Thank you.

Q. (By Ms. Herr-Cardillo) On slide 10, you indicated there were numerous observations in the 1840s and 1850s reporting dry reaches; is that correct?

A. I'm trying to --

Q. Oh.

A. Come on. I'm sorry. This is being very uncooperative. Somewhere I've said it. I know that. Slide 10 is not that spot. I agree that I said it.

Q. It's the next slide. Sorry.

THE CHAIRMAN: 11.

A. Slide 11.

Q. (By Ms. Herr-Cardillo) Okay. The observation in the 1840s, is that the one observation you note later on in your -- in your Power Point -- I can't remember -- where you talk about an 1849 -- I think it's slide 38.

A. The quotes I was referring to were in the Appendix A under the heading Intermittent Flows on pages

2, 3, and 4. I'm just looking through --

Q. Okay.

A. -- to see if -- I think the one in 1849 probably was it for the '40s.

Q. Okay. So just one from the 1840s, and that was 1849, and the other ones were in the 1850s?

A. That's how it looks.

Q. Okay. Are you not familiar with the term Q90?

A. I have never heard of it before Mr. Hjalmarson as a reference for base flow.

Q. But you'd heard of the term?

A. Well, I've heard Q sub number as referring to a percentage frequency.

Q. Okay. You talked quite a bit sort of in slide 17, 18, and 19 -- or I guess it's maybe 16, 17, and 18 -- I can't read my own writing here -- about these pie charts on the Freethey-Anderson plate; correct?

A. Correct.

Q. Okay. And you, I think, at one point said with respect to Mr. Hjalmarson that his interpretation of Freethey and Anderson was 10 CFS. Do you recall saying something to that effect?

A. Slide 18 --

Q. I believe that's it.

A. I corrected my asterisk because he had typed that

into the table from Kennedy and Gungle and then put an asterisk and cited to Freethey and Anderson.

Q. Okay. What did you mean by saying it was his interpretation of Freethey and Anderson?

A. Freethey and Anderson do not just put a number and say, "Here is the base flow." They have these pie charts. I don't know how he did it. What I did was I blew the pie charts up as big as my printer would let me. I put protractors on it or a protractor, the smallest one I could find, measured the size of each slice, converted it to percentages and then started calculating.

The only real number of relevance in Freethey and Anderson is -- this is slide 17, and this is the lower San Pedro. But all of them have this ratio. And the top number is the total inflow, which is shown on the pie chart as three slices on the right side of the pie, and the total outflow, which is the three slices on the left side of the pie.

So for example in this reach, which includes the Gila and Willow Creek, 25,000 acre feet came in, and going down to the lower right corner of slide number 17, mostly as recharge from infiltrating precipitation and runoff, in other words local recharge. A little bit is underflow from the upstream basin and recharge from the perennial aspect which would be the base flow is in the purple.

02:19:43 The amount that the ground water basin kicked up
02:19:47 to the stream in this reach was all taken by the plants.
02:19:53 So it's a number you have to compute based on this picture
02:19:59 and the 25,000.
02:20:01 Q. Were you aware you can just simply obtain the
02:20:04 numbers from the USGS if you request them?
02:20:06 A. No.
02:20:07 Q. Were you aware that's what Mr. Hjalmarson did?
02:20:14 A. No.
02:20:14 Q. On slide number -- looks like 19, you've -- well,
02:20:41 what did I do. How did I -- mine are off.
02:20:42 A. There were two parts. Is that what you're
02:20:44 looking for?
02:20:47 Q. I'm looking for where you'd circled 207.
02:20:48 A. Okay. I just did.
Q. Okay.
02:20:49 A. It was an animated slide, number 19.
02:20:52 Q. Animation in those slides always gets me. The
02:21:00 207 relates to the median for the years 1967 to 2009;
02:21:06 correct?
02:21:06 A. Correct.
02:21:07 Q. So in your opinion, was the river in its natural
02:21:11 condition during those years?
02:21:12 A. No. There would have been more base flow days or
02:21:19 more base flow in if it was undeveloped. And I told you

the depletions that this report talked about for that period.

Q. Also you used a typical year in slide 21. Thanks. Am I just off one? Somehow I --

A. Well, then I blew it up --

Q. Oh, okay.

A. -- so you could see the low flows.

Q. Right. Right. So this represents the flow in the river in 1953 --

A. Yes.

Q. -- correct? Okay. And in your opinion, was the river in its natural condition in 1953?

A. Well, no, it had a depletion of 1 CFS as I indicated that you should add at this point. And I'm talking only about flows. The channel, I believe, was natural.

Q. Speaking of the channel, in your modeling -- did you actually do modeling?

A. I used the same modeling procedure that Mr. Hjalmarson did.

Q. Okay. But you varied it correctly --

A. I varied it --

Q. Sorry. You varied it; correct?

A. I used different data in that model to represent different scenarios.

02:23:13 Q. Okay. And among the data that you used was the channel shape; correct?

02:23:17 A. That was on my sand channel, yes.

02:23:19 Q. Okay. So you -- you indicated, I think, in slide -- let me see if I can get this right. Looks like slide 30, you indicated that you used a rectangular channel?

02:23:22

02:23:25

02:23:31

02:23:38

02:23:39 A. I think the previous slide, 29? Is that the one?

02:23:44 Q. No, I was looking at --

02:23:45 A. Oh.

02:23:46 Q. -- at under the shape of the channel on the next one, I think. And the slide isn't that important.

02:23:50

02:23:55 A. Okay. On the sand scenario, I used a rectangular channel --

02:24:01

15 Q. Okay.

02:24:01 A. -- because that's what the people talked about.

02:24:07 Q. In your opinion, is the natural channel of the San Pedro would be square?

02:24:10

02:24:11 A. You cannot characterize the San Pedro River by giving it one cross-section. It is 140 miles long. It'll vary within one mile. So, no, I don't think the San Pedro is rectangular. I think it's rectangular, paraboloid, triangular, irregular, and probably some things I haven't thought of.

02:24:18

02:24:22

02:24:30

02:24:36

02:24:39

02:24:40 Q. Would you -- do you agree with Mr. Burtell that

the cross-sections of the channel in, I think, it's Appendix E of the Fuller report, are an accurate depiction of the San Pedro channel in its natural condition?

A. Yes, because what affects channels is not diversions. What affects the channel shape is the flood flows. And the diversions, those dams would wash out in the floods anyway. So what's happened to the channel shape is a result of rain, not humans.

Q. Rain -- you say diversions don't affect channel shape. Does the level of flow affect channel shape?

A. If you get up to the flood levels. You have to be at least a Q2, which means a two-year flood.

Q. So low flow would not impact channel?

A. Trivial at most.

Q. If you can look at slide 32 --

A. That is --

Q. -- Pre-Entrenchment Alluvium?

A. Yes.

Q. What is loam?

A. Loam is a mixture of the various soils -- trying to remember because I'm not a soils scientist. I had to just read it. It's down here, so there is a little clay in loam, and there is some -- there's a triangular chart that shows it. And that's why I'm waving my hands in the air.

Q. So it's in --

A. I don't remember exactly. I'd have to look it up. It's not --

Q. It's -- sorry. My assistant is providing me with his phone. A soil with roughly equal proportions of sand, silt, and clay?

A. It doesn't fit my memory, but I assume you're quoting something. So okay. But if you notice, that's the last item, and there are other items modifying it. So that moves it from the center of that diagram.

Q. And on that slide, you also say it's not medium silt clay?

A. Yes.

Q. Mr. Hjalmarson did not say it was medium silt clay, did he, in his model?

A. Yes, when he wrote his equation. That equation comes from the 1980 Osterkamp. He had a series equations for different soils. He picked the equation for that was for medium silt clay.

Q. Not sand, silt, and clay?

A. No.

Q. On slide 34, you talk about Post-Entrenchment Alluvium. What time period is post entrenchment?

A. It varies where you are on the river. The earliest was the sightings in 1850, give or take. And the

latest entrenchments occurred in 1926.

Q. If I can have you go to slide 37.

A. Yes.

Q. And can you just confirm for me that this diagram was prepared in 19 -- looks like either '85 or '95.

A. I can't --

Q. I think '95.

A. But, yes, it is modern day.

Q. So the mixtures, that represents the soil of that time period?

A. Yes, the post entrenchment period.

Q. Okay. Going on to slide 38, you reference in the 1849 description "a clear stream running over a rocky bed." And you indicate that that's from the Fuller report, page 3-15. I've pulled that page from the report. And it appears to me as I read this quote that that is actually not describing the San Pedro but a tributary or a nearby stream.

MS. HERR-CARDILLO: May I approach the witness?

MR. GOOKIN: There's no witness protection.

THE CHAIRMAN: We're off the witness protection program.

MS. HERR-CARDILLO: Thank you.

THE CHAIRMAN: You can go right ahead.

MS. HERR-CARDILLO: You know, the other guys do

that, so I feel like I have to.

THE CHAIRMAN: Pay no attention to the red boy.

A. Is it the first quote?

Q. (By Ms. Herr-Cardillo) I believe it's the first part, but if you could --

A. Ah, here it is.

Q. -- just confirm that for me.

A. Let me read the whole thing.

Q. Okay. Take your time.

A. "About five miles from camp, we passed a muddy stream in one of the flats. As we thought this was the San Pedro, we were very much disappointed. We continued for there was no wood to cook breakfast. At length, we passed a clear stream running over a rocky bed and, soon after, a still larger one running northeast. After passing the last one, we kept it up a short distance on to a small elevation of land and camped near the stream. We are not on Cooke's route now as we have passed the river I am satisfied above the fords. The left fork of the river on which we are encamped is the main branch. Cooke had a different..."

I think you're suggesting that the muddy stream was the San Pedro.

Q. No, I can't tell from that description that they're -- that any of what they've described is the San

Pedro.

A. I got the impression from this quote, and maybe I'm misreading it, they found one river that they thought was the San Pedro. Then they found another one. And they keep going, and they talk about they believe that's the main branch. I could be reading it wrong.

Q. And in fact, how does Fuller interpret that, if you want to just -- I think in the sentence introducing the quote, but it could be following the quote.

A. You're correct. From September 26th through 28th, HMT Powell traveled through the upper San Pedro valley probably southeast of the Huachuca Mountains but could not find Cooke's trail and was never able to identify the San Pedro River for certain. So --

Q. So we don't really know that that's the San Pedro?

A. No, it's not 100 percent sure, no.

Q. Okay. Thank you.

A. You're correct.

Q. Are there any other historical descriptions from that same general time period, the 1850s, 1840s, that describe any rocks in that river bed?

A. Not that I found.

Q. On slide 42, you indicate -- this is -- the source of this is Leenhouts. What year was this prepared,

and what time frame does it reflect?

A. It was post entrenchment if that's your substantive question. It didn't have --

Q. Yeah, that does.

A. Okay.

Q. On slide 48 -- I'm sorry. It's 46. Bad eyes. This slope that's reflected in this chart, is this for the natural -- the river in its natural condition?

A. Yes.

Q. And what time frame does it reflect?

A. Post entrenchment.

Q. Post entrenchment?

A. Yes.

Q. On slide 50, you reference reasons that have been suggested for the historic entrenchment. Others -- I don't recall. Maybe you expanded on it when you were talking.

A. Actually I jumped over this slide.

Q. You jumped over this slide. Okay.

A. Others would include the earthquake. Those are the three primary. I'm sure you could find -- oh, wagon trails.

Q. What about irrigation? Does irrigation contribute to entrenchment, or diversions?

A. If you have a concrete structure like a real dam,

yes, that'll affect things greatly, the river shape. But they didn't have that kind of -- those kinds of structures on the San Pedro.

Q. What about ground water pumping? Does that contribute?

A. Ground water pumping would effect the flow. And that's one reason I like the White Book because it's really after the -- or before the ground water pumping. It's a very hard thing to compensate for the ground water pumping because it affects the flow slowly. But it shouldn't affect the geology or the geomorphology of the channel.

Q. What part does vegetation -- sorry. I'm getting punchy.

A. That's all right.

Q. Long couple of days. What part does vegetation play in the entrenchment process?

A. The vegetation really was affected by the entrenchment but neither caused nor prevented it. The floods that caused the entrenchment were so big they just ripped out the vegetation. You were left with a denuded river channel afterwards. And it took quite a while for vegetation to come back in. Vegetation will protect the channel against lesser floods.

Q. You talked a little bit about beavers. Is it

your position that any river that has numerous beaver dams on it is nonnavigable?

A. If they have numerous, yes.

Q. What would qualify as numerous?

A. I wish the court gave us explicit definitions. But in Montana, they talked about if you had to port for a couple days. So in my mind, if you add up the portages to get around these beaver dams and it exceeds that period, you flunk.

Q. Exceeds a period of a couple days?

A. Whatever Montana said. I --

Q. Okay.

A. I don't have it in front of me.

Q. Have you ever seen a beaver dam that would require you to port -- portage for a couple days?

A. Of a canoe built in 1912, yeah. Not a couple days per dam. But to me, the fact that you're going to have to carry your freight or march your customer for so many days in order to get down a river, to me, it's additive as far as an inconvenience to the commercial effort.

Q. So in slide number 75, the condition of the river as of 1912. What you've described here is the river's actual condition in 1912; correct?

A. With the sole correction that the beaver dam, I

should have typed the beaver dams. They would be there, because they do come back quickly after they're washed out, the 1912.

Q. So it's your opinion that beaver dams were there in 1912?

A. No, because humans had killed certainly most of them or possibly all of them. The beaver trappers killed a bunch. The farmers killed some. It was -- so in 1912, as it existed, you didn't have beaver dams. In the natural condition in 1912, you would have had beaver dams.

Q. Okay. In the natural condition in 1912, would you have had the braided stream?

A. Yes.

Q. And your opinion is in the natural condition in 1912, the river would have had -- would have been mostly entrenched with vertical sides?

A. Yes.

Q. But that some of it was still in a pre-entrenchment state?

A. Yes.

Q. What portions were in the pre-entrenchment state?

A. The references talk about the lower San Pedro River -- this is confusing. Essentially the upper part of the lower San Pedro.

Q. Okay.

A. Redington, Mammoth, that area. I would refer you to Wood. He had an extensive discussion.

Q. What is -- I'm not clear. I listened carefully, so I apologize if I missed it. But what is your, in your opinion, is the amount of depth that's needed for a river to -- for a canoe to be able to flow down the river?

A. My impression was that is a legal question. I could tell you what various agencies had determined was necessary. I hadn't -- I had read the Utah Supreme Court case which made me think they thought Freethey, but they didn't explicitly say it.

What I was doing was presenting these depths and what flows it takes to achieve them or the width according to various criteria. I always get yelled at for giving legal questions. And my attorney and I talked about this quite a bit, and that's something the Commission's going to have to decide, What set of criteria really apply.

Then you go to that last table of mine and it'll tell you what flow you needed for the various types, the cross-sections, or the chart on page 91. And if you get above 200 CFS, well, give me a letter and I'll give you additional data.

Q. If -- do you believe that recreational boating can be a commercial enterprise?

A. I do not believe that modern recreational boating

is to be considered pursuant to the Montana case.

If you are, say, running tours or something like that, yes, I think you could have done it -- or you couldn't have done it on the San Pedro. But the concept of boating in 1912 in other areas as a commercial enterprise could have existed, boating customers, travelers.

Q. Commercial canoe, what is the difference between a commercial canoe and a regular canoe?

A. Well, Pinkerton talked about recreational canoes. They were just going to take the canoe and go out for a weekend, and then he talked about if you're going to haul freight. And that was the exact phrase in what I cited on the side which, to me, implies commercial. You're going to need 19 inches plus clearance.

Q. When you talk on slide 104 of commercial navigation -- I think that's the term you used -- but I don't see it anywhere on the slide. But there's this --

A. I'm getting there. Oh, the Langbein method?

Q. No, no, no. Army Corps of Engineers.

A. Army Corps of Engineers. Oh, I didn't put it on the slide. But, yes, I consider their directives to be related to commercial navigation.

Q. And what is the -- what -- is this a defined term, the four feet? And what is -- what is it defining?

A. The U.S. Congress passed an act or an appropriation, some sort of legislative action, in 1866 that told the Army Corps of Engineers to go up and work on the upper Mississippi in this case to make sure they had four feet of depth for boating --

Q. So --

A. -- navigation.

Q. -- that was a standard that was set by the U.S. Congress for --

A. Yes.

Q. -- the depth that they wanted for the upper Mississippi?

A. Yes.

Q. Okay. Was there any reference made by Congress that this was, quote, "navigable"?

A. I honestly don't know. I could find references to these acts but couldn't find the acts. They didn't tell me, you know, public law such and such and such and such. I wish they had.

Q. Okay. Oh, I do have one more question.

In your comments, you made, I think, a statement that birch bark cedar and king -- canvas canoes were -- are more fragile. What's the basis of saying that?

A. What, more fragile than fiberglass or plastic?

Q. Correct.

A. I am an engineer. I did look up the breaking point of cedar versus fiberglass. I don't remember the numbers, but it's a soft wood. Canvas has very little structural strength, and of course birch bark wouldn't either.

Q. Now prior to 1912, there were dugout canoes used in the area; correct?

A. Yes.

Q. And those would not be fragile; right?

A. Oh, absolutely. And one of the real problems with a dugout canoe is it's very hard to control the fire so it doesn't affect the wood on the bottom. What they do is they cut a log. They build a slow fire, and they try to turn the center of it into charcoal, and then they dig that out. So there's no real quality control on it. You put it in and hope it floats. And if it breaks, then you do it again.

Q. Is that how the dugout canoes -- how Pattie -- I didn't -- I don't recall hearing anything on Pattie made his dugout canoes?

A. I don't remember if he talked about it. I know Pinkerton talked about how you made -- I think he talked about it. I know I read it several places about how you make a dugout canoe. And, I mean, you're digging out -- that's kind of why you have the name -- dug out the

center. And you use fire as, a low fire, to turn it into charcoal so it's easier to pull it out.

MS. HERR-CARDILLO: That's all I have. Thank you.

THE CHAIRMAN: Thank you, Joy. Does anyone have any further questions for Mr. Gookin? Does the Commission have any questions? Breedlove?

MR. BREEDLOVE: I just have one.

EXAMINATION

BY MR. BREEDLOVE:

Q. You had talked about -- and it seemed -- please correct me if I'm wrong. I seem to recall several times you making a distinction of the natural condition of a channel versus the natural condition of the stream flows?

A. Yes.

Q. And so I'm just wondering how when you make a -- if you're saying -- well, number one, in your opinion, was the San Pedro River navigable in its ordinary and natural condition in 1912 or, you know, in February 1912?

A. Okay. There's a lot of legal issues in that question, but I sure don't think so. I don't see any way you could have floated a boat.

Q. When you determine that, the natural -- when you determine in the natural condition, are you considering,

you know, just the condition of the channel, the stream flows? What is your --

A. Well, what I tried to do to avoid the legal opinion of what kind of boat, how heavily ladened does it have to be, et cetera, was come up with these depths as shown on the last slide or 105, next to the last slide and the flows that you are required.

So to the extent that we really only had at most 25 CFS in that river most of the time, I don't think you could have gotten even a canoe down through the riffles, through the cienegas, and through the beaver dams in the normal -- the ordinary condition.

During the monsoons, yes, but not in the ordinary. Have I evaded the question sufficiently?

Q. So -- and in its natural condition --

A. Okay.

Q. -- it was -- well, you consider all those factors in determining its natural condition in February 1912 that it was --

A. Nonnavigable.

Q. Okay.

A. Okay. I -- in each case, I took the ordinary flow and I add the depletions back in that when I was speaking so that it would be the natural flow. In my condit -- in my opinion, the channel is, since it's never

been channelized that I know of, no real activity has taken place on the channel, it's in its natural condition. So you have an unnatural flow flowing over a natural channel.

And I compensated the unnatural flow to make it natural. So I think the channel in its current state is where nature intended it to be. I think the flows are depleted.

But even if you add that back in, you don't have enough water to float the canoe or the whatever else, the steamwheeler or whatever, mast ship, whatever you want to put on it. I don't think it'll work.

THE CHAIRMAN: Anything else?

EXAMINATION

BY THE CHAIRMAN:

Q. Mr. Gookin, early in your testimony you described what you concluded to be an incident of canoe travel on the San Pedro River?

A. Yes, maybe.

Q. Then it may have happened?

A. It may. We know canoe travel happened. It's not 100 percent clear it was on the San Pedro. Possibly it was on the Gila. I think it was on the San Pedro, but that's a guess.

Q. Would that have been during an ordinary condition on the river?

A. No.

THE CHAIRMAN: Anyone else have any other follow-up questions for Mr. Gookin?

Mr. Gookin, we certainly appreciate your being here today, and we appreciate your testimony.

MR. GOOKIN: Thank you for staying for it.

THE CHAIRMAN: Okay. Are there any other matters to come before the Commission that either party feel important? I'm about to announce the briefing schedule. Okay.

You might want to take notes. The record for submission of evidence will remain open until noon, Friday, August 23rd, 2013. At that point, the record will be closed. And might add additionally as far as the submission of oral testimony, that has closed as of now.

Parties desiring to file memoranda may do so providing such memoranda are filed no later than noon, Friday, September 13, 2013, if you feel lucky. Otherwise, submit it on Thursday, September 12. But in no event should you submit it at 1300 hours on Friday, September 13th.

Okay. Mark's awake again. Responsive memoranda, if you desire to file them, should be filed or must be

filed no later than noon, Friday, September 27th, 2013. As of noon on Friday, September 27, briefing will be closed.

Any party that is filing an opening or responsive memorandum is asked to file a proposed form of order which will include findings of fact and conclusions of law. We recognize that this is somewhat different than what we have done in the past.

But inasmuch as we are likely to be in the Superior Court and the Court of Appeals, what we're asking is that the parties provide us with the basis to show that the Commission is acting in compliance with the mandate from the Court of Appeals and with what has come down in the PPL Montana versus Montana U.S. Supreme Court case so that the Commission can act with the best understanding of what we are supposed to do. And we appreciate your guidance and counsel on that.

After we get all the briefing in, probably shortly thereafter, the Commission is going to schedule a meeting at which it is the intent to discuss the memoranda filed prior to the Commission adopting a final report and order.

Any questions? Yes, Joy?

MS. HERR-CARDILLO: The last meeting that you mentioned, will the discussion just be occurring between

the Commission members, or are you anticipating some sort of oral argument or --

THE CHAIRMAN: I'm anticipating this row of tables here and a likewise row of tables right out there, and we'll have microphones for all the lawyers and we'll sit and discuss this.

MS. HERR-CARDILLO: Okay.

THE CHAIRMAN: His name's Sean? Mr. Hood.

MR. HOOD: Mr. Chairman, findings of fact, conclusions of law, do you want those filed with the opening memoranda or with the responsive memoranda?

THE CHAIRMAN: We'd like them filed by Friday, September 27th.

Any other questions? We appreciate everybody that's been here. Again, we appreciate most of all the witnesses. A lot of preparation went into it. Great information, great evidence, and we do appreciate that. It will be in important in reaching a conclusion on the San Pedro River.

Do you have anything else we want to call to the public?

MR. BREEDLOVE: Future meeting dates. Future agenda items. I don't know. Do we have any -- anything like meeting dates or agendas, schedules?

MR. MEHNERT: Well, no, they all have what they

02:56:43 have received has to do with the evidence, submission of
02:56:46 evidence. And those dates are firm. Yeah.
02:56:51 THE CHAIRMAN: The official call to the public is
02:56:58 given. It appears we're ready to adjourn. We are
02:57:05 adjourned.
02:57:13

(Transcript of Proceedings concluded at 2:57 p.m.)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I DEBORAH CLEARY, do hereby certify that the foregoing Transcript of Proceedings constitutes a true and accurate transcript of the proceedings held in the foregoing matter, all done to the best of my skill and ability.

DATED at Phoenix, Arizona, this 25th day of August, 2013.

Deborah Cleary, RPR/CR
Certified Reporter
Certificate No. 50663