SUPREME COURT OF THE UNITED STATES
No. 142, Original

STATE OF FLORIDA, )
)
Plaintiff, )
)
V. ) VOLUME XVI
)
STATE OF GEORGIA )
)
Defendants. )

TRANSCRIPT OF PROCEEDINGS

The above-entitled matter came on for HEARING before SPECIAL MASTER RALPH I. LANCASTER, held in the U. S. Bankruptcy Court, at 537 Congress Street, Portland, Maine, on November 30, 2016, commencing at 8:38 a.m., before Claudette G. Mason, RMR, CRR, a Notary Public in and for the State of Maine.

APPEARANCES:

For the State of Florida: PHILIP J. PERRY, ESQ.
JAMIE L. WINE, ESQ.
ABID R. QURESHI, ESQ.
MATTHEW Z. LEOPOLD, ESQ.
STACEY van BELLEGHEM, ESQ.

For the State of Georgia: CRAIG S. PRIMIS, ESQ.
ZACHARY A. AVALLONE, ESQ.
KAREN McCARTAN DeSANTIS, ESQ.
EMILY K. MERKI, ESQ.

Also Present: JOSHUA D. DUNLAP, ESQ.





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PROCEEDINGS

SPECIAL MASTER LANCASTER: By the size of the crowd, I think they have been rained out.

MR. PRIMIS: Good morning, your Honor.

SPECIAL MASTER LANCASTER: Good morning.

MR. PRIMIS: The game plan for today is to start with a video deposition of Steve Leitman. We will then proceed with Dr. William McAnally, who is an expert in hydrodynamics and, in particular, salinity in Apalachicola Bay. And then we'll move to Dr. Charles Menzie. Dr. Menzie is an ecologist who will testify concerning the ecology of Apalachicola River and Bay and the species that live there.

And then tomorrow we plan to have an oyster day with some video designations and an oyster biologist who can answer all of your questions about the oddities of oyster biology.

SPECIAL MASTER LANCASTER: Terrific.

MR. PRIMIS: Thank you. My colleague, Zachary Avallone, will be handling the video designations.





We think Mr. Perry had a good approach to it with taking breaks to let you get to the document that will be the subject of it, and Mr. Avallone will handle that.

SPECIAL MASTER LANCASTER: Thank you.

MR. AVALLONE: Good morning, your Honor. As Mr. Primis mentioned, my name is Zach Avallone. I have been at the counsel table throughout this trial, but this is the first time at the podium; so I want to introduce myself.

Your Honor, Florida and Georgia have conferred; and we'll be playing clips selected by both parties. The first series of video clips has been organized into topics by Georgia. And some of Florida's requested clips have been included into those sections. And after those sections are complete, we'll be playing some additional video that was requested by Florida.

And as we just handed up, Georgia has created a binder to make it easier to follow along with some of the documents that are being discussed in the video.

SPECIAL MASTER LANCASTER: Thank you.

MR. AVALLONE: And we also placed a copy of the testimony in the front of the binder in the order that it will be played in the video so it's easier to follow along.

Your Honor, the first set of clips describes Mr. Leitman's background. And there are no exhibits that are going to be discussed during this set of clips.

(Whereupon the video was played.)

MR. AVALLONE: And, your Honor, the next set of clips discusses the impact of the Army Corps of Engineers on the Apalachicola River. And this discussion does not relate to any of the documents in the binder.

SPECIAL MASTER LANCASTER: They do not what?

MR. AVALLONE: It does not relate to any of the documents in the binder.

SPECIAL MASTER LANCASTER: Thank you.

(Whereupon the video was played.)

MR. AVALLONE: Okay. Your Honor, the next set of clips relates to the Army Corps of Engineers' operations of the reservoir system in the ACF Basin. The first document that's being discussed is behind tab 1 in





your binder.

A number of these documents are PowerPoint presentations that do not have page numbers; so to make it easier, we have put a blue flag on page 26. And that is the page that will be being discussed in this first clip.

SPECIAL MASTER LANCASTER: Thank you.

(Whereupon the video was played.)

MR. AVALLONE: And, your Honor, the next document that will be discussed is behind tab 2 in the binder. The document is titled Seeing the ACF Watershed As a System: Examining the Effect of Reducing Irrigation Withdrawals. The first set of questions relates to a slide entitled Conclusion. And we have marked that page with a green flag with the letter A.

SPECIAL MASTER LANCASTER: Thank you.

(Whereupon the video was played.)

MR. AVALLONE: And, your Honor, the next document that will be referenced is in your binder behind tab 3. It is a draft manuscript titled An Investigation Into the 2012 Drought on the Apalachicola River By





Leitman, Pine, and Kiker. The document is GX-754. And it was marked during Mr. Leitman's deposition as Exhibit 14. The first set of clips relate to the first page on line 27. Then the -- we have included a yellow flag to indicate where there will be another discussion, which is on page 14, lines 397 through 400.

(Whereupon the video was played.)

MR. AVALLONE: And, your Honor, at the time of Mr. Leitman's deposition, only the draft article behind tab 3 was available. So the final version of that article was published in June of 2016 in a journal titled *Environmental Management*. And we have included the final version of that paper for your reference behind tab 4. And it has been marked GX-1131.

And the net set of clips will be referencing a document behind tab 5. And this document is a presentation titled An Evaluation of the Supreme Court Lawsuit Filed by the State of Florida Against the State of Georgia in 2003. This document is marked GX-683. The first set of clips we'll be





discussing the slide at page 15. And we have marked this with a red flag with the letter A.

(Whereupon the video was played.)

MR. AVALLONE: And, your Honor, we're going to be staying in tab 5. The next set of clips discusses slides 18 through 20. And we have marked slide 18 with a red flag with the letter B; and it begins with, in the lawsuit.

(Whereupon the video was played.)

MR. AVALLONE: And, your Honor, the next set of clips will be discussing slides 22 and 23. And we have placed a red flag with the letter C on slide 22.

(Whereupon the video was played.)

MR. AVALLONE: And, your Honor, the next document that will be discussed is still in GX-683; and it is marked with a red flag with the letter D. And it's on slide 35.

(Whereupon the video was played.)

MR. AVALLONE: And, your Honor, the final set of clips designated by Georgia relates to slides 38, 39, and 40. And we have placed a red tab with the letter E.

(Whereupon the video was played.)
MR. AVALLONE: And, your Honor, the final video we'll show additional clips from Mr. Leitman's deposition that Florida requested to be included.
(Whereupon the video was played.)
MR. AVALLONE: Okay. Your Honor, that's it for the video this morning. Thank you.
MR. PERRY: Good morning, your Honor, I just have one point I would like to make on the presentation. I think there was perhaps just a little bit of confusion with some of the clips. And so if I might, I would like to point out just two pages in one of the exhibits that Georgia put forward. It's tab 1. It's the 6th and 7th pages that address the effects of reducing agricultural irrigation in the Flint Basin. And on those pages, there's a discussion of, among other things, sod-based rotation, and on the seventh page, which is titled The Effects of Reducing Agricultural Irrigation in the Flint Basin, there's a description of means to reduce the need for irrigation in the basin by 50 to 75 percent on peanut and cotton





crops and a various number of different means that can be used to reduce irrigation by 22 percent, 15 percent, and the like. So that's the 7th page.
They're unnumbered, which is why I'm calling it 7th. It's the 7th page of the document at tab 1 of the binder that Georgia handed up.
Thank you, your Honor.
MR. PRIMIS: Your Honor, the State of Georgia will now call Dr. William McAnally. My colleague, Karen DeSantis and Mr. Avallone, will be handling that witness.
THE CLERK: Please raise your right hand.
Do you solemnly swear that the testimony you shall give in the cause now in hearing shall be the truth, the whole truth, and nothing but the truth, so help you God?
THE WITNESS: I do.
THE CLERK: Please be seated.
Pull yourself right up to the microphone and please state your name and spell your last name.
THE WITNESS: My name is William





McAnally, M C A N A L L Y.
MS. DeSANTIS: Your Honor, may I approach to hand the witness his direct testimony?
SPECIAL MASTER LANCASTER: Please.
DIRECT EXAMINATION
BY MS. DeSANTIS:
**Q.** Dr. McAnally, I have handed you your written direct examination testimony in this matter. Do you adopt this testimony as your sworn testimony in this case?
**A. I do.**
MS. DeSANTIS: I tender the witness.
MR. LEOPOLD: Good morning, your Honor.
SPECIAL MASTER LANCASTER: Good morning.
CROSS-EXAMINATION
BY MR. LEOPOLD:
**Q.** Good morning, Dr. McAnally.
**A. Good morning.**
**Q.** Good to see you again.
Dr. McAnally, you have offered an expert opinion in this case on the effect of various hypothetical scenarios of Apalachicola River flows on average salinity and water quality in Apalachicola Bay. Correct?





**A. That's correct.**
**Q.** And specifically, you evaluated the effects of changes in those river discharge scenarios on salinity in Apalachicola Bay. Correct?
**A. That's correct.**
**Q.** And to arrive at that opinion, you relied on two primary types of modeling, a physics-based model and a statistical-based model. Is that right?
**A. That is right.**
**Q.** And you have stated previously that your statistical-based model alone cannot establish a cause and effect relationship; isn't that right?
**A. A statistical model can establish correlations and mathematical relationships. Interpretation of those results to indicate cause and effect is then another step.**
**Q.** Okay. And you also used those models, sir, to evaluate the effect of sea level change on salinity in Apalachicola Bay; isn't that correct?
**A. That is correct.**
**Q.** And so I know you have discussed both river discharge and sea level rise in your opinions. I want to first focus on your assessment of the effects of river discharge on salinity. Okay?
**A. Okay.**

**Q.** And you're familiar with Dr. Greenblatt, Florida's expert in this case. Right?
**A. I am.**
**Q.** And you know that she assessed the impact of changes in river flows on salinity in Apalachicola Bay. Correct?
**A. I'm sorry. Could you repeat that.**
**Q.** Sure. Dr. Greenblatt assessed the impact of changes in river flows on salinity in the bay; isn't that true?
**A. That's true.**
**Q.** And you're aware also that Dr. Greenblatt testified as a general matter that salinity decreases when more flow enters the bay from the river: Isn't that true?
**A. I'm aware that she has expressed that opinion in her report.**
**Q.** And she also said that salinity increases as less flow from the river enters the bay. Do you recall that?
**A. I recall that her report says that as well.**
**Q.** And you would agree, would you not, Dr. McAnally, that all else being equal, input increased freshwater inflows into Apalachicola Bay decrease salinity. Isn't that true?





**A. Since you added the phrase that she did not; that is, all other things being equal, then I can agree with the statement.**
**Q.** And in the converse, all else being equal, decreased freshwater flow leads to higher salinity in Apalachicola Bay; isn't that true?
**A. That is true.**
**Q.** And you testified that you modeled for specific scenarios of river discharge as part of your opinion. Right?
**A. I did.**
**Q.** And one of those contemplates additional flows into Apalachicola of a thousand cubic feet per second, which you call a conservation scenario. Right?
**A. I'm sorry. I missed the first part of your question about the conservation scenario.**
**Q.** One of those scenarios contemplates a thousand additional cubic feet per second, which is what you called a conservation scenario. Right?
**A. That was what -- how the conservation scenario was described, yes.**
**Q.** But you did not model for any scenarios where there's more than an additional thousand cubic feet per second into the Apalachicola Bay.





Correct?
**A. I don't know the precise comparison of the other flows that were considered. I tested -- I tested four flows; plus I did also run two of Dr. Greenblatt's flows. So how those would compare to the thousand cfs during the dry season I'm afraid I can't answer.**
**Q.** But you're aware, aren't you, Dr. McAnally, that Florida is seeking more than an additional 1,000 cubic feet per second in riverflow as part of the remedy in this case?
**A. I'm not aware of what Florida is seeking, sir, other than what was expressed in my report.**
**Q.** So you didn't model the effect on salinity of an additional incremental freshwater inflow as part of a remedy scenario. Right?
**A. As I said, I modeled four scenarios, the 1992 -- that were labeled as 1992 consumption, as 2011 consumption, and as 2040 consumption, and then the conservation scenario, which was the 2011 or baseline case plus a thousand cfs during selected months. Then I also modeled the two flows by -- that Dr. Greenblatt used entitled No Withdrawals and Remedy. And so those are, a round-up, six different freshwater flow scenarios. But those**





**were the only ones that I ran.**
**Q.** And you're aware that Dr. Greenblatt's remedy scenario was also a thousand cubic feet per second. Right?
**A. I don't recall the specifics of her remedy scenario. I recall that it included -- the only thing that I recall specifically about it was that it included a reduction -- maybe a 50 percent reduction in agricultural use and some other conservation measures.**
**Q.** Okay. All right. Well, you would agree with me, sir, would you not, that all else being equal, additional increments of flow into Apalachicola Bay would have the effect of decreasing salinity. Correct?
**A. As long as you include the statement all else being equal, then, yes, additional inflow will decrease salinity in Apalachicola Bay, although perhaps not by significant amounts, which is the -- one of the things that I found in my analysis.**
**Q.** And you also are aware, are you not, Dr. McAnally, that Dr. Greenblatt testified with regard to something called residence time in Apalachicola Bay. Right?

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**A. I recall seeing that in her report.**
**Q.** And you're aware that she looked at the effect of freshwater flows on residence time in the bay. Right?
**A. I do.**
**Q.** And are you aware that Dr. Greenblatt testified that persistent low flows would increase residence time and corresponding salinities in the bay?
**A. I do recall that her analysis suggested that decreased freshwater flows would increase residence times in Apalachicola Bay.**
**Q.** I'm sorry. Just to clarify, that persistent low flows would increase residence time. Right?
**A. I think you can add persistent to that sentence without any problem.**
**Q.** Great. And you didn't conduct any analysis of residence time; did you, Dr. McAnally?
**A. I did.**
**Q.** Well, you didn't present any analysis regarding the change in river discharge in residence time in your direct testimony; did you?
**A. In my direct testimony, I don't believe I included anything about residence time.**
**Q.** And you're not aware, sir, are you, of the effect



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of residence time on the Apalachicola Bay ecosystem; are you?
**A. I have no opinions to offer on ecosystems, sir.**
**Q.** So you -- you're not aware of the biological impact of the change in freshwater flows on the bay ecosystem. Right?
**A. I have no opinion to offer on biological effects.**
**Q.** Now -- but you are aware that persistent low flows occurred in the Apalachicola River in 2011 and 2012. Right?
**A. I'm aware of that.**
**Q.** And, in fact, your expert report included a chart that reflected the low flows at the Sumatra Gage in 2011 and 2012. Right?
**A. I believe that -- that chart -- such a chart was in my report, yes.**
MR. LEOPOLD: If you would, Mr. Walton, please bring up appendix C, page C-48, in Dr. McAnally's report. And this is tab 2 in your binder.
Your Honor, may I approach?
BY MR. LEOPOLD:
**Q.** Sir, if you want to turn to the hard copy, it's tab 2, appendix C at page C-48.
**A. I'm there.**



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**Q.** I want to invite your attention to the plate, plate 1, at the top of the page. Do you see that?
**A. I do.**
**Q.** And this is your plot of the daily discharge of -- at the Sumatra Gage from 2002 to 2014. Right?
**A. The date range on this plot is 2002 to 2014.**
**Q.** And it's plotting riverflow measured at the Sumatra Gage in the river. Correct?
**A. That's correct.**
**Q.** And I want to direct your attention, if you would, to the portion of the plot that covers the years 2011 and '12. Can you see that portion?
**A. I do.**
**Q.** And that's the period of low flows that I'm -- I have been referring to here plotted on your chart. Isn't that correct?
**A. Yes.**
**Q.** Now, I would like you to now focus your attention on plate 2 on the same page. Okay?
And on plate 2 now you have plotted salinity at Dry Bar in the same time period. Correct?
**A. That's correct.**
**Q.** And if I can invite your attention to the portion



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of the chart that reflects 2011 and 2012 on the right-hand side.
MR. LEOPOLD: If you could highlight those, Mr. Walton.
BY MR. LEOPOLD:
**Q.** Do you see that that period has a corresponding period of higher salinity; isn't that true, Dr. McAnally?
**A. I see that.**
**Q.** And unlike other years, salinity never dropped to the lower levels that it did in prior years on this graph. Correct?
**A. If you're saying there were lower salinities in prior years than in 2011-2012, then, yes, that is correct. That is a correct statement.**
**Q.** And are you aware, Dr. McAnally, that those lower levels of salinity are necessary to flush out saltwater predators in Apalachicola Bay?
**A. I'm sorry. I didn't follow the question.**
**Q.** Are you aware that biologically the system needs lower levels of salinity to flush out saltwater predators in Apalachicola Bay?
**A. I am not offering any opinion on biological predators.**
**Q.** All right. And, now, moving on, your statistical

analysis looked at salinity from three stations in Apalachicola Bay, East Bay, Cat Point, and Dry Bar; isn't that correct?

**A. That's correct.**

**Q.** And you would agree that all three of those stations are influenced by freshwater flow from the river. Correct?

**A. All three of those stations are influenced by freshwater flow from the river.**

**Q.** And you would agree also, would you not, that the locations closer to the freshwater discharge are more impacted from changes in those freshwater flows. True?

**A. Not necessarily, no, sir.**

**Q.** That's not what your modeling shows?

**A. One of the things that I found was that East -- the East Bay station was also influenced by flow out of Tate's Hell Swamp. And so it was the contribution from the Apalachicola riverflow, which is distinct from that, was, therefore, I'll say moderated somewhat or altered somewhat because of the Tate's Hell drainage into the East Bay right -- very close to the East Bay Gage.**

**Q.** And didn't you opine, Dr. McAnally, that the Tate's Hell influence on salinity was 1 percent





approximately?

**A. I don't recall the percentage at East Bay. I recall that at Cat Point and Dry Bar it was a very small fraction. It was probably on the order of 1 to 3 percent. But I don't recall if that was also the case at East Bay or not.**

**Q.** So, Dr. McAnally, if you would, I would like you to turn in your testimony to page 12, which is your demonstrative Exhibit 4. That's tab 1 in your binder, if you want to use that, or you can use --

**A. Okay. Tab 5?**

**Q.** Tab 1, page 12.

Are you with me?

**A. I am.**

**Q.** Okay. And this page shows a comparison between your baseline 2011 consumption scenario and the proposed 1,000 cubic feet per second remedy. Right?

**A. It shows a comparison of -- it says salinity changes between the baseline 2011 versus the conservation scenario was 1,000 cfs.**

**Q.** And it's correct, is it not, that the colored portions of the map indicate the salinity changes. True?





**A. That is true.**

**Q.** And the darker the color indicates the greater change in salinity. True?

**A. That is also true.**

**Q.** So if I could focus your attention to the upper portion of the bay, you will see areas that are in a dark orange color. Right?

**A. I see that.**

**Q.** And you would agree with me, would you not, those areas are closer to the mouth of the river?

**A. They are close to the mouth of the river. I'm not sure -- closer than what?**

**Q.** And part of that area includes East Bay; does it not?

**A. That is in East Bay.**

**Q.** Now, you can set that aside for a moment, Dr. McAnally.

In your testimony you have also offered opinions regarding salinity levels in the bay under different discharge scenarios created by Dr. Bedient. Correct?

**A. I did.**

**Q.** And your model predicted that salinity levels would be at various locations -- would change at various locations in the bay given those inputs.





Right?

**A. My model showed what changes would occur in salinities as a result of differences in those flows that Dr. Bedient provided.**

**Q.** But you didn't do any independent analysis of Dr. Bedient's flow scenarios. Correct?

**A. I did not.**

**Q.** And you never spoke with Dr. Bedient about how he conducted his work. Right?

**A. I did not.**

**Q.** You just modeled the scenarios that counsel for Georgia gave you. Correct?

**A. I modeled the scenarios that Dr. Bedient provided in his spreadsheets.**

**Q.** Which were provided to you by counsel for Georgia. Right?

**A. I believe that's the case, yes.**

**Q.** And are you aware, Dr. McAnally, that Dr. Bedient has testified that all his scenarios relied on data he received from Wei Zeng, who works for the Georgia EPD?

**A. I am not aware.**

**Q.** Okay. And so you're not aware then that Dr. Bedient testified that he did not look at Georgia Tech's criticism of the UIF assessment

report. Is that right?
**A. I'm not aware of that discussion.**
**Q.** And you have no basis to know how that criticism would affect Dr. Bedient's scenarios. Right?
**A. I do not.**
**Q.** You just took the scenarios that Dr. Bedient gave you at face value. Correct?
**A. I took the flows that Dr. Bedient provided and ran them in my model.**
**Q.** And then -- so Dr. Bedient also provided you with a -- or one of the scenarios provided was a 2011 baseline scenario. Right?
**A. That's correct.**
**Q.** And you used that baseline as a comparison for the changes in your flow scenarios; isn't that true?
**A. I used that as the baseline or the comparison point between the -- that and the other three scenarios.**
**Q.** And you're also aware that 2012 was a drought year. Right?
**A. I'm aware of that.**
**Q.** As was 2011. Right?
**A. Correct.**
**Q.** In fact, are you aware that 2012 was a -- was





more impactful in terms of the dry year than was 2011?
**A. I don't recall the specific measures of degree of drought for those two years, but I do know that they were both low flow years.**
**Q.** But you didn't model salinity based on the 2012 Apalachicola riverflow; did you?
**A. I did in the -- in the data model. In the physics-based numerical model, I stopped at 2011 because that was the -- at the time I was running it, that was all that Dr. Bedient had generated.**
**Q.** He didn't provide you with a 2012 scenario. Correct?
**A. Not before I completed my report.**
**Q.** And you're also familiar that Dr. Greenblatt ran something called an unimpacted scenario which assumed no withdrawals of water in the Georgia portion of the basin. Right?
**A. I'm aware that she had a scenario that she called no withdrawals.**
**Q.** And you aren't offering opinion, are you, Dr. McAnally, on the change in salinity levels based on an unimpacted scenario where there is no Georgia consumptive use. Right?
**A. I'm not offering an opinion on that.**





**Q.** But as you have agreed, upstream consumptive uses can result in lower discharges. Right?
**A. As a general statement, upstream consumptive uses do usually produce downstream flows that are smaller.**
**Q.** That's an obvious fact; is it not?
**A. It is, provided you include that remark about as a general matter. I have dealt with some cases in which the -- that are not the general matter. And things can behave in unpredicted ways.**
**Q.** And continuing with Dr. Greenblatt's opinion, one of the things you criticized about Dr. Greenblatt's opinion was that she did not include uncertainty bounds for her model results. Correct?
**A. That's correct.**
**Q.** And you testified that uncertainty bounds analyses are common in these types of studies, and the omission is a serious deficiency. Right?
**A. Could you repeat that?**
**Q.** I believe you testified, sir, that uncertainty bounds analysis are -- is common in these types of studies; and the omission by Dr. Greenblatt is a serious deficiency. Right?
**A. I did say that, yes. And I believe it.**





**Q.** You're aware that Dr. Greenblatt ran a hydrodynamic model in this case. Right?
**A. She ran a hydrodynamic model as well?**
**Q.** As part of her opinion in this case, she ran a hydrodynamic model?
**A. Yes, she did.**
**Q.** Which was similar to your physics-based model. Right?
**A. Correct.**
**Q.** Now, Dr. McAnally, if you would, please, I would ask you to turn in your binder to tab 5. That's FX-922. And this is a document titled Uncertainty Analysis of Estuarine Hydrodynamic Models: An Evaluation of Input Data Uncertainty in the Weeks Bay Estuary, Alabama. Do you recognize this document?
**A. I do.**
**Q.** And it's from 2014. Correct?
**A. That's correct.**
**Q.** And you are listed as a co-author of that. Right?
**A. That's correct.**
**Q.** Now, if you would, please, look at the bottom paragraph in the right-hand corner which starts with the word despite. Do you see that?

**A. Yes.**
**Q.** Take a moment and read that.
**A. Yes.**
**Q.** So are you -- have you had a chance to review that, sir?
**A. I have.**
**Q.** So based on this paragraph, despite its importance, your paper says that uncertainty analysis is an uncommon practice in hydrodynamic investigations. Right?
**A. In -- yes. That's what it says. And in 2013 when this paper was written, that was, indeed, the case.**
**Q.** Thank you, Dr. McAnally.
I would like to move on to a new topic.
It's your opinion, is it not, that sea level is rising in Apalachicola Bay. Right?
**A. It's my opinion that sea level is rising in Apalachicola Bay.**
**Q.** And you have also offered an opinion that sea level rise has increased salinity in Apalachicola Bay since at least 2002. Correct?
**A. That is correct.**
**Q.** And to evaluate the effects of sea level rise in the future on Apalachicola Bay, you used your





model to simulate a sea level rise of approximately .26 meters or 10 inches by 2040. True?
**A. That's correct also.**
**Q.** And that was -- that 10 inches was from a 1992 baseline. Correct?
**A. That is correct.**
**Q.** Now, it's Georgia's position in this case, Dr. McAnally, that this sea level rise is being caused by global climate change. Right?
**A. I'm sorry. I don't know what -- how Georgia feels on it. It's my opinion that sea level rise is -- in Apalachicola Bay is caused primarily by climate change.**
**Q.** Okay. So you believe global climate change is the driver for the increased sea level that you discuss in your opinion. Correct?
**A. I do.**
**Q.** But you're not a climatologist, are you, Dr. McAnally?
**A. I am not.**
**Q.** And you're not offering an opinion in this case about climate change; are you?
**A. In this case I'm offering an opinion about sea level rise, which is a product of climate change.**





**And to the extent that I can read and understand the literature on climate, I have -- do believe that climate change is occurring, has occurred, and will occur in the future.**
**Q.** Okay. And, Dr. McAnally, if you would, I would ask you to turn to tab 3 of your binder, which is a copy of your deposition transcript. If you would, sir, please turn to page 61, lines 12 through 61 -- I'm sorry. Starting at line 12 -- 61, line 12, through 61, 15.
Are you with me?
**A. Page 61, line 12.**
**Q.** Right. And that states, and just going back to your areas of expertise, do you consider yourself an expert in climate change?
Answer. I do not.
Did I read that correctly?
**A. That is correct.**
MS. DeSANTIS: Objection, incomplete impeachment. Could the witness please be directed to look at surrounding lines?
BY MR. LEOPOLD:
**Q.** Sir, would you like to look at surrounding lines of the testimony, Dr. McAnally?
**A. Just that I went on to explain that what I have**





**actually said earlier, I think, is that while I don't consider myself an expert in climate change, I do consider myself expert in sea level rise that is caused by climate change.**
**Q.** Thank you.
**A. Is that -- does that answer your question, sir?**
**Q.** I'll move on. Thank you.
So if you would, please, turn in your binder to tab 6. And this is FX-339. And my first -- are you -- sorry. Are you with me, Dr. McAnally?
**A. And what page?**
**Q.** Just starting on the first page of tab 6.
**A. All right.**
**Q.** And do you recognize this document, sir?
**A. I believe I do.**
**Q.** And this is a chapter, chapter 13, from the IPCC's fifth assessment report, which you cite in your testimony. Correct?
**A. It appears to be that, yes, sir.**
**Q.** And just for the record, Dr. McAnally, the IPCC is the Intergovernmental Panel on Climate Change which was set up through the United Nations. Right?
**A. I believe that's correct.**
**Q.** And you're familiar with the IPCC; aren't you?

**A. I have been following their reports for a number of years; yes, sir.**
**Q.** And you're aware, Dr. McAnally, that it's been regarded by NOAA, the federal government agency, as the most senior and authoritative body providing science advice to global policymakers. Right?
**A. I don't guess I have any personal knowledge of what NOAA says about the IPCC. There are several hundred NOAA scientists that have worked on the IPCC. And I do know that in their reports, NOAA uses IPCC's data and methods. But as far as an official policy, I'm afraid I'm unable to comment.**
**Q.** Okay. If you would turn in your binder to tab 7, please, sir, which is FX-935. Are you there?
**A. I'm there.**
**Q.** Take a moment to review it. And I would like to invite your attention, sir, to the second paragraph from the bottom, which begins internationally.
**A. I see that.**
**Q.** Do you see that?
And that -- that's -- you would agree with me that this web page is from NOAA's climate data





center?
**A. Yes.**
**Q.** Okay. But you did not draw on your sea level rise projections from the IPCC in this case. Correct?
**A. I'm sorry. Please repeat that.**
**Q.** You did not draw your future sea level rise predictions from the IPCC in your opinion for this case. Correct?
**A. Indirectly, yes, sir, I did, because the NOAA and Corps of Engineers protections are based on the IPCC data and methods.**
**Q.** It's -- so as you have testified, you used a planning tool from the Army Corps of Engineers. Right?
**A. Army Corps of Engineers and NOAA.**
**Q.** Okay. So I would like to invite your attention back to tab 6 of your binder, which is the IPCC document, sir. And at this time if you would turn to page 1181.
**A. I'm there.**
**Q.** Okay.
MR. LEOPOLD: Mr. Walton, if you could bring that up.
BY MR. LEOPOLD:





**Q.** All right. I would like to focus your attention, if I may, to the four graphs at the top of the page under the section sub(a). Do you see that?
**A. I see that.**
**Q.** And you have seen this before, correct, Dr. McAnally?
**A. I believe I have.**
**Q.** And you would agree with me that this is the IPCC's likely range of global mean sea level rise as shown through the gray-shaded bands around the black line. Correct?
**A. That's correct. And it's shown for various stages.**
**Q.** Right. And the stages -- you mentioned there's four different scenarios here. Correct?
**A. Correct.**
**Q.** And those scenarios are called RCP's, or representative concentration pathways?
**A. Correct.**
**Q.** And would you agree with me that the different scenarios consider future sea level rise from more conservative to more aggressive. Correct?
**A. That is the intent.**
**Q.** Right. Now, if you would, sir, please turn in your binder to tab 8. And this is McAnally





demonstrative Exhibit 1.
Now, Dr. McAnally, this is the same page or for the same four scenarios that I just showed you from the IPCC. However, on this one, we have plotted your sea level rise future projections with the red data point, which was .26 meters or 10 inches of rise by 2040. Do you see that?
**A. I see that.**
**Q.** Okay. And as you can see, Dr. McAnally, your prediction is in excess of the gray bands on each of these scenarios. Correct?
**A. Sir, by presenting this plot, you have committed a fairly bad error. These plots used by the IPCC are for global average sea levels. They -- those then must be turned into site specific estimates, which is what the Army Corps of Engineers and NOAA does. And they have done -- taken these results and applied them to the standard methods to Apalachicola Bay specifically. And that .26 meters or 10 inches is in the middle of how they have applied these results to the specifics of Apalachicola Bay, which are different than the worldwide averages.**
**Q.** So is it your testimony, Dr. McAnally, then that the sea level rise in the future in Apalachicola

Bay is going to exceed the worldwide average? Is that your testimony?

**A. I don't know what the worldwide average will be. I strongly believe that the worldwide average will be higher than the 2000 -- the 2013 IPCC projections. But the -- as those were used, these 2013 projections that we're looking at here, were the ones that were used by the Corps and NOAA to generate the authoritative results to be used in the United States.**

**Q.** Right. And your point that you selected exceeded even RCP 8.5, which is the most aggressive sea level rise scenario that the IPCC used in this chart. Right?

**A. I believe I have already pointed out that you're making a serious error by --**

**Q.** And, sir --

**A. -- making such a statement.**

**Q.** -- I'll let your counsel -- I'm sure your counsel will get to that when you're doing your redirect; but for now, I would just like to try to get through the questions.

And you testified a moment ago you're not a climatologist. Right, Dr. McAnally?

**A. That I'm not a what?**





**Q.** A climatologist.

**A. That's correct.**

**Q.** And you're not offering an opinion on future climate change. Correct?

**A. I am not offering it in this case.**

**Q.** But you testified in your direct testimony, sir, that there will be a greater level of sea level rise from glaciers in the Greenland ice sheet. Do you recall making that statement?

**A. I do.**

**Q.** But you, yourself, do not have any expertise with Greenland ice sheet melting. Correct?

**A. You seem to be mistaking the -- or misunderstanding the various disciplines. Greenland ice sheet melting is a geophysical process and is included in oceanography. And climatology affects that, but the actual melting of the land-based glaciers is part of coastal engineering and oceanography.**

**Q.** So my question was do you have any personal expertise with Greenland ice sheet melting?

**A. I would not attempt to do an independent research on Greenland or West Antarctic ice sheet melting. However, once again, I do have a reading familiarity with the professional literature in**





**those areas; and I believe I'm capable of reading and evaluating that literature.**

**Q.** So you haven't done any climate modeling yourself. Correct?

**A. I have not.**

**Q.** Now, sir, moving on, you opine in your direct testimony that sea level rose about 3 inches from 2002 to 2014 in Apalachicola Bay. Right?

**A. That's correct.**

**Q.** And when you were asked about that opinion at your deposition, you couldn't recall how you arrived at the 3-inch sea level rise. Do you remember that?

**A. Actually, I don't. But I do recall because I have re-examined my report, perhaps in response to that question.**

**Q.** And you have offered that opinion again in your direct testimony. Right?

**A. That's correct.**

**Q.** But your prefiled direct testimony doesn't provide any citation for your determination that sea level rise has risen 3 inches in 12 years in Apalachicola. Right?

**A. It cites my original expert report, particularly appendix C. And that's where the 3- inch rise**





**was calculated.**

**Q.** So if you would, please, sir, turn in your direct testimony, which, again, is tab 1 in your binder, to page 24; and I would like to focus your attention to paragraph 49.

**A. I'm at page 24.**

**Q.** Okay. And paragraph 49 is where you authored this opinion. Right?

**A. Correct.**

**Q.** And, sir, my question is it doesn't offer any citation to the data that you relied upon to offer this opinion. Correct?

**A. I'm sorry. Are you complaining that I don't offer a citation in this paragraph?**

**Is that your question or --**

**Q.** My question, Dr. McAnally, is simply you haven't cited to the basis for your opinion that sea level rise rose 3 inches in 12 years. Correct?

**A. It does not -- okay. That's part of my confusion here. It says, the statistical analyses of observed data show that. And that is my citation. And that is what occurred in, I believe it was appendix C of my original technical report.**

**So it doesn't cite an external source; it**

**cites my own work. Is that what you mean?**
**Q.** All right, Dr. McAnally. So if you would, turn with me to tab 9 of your binder, please. And this is simply a conversion chart which we have to help us with some mathematical calculations. This is demonstrative Exhibit 2.
And you agree with me, sir, would you not, that the top line shows that 1 inch equals 2.5 centimeters. Right?
**A. That is, indeed, what it says.**
**Q.** And you agree with that conversion?
**A. Yes, sir. It's -- that's slightly rounded; but it is correct.**
**Q.** Approximate?
So -- and you would also agree 25 centimeters is 25 millimeters. Correct?
**A. 25 centimeters is not 25 millimeters; no, sir.**
**Q.** I'm sorry. I apologize. 2.5 centimeters converts to 25 millimeters. Correct?
**A. Yes, sir.**
**Q.** And so you would agree with me then that 3 inches is approximately 75 millimeters. Correct?
**A. That's correct.**
**Q.** And you would also agree that 2002 through 2014 is 13 years if it's -- if you include all the





years. Correct?
**A. Okay.**
**Q.** And so if you -- if you divide 75 by 13, that's approximately 5.8. Do you agree with that math; or I can give you a calculator to -- if you would like to do it yourself.
**A. I'll take your word for it.**
**Q.** Okay. So a 3-inch sea level change from 2002 to 2014 would result in a rate of rise of approximately 5.8 millimeters per year. Correct?
**A. I can't -- I can't confirm that calculation. But if you wish to say so, then I'll accept it.**
**Q.** Well, I just divided 75 millimeters, which is 3 inches; right?
And dividing that by 13, which is the years that you looked at from 2002 to 2014, that yields a rate -- a rise rate of 5.8 millimeters per year. Correct?
**A. Again, I'll take your word for it.**
**Q.** But you would agree with me, Dr. McAnally, would you not, that the gage at Apalachicola only shows an observed rate of sea level rise of 1.96 millimeters per year. Correct?
**A. No, sir; that's not correct.**
**Q.** So if you would, sir, please turn in your direct





testimony to page 35. And, again, that's tab 1 of your binder.
Are you with me, sir?
**A. I'm with you.**
**Q.** Okay. And this is your demonstrative Exhibit 13. Correct?
**A. It is.**
**Q.** And specifically, if you look at the bar on the right-hand side, you can see the median rate for sea level rise observed at the tide gage is 1.96 millimeters per year. Correct?
**A. That is the number on this chart. However, it is not directly comparable to the number that we -- you just calculated.**
**Q.** Okay. And so your assertion that sea level rise rose 3 inches over 2002 to 2014 would require a rate of sea level rise that is approximately triple of what this NOAA tide gage suggests. Right?
**A. First of all, it's not a triple; it's more like a double. But on any trend it's dependent on the period of record. And so in the case of the 2015 figure here, they're using a long-term average number, 19 years, sometimes longer, and factoring in all of the preceding data. And so rather than**





**taking a specific period, like I did, from 2002 to 2014, they are taking a very long-term average of hourly measurements. So the numbers, again, are not directly comparable.**
**Q.** So you would agree with me then your rate of rise that you calculated is almost, not quite, three times the long-term average observed at the tide gage?
MS. DeSANTIS: Objection, asked and answered and misstating the witness's testimony that he just gave.
MR. LEOPOLD: Can he answer, your Honor?
SPECIAL MASTER LANCASTER: Can he?
I don't know.
MR. LEOPOLD: All right.
BY MR. LEOPOLD:
**Q.** Dr. McAnally, you would agree with me, would you not, that the rate of rise that I presented, a 5.8 millimeters, is almost three times 1.96. Correct?
MS. DeSANTIS: Same objection.
**A. I agree that if you compare apples and oranges, you will get a different result.**
**Q.** Now, if you would, sir, please turn in your binder to tab 10.

**A. Tab 2?**
**Q.** Tab 10 of the binder, which is Joint Exhibit 61.
All right. And this is a report by NOAA discussing sea level rise. Correct?
**A. It is.**
**Q.** And you're familiar with this document as well; aren't you?
**A. I believe so.**
**Q.** I would like to invite your attention to page 6 of the document. Are you there?
**A. Page 6?**
**Q.** Yes. And in the second sentence, NOAA also reports a rate of sea level rise of 3.2 millimeters per year. Do you see that?
**A. I see that.**
**Q.** And you're familiar with that as well. Correct?
**A. I'm not specifically familiar with this paragraph. It's been awhile since I have looked at this.**
**Q.** But you would agree with me that that reported rate in the NOAA document I'm showing you is almost double -- or, excuse me. You would agree with me the 5.8 which we discussed earlier is almost double this rate. Right?
**A. Sir, in my age it is many times larger than 3**





**inches; but it has just about as much relevance to the discussion we're having as that number right there.**
**As I told you, these were calculated by two very different methods; and they're based on different ways of treating the data. And so, therefore, they should not be comparable. I would be astonished if they were the same.**
**Q.** Right. I would like to move on to a new topic, Dr. McAnally, and specifically discuss your physics-based model with regard to sea level rise. Okay?
So you tried to predict in your opinion what would happen to salinity in Apalachicola Bay under various changes in sea level conditions in the future. Is that right?
**A. I did.**
**Q.** And you first ran the model with a base condition for current sea level. Correct?
**A. I did.**
**Q.** And you also ran it with a value of sea level rise imposed on that base scenario. Right?
**A. I believe that's -- you stated that correctly.**
**Q.** And then you modeled the effects of that same amount of sea level rise and the effects from the





narrowing of the two easternmost passes based on Dr. Douglass, Florida's expert's report. Correct?
**A. That's correct.**
**Q.** And the value of sea level rise I used simply means that in your future projections, you raised the mean water level in the Gulf of Mexico by the amount that you say sea level rise will have increased. Correct?
**A. We raised the Gulf elevation by the amount that we were testing.**
**Q.** And your -- Dr. McAnally, you're also familiar with the field of geomorphology. Right?
**A. I am.**
**Q.** And you're familiar with something called sedimentation; right?
**A. I am.**
**Q.** Now, the Court hasn't heard any testimony on these topics yet; so I want to ask you a couple of foundational questions. Okay?
**A. Okay.**
**Q.** And in this case, geomorphology refers to the study of the shape of Apalachicola Bay. True?
**A. I think that's an oversimplification, but I'll take it.**





**Q.** Okay. I'll ask more detailed questions as we move forward.
And sedimentation is essentially the deposit of sand and other sediment in the bay. Correct?
**A. Sedimentation is the deposition of sand, silts, and clay sizes as well as organic material in a water body.**
**Q.** And you would agree that the geomorphology of the bay can be affected by sedimentation. Right?
**A. It can be, yes.**
**Q.** And you would also agree that sedimentation can change the depths of the bay. Correct?
**A. It can.**
**Q.** And you would also agree in general other forces like sand washing into inlets to the bay due to wave action can change the depth of the inlet. Right.
**A. It can.**
**Q.** Now, you have acknowledged that your model simulations do not account for all the responses of the bay to sea level rise. Correct?
**A. The physics-based model does not respond to -- does not include all of the various effects of sea level rise.**
**Q.** For example, your model does not assume any

changes to the depth of the bay. Right?
**A. It does not.**
**Q.** And it assumes no changes to the size of the -- to the depth of the inlets. Correct?
**A. It considers only the width of the inlet changing, not the depth.**
**Q.** So -- right. So you did perform a scenario where you decreased the width of the -- of two of the inlets to Apalachicola Bay. Correct?
**A. That's correct.**
**Q.** That was East Pass and Dog Island, which are the two easternmost inlets to the bay. Right?
**A. That's correct.**
**Q.** So in that model run, you attempted to account for this particular geomorphic change. Right?
**A. I did account for that particular geomorphic change to evaluate in a stand-alone mode how it would affect salinity in Apalachicola Bay.**
**Q.** So you ran the same amount of sea level rise in this scenario, which was 10 inches; but this time you narrowed the inlets. Right?
**A. That's correct.**
**Q.** And you would agree with me that narrowing of the inlets, in fact, can result in lower salinities compared to the nonnarrowing of the inlet





scenario. Right?
**A. No, sir. I could not agree with that.**
**Q.** Well, didn't you find that it actually did in that model run that we just discussed?
**A. The -- that model run that we just discussed, the changes were so slight as to be within -- well within the noise level of the model.**
**Q.** Okay. If you would turn to page 29 of your direct testimony, sir. That's McAnally demonstrative 12. Are you with me?
**A. Not yet.**
**Okay. I'm on page 12.**
**Q.** Okay. And I would like to invite your attention to -- well, first of all, Dr. McAnally, this is the comparison of the two scenarios we have just been discussing, one with no geomorphic change and the other with the passes narrowed as we discussed. Right?
**A. It does.**
**Q.** And I would like to invite your attention to the Mid-Bay and St. George Sound lines. Do you see that?
**A. I'm sorry. I couldn't hear that.**
**Q.** The lines on the chart that say Mid-Bay and St. George Sound, do you see those?





**A. I'm sorry. I -- I don't see those words.**
**Q.** On the left-hand column. And we're on -- you're on page 29. Correct?
**A. Oh, I'm sorry. I'm on the table.**
**Yes, sir. I'm sorry. I'm now on page 29.**
**Q.** Okay. And you will see on the screen we have highlighted the Mid-Bay and St. George Sound columns or rows.
**A. Uh-huh.**
**Q.** And you would agree with me that in the pass narrowing scenario, both of those showed a .1 reduction. Right?
**A. Oh, I see what you're saying. You're saying that the Mid-Bay line and the St. George Sound show a .1 change in salinity.**
**Q.** Isn't that correct?
**A. That's correct.**
**Q.** A reduction from salinity?
**A. That's correct.**
**Q.** And, sir, isn't it true that the salinities you're reporting here are average annual salinities?
**A. They are.**
**Q.** And you didn't present in your report or your opinion monthly or weekly average salinities; did





you?
**A. In my report I did not include the weekly. I believe I included some monthly. But the monthly and the seasonal were essentially the same.**
**Q.** And your model, again, moving on from this chart, sir, assumes no raising of the bottom of Apalachicola Bay over time. Right?
**A. That's correct.**
**Q.** And so other than the one example we have discussed where the passes were narrowed, you have essentially increased the depths of the inlets by raising the water levels of the Gulf of Mexico. Right?
**A. Yes, sir. That's what will happen. If you raise the water level, the inlets will get deeper.**
**Q.** And that would result in an increased volume of seawater entering the bay. Right?
**A. Not necessarily.**
**Q.** Didn't you testify, sir, that the salinity in Apalachicola Bay is a mix of the freshwater discharge from the Apalachicola River and the seawater entering the five passes in the barrier islands in Apalachicola Bay?
**A. The -- as I believe I said in my testimony, the level of salinity at a location in Apalachicola**

**Bay is a result of the opposing forces of sea level stand and freshwater flow. Tides can make that bounce around a little bit, but basically it's between those two opposing forces.**

**Q.** Right. And all else being equal, if you raise the level of the Gulf of Mexico, that would mean more saltwater is entering into the bay. Right?

**A. If all else being equal, raising the Gulf level will increase salinities at a location -- any given location in Apalachicola Bay.**

**Q.** But you did not take into account whether the bottom of those inlets will also rise over time; did you?

**A. I considered it. And based on my knowledge of the physics involved and my experience elsewhere, particularly in Louisiana, that it would not have a noticeable effect on propagation of tides or salinity in Apalachicola Bay.**

**Q.** But you're not offering an opinion here on geomorphology; are you?

**A. Yes, I guess I am.**

**Q.** Okay. If you would, please, sir, turn in your binder to tab 3, which is your deposition transcript.

**A. Okay.**





**Q.** And if you would turn to page 325, and I would like to focus your attention to lines 18 to 22.

**A. I'm on 325.**

**Q.** Okay. Line 18 through line 22, do you see that?

**A. I see it.**

**Q.** You testified under oath that you were not offering an opinion on the coastal geomorphology. Correct?

**A. No, sir. That's not what I said.**

**Q.** Doesn't it say, sir, you are offering an opinion here today on the analysis that Dr. Douglass did with respect to the geo -- coastal geomorphology of the barrier islands in Apalachicola Bay?

Answer. I am not?

**A. I did not offer then and I'm not offering now an opinion on Dr. Douglass's analysis on geomorphology.**

**Q.** And, likewise, you have not offered an opinion on the rates of sedimentation in Apalachicola Bay. Correct?

**A. I'm trying to recall. I don't believe my report said anything about it. But in my direct testimony, I believe I did offer an opinion on sedimentation in the bay.**

**Q.** And my question was you didn't offer an opinion





on the rate of sedimentation. Correct?

**A. I don't recall estimating a rate.**

**Q.** And you did not model sedimentation for Apalachicola Bay. Correct?

**A. I chose not to model sedimentation in Apalachicola Bay because I had found in previous instances that it was not a significant factor.**

**Q.** Okay. And, sir, you're aware that sedimentation rates for Apalachicola Bay have been published. Correct?

**A. I have -- I have read reports that report on average rates, yes.**

**Q.** Okay. And you're aware of one rate of up to 8 millimeters per year. Correct?

**A. I'm aware that in 19 -- early 1990's that such an estimate was published.**

**Q.** And you're aware that Dr. Greenblatt reports that rate of sedimentation in her opinion, right, as well as Dr. Douglass?

**A. I don't recall Dr. Douglass offering that number. But I -- I do recall Dr. Greenblatt offering that number, which I discounted because, No. 1, it's -- it was 20 years ago and then was based on data from years before that. So it was too old to be useful.**





**Q.** And, yet -- sir, you will get a chance to expand on your opinion in redirect.

And Dr. Douglass, he did opine on the effects of sedimentation on salinity levels in the bay. Correct?

**A. Doctor -- both Dr. Douglass and Dr. Greenblatt speculated on the effect of sedimentation. I don't believe that speculation was based on the evidence that I have in my experience. So, therefore, I don't believe they were correct.**

**Q.** Thank you. So, Dr. McAnally, you have offered an opinion that sea level rise is accelerating in Apalachicola Bay. Correct?

**A. I have.**

**Q.** And in reaching that opinion, you considered a number of sources. Right?

**A. I did.**

**Q.** And one of those sources you considered is the data from the tide gage at Apalachicola Bay, which is maintained by NOAA. Right?

**A. It is -- I believe it's maintained by NOAA. It is the tide gage there, yes.**

**Q.** And, in fact, you included the chart, which we discussed earlier, in your direct testimony showing this data. Right?

**A. I did.**
**Q.** And if you would turn again in your prefiled testimony to page 35. That's tab 1 in the binder, page 35.
**A. I see it.**
**Q.** Are you with me?
And, now, if I could -- this is the tide gage chart that you cited. Correct?
**A. This is the mean sea level rise chart.**
**Q.** Okay. And if you would, turn back just briefly to page 34. And I would like to invite your attention to paragraph 77 of your testimony.
**A. Yes.**
**Q.** And you state in the last sentence that this demonstrative exhibit clearly shows that sea level rise in Apalachicola accelerated from 1.38 millimeters per year prior to 2006 to 1.96 millimeters per year in 2015 --
**A. I see that.**
**Q.** -- right?
And, now, Dr. McAnally, the image on page 35 of your testimony was taken from NOAA's website. Right?
**A. That's correct.**
**Q.** And so if you would, please, sir, turn in your





binder to tab 14. And that's FX-923.
**A. I'm at tab 14.**
**Q.** Okay. Now, what we have done here is we have reproduced the same image, but it includes the rest of the web page from which it was taken. Do you agree?
**A. That's what it appears to be, yes.**
**Q.** And, sir, have you had a minute to review it?
**A. I see it.**
**Q.** Just to be clear, the word acceleration does not appear in the text on NOAA's web page. Right?
**A. I don't believe the word acceleration appears on this page.**
**Q.** And I want to focus your attention to the text at the bottom of the page. Do you see the sentence that begins, although the mean trend may change -- do you see that sentence?
**A. I see that.**
**Q.** Okay. Now, if you would, turn in tab -- to tab 15 of your binder, which is McAnally demonstrative 3. Dr. McAnally, here we have simply enlarged the same chart that you used; and we have enlarged the sentence at the bottom for ease of reading. Okay?
**A. I see that.**





**Q.** So the sentence immediately after the graph reads, although the mean trend may change from year to year, there is no statistically significant difference between the calculated trends if their 59 percent confidence intervals overlap.
Is that -- did I read that correctly?
**A. That is what it says.**
**Q.** Okay. And you were aware of that language when you included this chart in your prefiled testimony. Correct?
**A. I was.**
**Q.** Now, if you would, please, sir, turn to page 2 of tab 15.
**A. Of tab 15?**
**Q.** Same tab, just the second page. It's the same demonstrative exhibit.
**A. Oh, I see. It's the back of it.**
**Q.** The back of the page.
Are you with me?
**A. Yes, sir. I see it.**
**Q.** Now, on page 2 we have highlighted the confidence intervals in the shaded green.
**A. I see that.**
**Q.** And you would agree that the vertical bar on the





far right is the confidence interval from 1967 to 2015. Right?
**A. That is correct.**
**Q.** And you would also agree with me that the vertical bar on the far left is the confidence interval for 1967 to 2006. Right?
**A. That is correct.**
**Q.** And you can see in the green shading on this demonstrative that the two confidence intervals overlap. Correct?
**A. I can see that.**
**Q.** And when you included this in your testimony, you were aware that this chart demonstrates no statistically significant change in the trend in sea level rise. Correct?
**A. No, sir.**
**Q.** So when you testified that NOAA's chart showed accelerating rates of sea level rise, you knew this chart didn't show that. Right, Dr. McAnally?
**A. I used that chart to show it because that caveat is a very standard one. And in essence, NOAA is protecting their rear end.**
**I can read this chart, and I can understand the statistics. And I -- my interpretation of**

**this is that it clearly shows an acceleration of sea level rise.**

**Q.** Okay.

MR. LEOPOLD: No further questions, your Honor.

SPECIAL MASTER LANCASTER: We'll take a break.

(Time Noted: 10:50 a.m.)

(Recess Called)

(Time Noted: 11:00 a.m.)

MS. DeSANTIS: Good morning, your Honor.

SPECIAL MASTER LANCASTER: Good morning, counsel.

REDIRECT EXAMINATION

BY MS. DeSANTIS:

**Q.** Dr. McAnally, before we look at your salinity modeling and your opinions regarding sea level -- before we look at your salinity modeling and your opinions regarding sea level rise, I would like to ask you to look again behind tab 1 of your binder, page 35, demonstrative 13 in your written direct.

So it is page 35.

**A. I'm sorry, which tab?**

**Q.** Tab 1.





**A. Tab 1, page 35.**

**Q.** Yes. Your written direct testimony, page 35, demonstrative 13.

**A. I'm there.**

**Q.** And at the conclusion of his questioning, Mr. Leopold was asking you about demonstrative 13. Doctor, how does this chart show accelerating rates of sea level rise in the Apalachicola Bay?

**A. By definition, acceleration is a change in velocity. And so this is in effect a -- the millimeters per year makes it a velocity plot or a speed plot.**

**So it shows that back in the early 2000's, it was -- the calculated speed was about 1.3 millimeters per year. And then it -- as it increases, that is a positive acceleration. So that is a -- its acceleration would be whatever the difference is between 1.96 and 1.38, divided by then the time in years.**

**So the fact that it's sloping upwards shows that it's a positive acceleration.**

**Q.** And would you please explain for the Court why you chose to include this particular graph in your written direct and how it's relevant to your testimony.





**A. Dr. Douglass, in his analysis and report, used a linear extension of sea level rise into the future, which corresponds roughly to the low estimate that I used. Then in his direct testimony, he added that inspection of this web page showed that there was no evidence of acceleration and says that it has been 1.96 millimeters per year for the past 40 years. And clearly, that is a mistaken statement.**

**I don't believe that Dr. Douglass would intentionally misrepresent this; but he simply didn't look at this closely enough to realize that 1.96 millimeters per year is a good bit larger than 1.26 millimeters per year.**

**Q.** Thank you, doctor. We will return to a discussion of sea level rise, but I do want to focus on your salinity modeling. And I would like to focus particularly, again, in your written direct behind tab 1, page 7. And we will pull up on the screen the four bullets on page 7 of your written direct testimony on the screen.

And, Dr. McAnally, looking at the particular bullets in your written direct to guide you, can you please describe the hydrodynamic modeling that you did and the scenarios that you used for





your opinions in this matter.

**A. I used these four scenarios, which we took -- again, they were generated by Dr. Bedient. And they represented the scenario 2011, which I called it the baseline. And that is -- represented Georgia's upstream consumptive use quantities of 2011. And scenario 2040, which was the same thing but with upstream consumptive uses to be projected basin-wide in 2040. And then 1992 was a look back at what those consumptive uses were occurring in 1992. And then finally, the conservation scenario, which was the same as the baseline except that the flows were increased by a thousand cfs during the low flow season.**

**Q.** And I would now like to ask you to please turn to page 8 of your written direct testimony -- and we'll bring that up on the screen -- going over to the top of page 9.

And, doctor, could you please look at the bullet points on the bottom of page 8 and the top of page 9 and describe for the Court your findings on salinity changes as a result of the modeling of these scenarios.

**A. Okay. The model showed that the -- going back to 1992 would decrease salinity -- average salinity**

**in the dry season in Central Bay by up to about .5 psu, or practical salinity units, which is equivalent to ppt.**

**The scenario of 2040, however, was -- had a negligible change from the baseline. It was 0.1, which is really within the level of noise of the model. And I considered it to be equivalent to no change.**

**The conservation scenario had the greatest effect. And it showed that it would decrease both annual and dry season average salinity in Central Bay by as much as 0.7 psu, or practical salinity units, plus or minus the confidence limits.**

**Q.** Doctor, the Court has heard before during the testimony of Dr. Greenblatt about the meaning of ppt. But could you please refresh all of us on the definition of ppt and how that corresponds to psu.

**A. Okay. Ppt, or parts per thousand, is a mass concentration that was used for decades, perhaps centuries, in the oceanographic and water quality fields. It was rather difficult to take -- make that measurement because it involved titration of -- in a lab and so forth, so on.**





**And sometime in the 1980's, I think it was, the international community got together and decided that they would change it over to an electrical conductivity standard and just defined the new practical salinity units based on electrical conductivity; that is, sticking a probe into the water, and making it equivalent -- exactly equivalent at 1 ppt and 35 ppt. And then generally they would fit elsewhere.**

**So most of the -- most of the world has converted to using psu, or practical salinity units. There are still some folks in the U.S., including myself when I forget, that drop back to say ppt.**

**Q.** But is psu equivalent to ppt numerically?

**A. For all practical purposes, they are equivalent numerically.**

**Q.** Okay. And, doctor, again, please remind us of the range of ppt values in the Apalachicola Bay.

**A. The values in Apalachicola Bay observed data ranged from very near zero to 39 psu, which is slightly saltier than Gulf water because of local evaporation.**

**Q.** And as you have just described the results of your hydrodynamic modeling, did your modeling





under any of the scenarios that you used show any salinity changes in the bay above 1 psu or 1 ppt as a result of increased flow?

**A. There may have been individual locations -- in fact, there were individual locations, individual days when the change would have been greater than that. But averaged over weeks and months and averaged over space -- well, just it's enough to say averaged over weeks and months I didn't see any that were larger than those -- that 0.7 is the highest I saw.**

**Q.** And, doctor, before we go into the details of some of your hydrodynamic modeling, I don't want to neglect the second kind of modeling that you did for this case. Can you please describe the second type of modeling work, the numerical modeling work you did, and what that showed.

**A. The other -- for many years I have practiced using at least two approaches for every problem. That way if I should make a mistake or miss a decimal point or there may be something fundamentally wrong with the method in one approach, in using a very different approach I'll catch it.**

**And so in this case I used the statistical**





**methods to analyze the observed data from the National Estuarine Research Reserve and to formulate actually a set of opinions and results based on those calculations. And then I was able to compare those with the -- those from the physics-based EFTC numerical model. And they confirmed each other. And so the fact that they confirmed each other and were also consistent with my own experience in the Gulf gives me complete confidence in my conclusions.**

**Q.** And, doctor, would you consider your hydrodynamic modeling to be more understandable perhaps to the layperson?

**A. Yes, it is, certainly. It -- the layperson tends to regard it as a black box, but -- but it's -- certainly, the results look obvious; and people can understand it when they look at the plots.**

**Q.** All right. Well, we're going to focus then on a couple of particular -- a particular finding of your hydrodynamic modeling since it is somewhat more understandable to a layperson. And I particularly want to focus on the conservation scenario that you ran. And I also want to focus on some modeling work done by Dr. Greenblatt under a remedy scenario.

You are familiar with the work that was done by Dr. Greenblatt, as you have testified. Right?

**A. I am.**

Q. And are you critical of some of Dr. Greenblatt's methods?

**A. I am, and I was. I think that Dr. Greenblatt is a very bright person and will become a good engineer with sufficient experience and good guidance on how to approach these problems.**

Q. Regardless of your criticisms of her methodologies, are you critical of her findings?

**A. Her -- Dr. Greenblatt's model results were very similar to my own. So I'm -- obviously I can't say that I'm critical of those results.**

Q. And did you find the results of her modeling to be results that you would have expected?

**A. Yes.**

Q. All right. And, doctor, in particular, I would like to look at Dr. Greenblatt's remedy scenario. What was your understanding of Dr. Greenblatt's remedy scenario?

**A. My understanding of that -- of Dr. Greenblatt's remedy scenario was that it included a 50 percent reduction in irrigation use of water in Georgia. Plus there were some other conservation measures**





**that escape me at the moment. Probably -- I think it was evaporation control and some other things that were included in that remedy.**

Q. And was it your understanding that that remedy scenario run by Dr. Greenblatt would result in increased flow into the Apalachicola Bay?

**A. I believe that I recall that it would, yes.**

Q. All right. I would like to look now behind tab 4 of the binder that was given to you by counsel for Florida, which has Dr. Greenblatt's written direct testimony. And we'll ask the Court and you, Dr. McAnally, to please turn to pages 36 and 37 where we see Dr. Greenblatt's figures 3-15 and 3-16.

**A. Okay.**

Q. And Mr. Smith has helpfully put up both figure 3-15 and 3-16 side by side on the screen.

Is it your understanding, doctor, that these maps show salinity changes in the bay if Florida's proposed 50 percent cut remedy were in place for the years 2011 and 2012?

**A. Yes.**

Q. And what do you see with respect to salinity changes on these maps as modeled by Dr. Greenblatt if Florida's remedy scenario were in place?





**A. They show that -- well, let me first quibble. One of the things that I am critical of her approach was here she used observed flows versus calculated flows. And in the modeling world, that is -- that's -- that shouldn't be done. It should be model results compared to model results. So she used observed flows versus modeled, which is not a good idea.**

**But, again, that's a quibble rather than a criticism of the results, actually.**

**But what I see here is that over most of Apalachicola Bay, the changes are -- the plot shows all white over most of the bay; so that means changes less than 1 psu. There are areas in July of 2012, for example, that show higher changes of between 1 and 2 psu very close to the river mouth, essentially where the river distributaries discharge into the bay.**

Q. So is it your understanding that the white areas on Dr. Greenblatt's map represent salinity changes of less than 1 ppt or 1 psu?

**A. That's my interpretation of this plot.**

Q. All right. Now, doctor, in your work, did you run another conservation scenario that was called the 1000 cfs conservation scenario?





**A. I did.**

Q. And I would like to ask you now to turn back to your own written direct testimony behind tab 1, and specifically to look at page 12. And demonstrative 4 -- and Mr. Smith is bringing that up on the screen.

Now, does demonstrative 4 shows the results of your conservation scenario and the modeling that you ran?

**A. It does.**

Q. And what did you find when you ran your 1,000 cfs conservation scenario?

**A. I found that all of the changes were less than 1 psu. However, I did -- in this graphic, for example, I used a different scheme for creating a color bar; so I was showing down to actually .25 and .1 psu, which is the -- about the lower limit of detection. And so mine, therefore, show a lot more color than hers; but they are showing essentially the same results. If I plotted -- used her scale, these would have been all white.**

Q. All right. So if you could use Dr. Greenblatt's color coding scale, your maps would have been all white?

**A. That's correct.**

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Q. All right. I'm going to ask Mr. Smith to please show us your maps as they would have looked if they had been coded according to Dr. Greenblatt's color scheme.

And Mr. Smith has put up demonstrative -- what we keyed as demonstrative 4 shows your maps color-coded according to Dr. Greenblatt's color scheme; is that right?

**A. That's correct.**

Q. All right.

MS. DeSANTIS: I would like to ask that both this particular map be put side by side with Dr. Greenblatt's maps from figures 3, dash -- figure 3-15, which are her results from 2011.

BY MS. DeSANTIS:

Q. Now, Dr. McAnally, when you look at your maps on the left using your conservation scenario of 1,000 cfs -- additional 1,000 cfs of flow next to Dr. Greenblatt's maps for 2011 showing the 50 percent cut remedy resulting in increased flow, what do you see with respect to salinity changes in the bay under each of these two remedy or conservation scenarios?

**A. I see the same as my conclusion in my testimony,**



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**and that is is that the conservation scenario -- and it turns out her remedy scenario -- both produce changes of less than 1 psu in Apalachicola Bay.**

Q. Okay. Doctor, I want to turn now to sea level rise.

**A. I'm sorry. Let me correct that. About 1 psu in hers.**

Q. Approximately 1 psu?

**A. Approximately 1 psu, yes.**

Q. So whether you run the remedy scenario by Dr. Greenblatt or your scenario based on the 1,000 cfs additional flow, you are seeing comparable salinity changes in the bay?

**A. Yes. They are comparable.**

Q. Doctor, let's talk about sea level rise. And you also, as part of your work in this matter, analyzed the impact of sea level rise on salinity in the bay, as you testified; correct?

**A. Correct.**

Q. And can you please explain the basis for your opinion that there has been a sea level change in the bay in the years that you analyzed up to 2014?

**A. Okay. I took the two methods actually, but the**



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**NOAA data showed that there has been a sea level rise during that period. But I also took the tide gage data and analyzed it and found that it had -- it had, indeed, risen -- sea level had risen during that period from 2002 -- actually, from 1992 to 2014; but particularly I looked at 2002 to 2014. And it showed that it had risen.**

Q. And is it your opinion that sea level rise will have an impact on future salinity levels in the bay?

**A. It most certainly will.**

Q. And what is the basis for that opinion?

**A. It -- that's sort of like asking what is the basis of my opinion the sun is going to rise tomorrow?**

**The literature is unanimous to that effect. I cited some literature about Apalachicola Bay in my report. It's -- that's been a result of, for example, my experience in Louisiana where land subsidence has introduced an apparent sea level rise that is much accelerated over what we see elsewhere in the Gulf. And so in those cases we see the morphological changes. We see the sediment deposition, and we see the shoreline extend inland. In every single case that I'm**



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**aware of, salinity has increased, sometimes precipitously.**

Q. Doctor, could you please turn again, tab 1, your written direct testimony, to page 26, and particularly to your demonstrative 10. Can you explain, please, what this particular graph shows.

**A. Okay. Page 26?**

Q. Page 26, demonstrative 10, which is on the screen.

**A. This shows a range of potential projections of salinity increases from 1992 forward based on, first of all, two levels of -- of projected sea level rise. One, the low estimate by the Corps of Engineers; the other, the high estimate by NOAA, which happens to be the same as that for the Corps of Engineers. And then in addition to those -- that range of sea level rise rates, I have applied the -- a low estimate of my calculations showing the effect of sea level rise on salinity and a high -- higher rate, not the highest rate. But these are extremely conservative estimates of the band that would be most likely experienced by average salinity in central Apalachicola Bay in the future due to sea**

**level rise.**

**Q.** And which of these bands shown do you believe to be the most likely?

**A. I strongly believe that the highest is the most -- that the actual experience is going to be much closer to the high estimate than it is to the low estimate.**

**Q.** And on what do you base that opinion?

**A. I base that on the fact that the National Academy of Sciences has provided a method to project sea level rise in the future and based on IPCC estimates.**

**IPCC -- I'm putting in too many C's. IPCC estimates in the past have been shown to be too low. They're being too conservative. And in the 2013 report, they were -- they were corrected for the effect of Greenland ice sheet melting. And they -- it increased the values. They did not include the effect of accelerated West Antarctic ice sheet melting. And I am -- I read the literature on that; and I am virtually certain that when the next update occurs in the IPCC report and which would then be translated into the Corps' and NOAA's projections, that the number will be higher still. And so I think it**





**will be pushing certainly the upper limit of this and perhaps being even higher than my high projection.**

**Q.** Dr. McAnally, when Mr. Leopold was questioning you, he was asking you to compare what you termed apples and oranges concerning some sea level rise data. Would you please explain why Mr. Leopold was asking you to compare data that should not be compared?

**A. Okay. The -- well, the data that was shown on NOAA's website are calculated by a prescribed formula that all of us involved in coastal engineering are familiar with that -- but it involves long-term averages of many values per day. And so as a result, the 2015 value is -- inherits all of the tendencies of the data going back to the start of the -- of the gage. And in that case, I -- it's sometime in the 1960's, I think, for the Apalachicola Gage. So that 2015 value is, in fact, a very long-term average over decades and reflects the weight of all that has happened before.**

**What I did was I took two distinct dates, 2002 and 2014, and said, what was the mean sea level on these two years? And I compared those**





**and got a difference in the two values.**

**So mine was a discrete analysis of the difference of the rise in -- over that 12, 13-year period, whereas, NOAA's was a weighted average that goes back decades.**

**Q.** Now, Dr. McAnally, in her testimony in this court Dr. Greenblatt suggested that changes in inlet size will offset the impact of sea level rise on salinity in the bay in the future. Is she right?

**A. No, she's not. It betrays, frankly, a lack of knowledge of coastal processes, and in particular those for -- of those of bay estuaries with multiple inlets.**

**They are very dynamic systems. And so, for example, if they get narrower, if a tidal inlet gets narrower, usually the tidal currents will scour it deeper so that the total exchange remains about the same. We have seen this over and over again throughout the world. So it does not follow that as an inlet narrows, it would also become more shallow. In fact, it's usually the reverse.**

**Q.** Did Dr. Greenblatt or any other expert for the State of Florida report on any modeling done regarding changes in inlet size and the effect on





salinity in the bay?

**A. No. And that's -- that's one of the star differences. Drs. Greenblatt and Douglass did no modeling, did no calculations of the effect of sea level rise on salinity. Instead, they were speculating. And, in fact, Dr. Douglass, to his credit, said likely. And I think even in using that word likely, he was -- he was overstepping what he should have concluded.**

**But neither one of them performed any actual calculations. They simply speculated, whereas, I performed detailed calculations; so did Drs. Freeman and Huang and Clough. And they all came to the same conclusion I did when they made their calculations saying that salinities would increase as a result of sea level rise.**

**Q.** Dr. Greenblatt also suggested in her testimony in this court that sedimentation will offset the impact of sea level rise on salinity in the future in the bay. Is she correct about that?

**A. Absolutely not.**

**Q.** And why not?

**A. First of all, the nature of sedimentation from the river is that the vast majority of that sediment will settle out in the delta. That is**

**very close to the mouth of the river. And this is a pattern that we see over and over again throughout the world. And so it does not go out and deposit in the bay. There are -- there's a certain fraction that's very light, settles very slowly, and that would tend to be washed out.**

**And, in fact, if we look at the bottom sediments in Apalachicola Bay, we see that that's the case. It's primarily beach sand and shell fragments throughout much of the bay with a few spots of fine sediment.**

**So there's that. There's also the fact that, again, my experience in other estuaries in which -- for example, Atchafalaya Bay, there is massive sedimentation going on in Atchafalaya Bay. The barrier islands did move and were submerged by sea level rise, and salinity increased steadily throughout the system.**

**And I have -- I have seen that. I have documented it. I have experienced it.**

**So both the -- from basic physics and from my own personal experience I can say that Dr. Greenblatt is totally incorrect when she says that bay sedimentation would offset salinity increases.**





**Q.** Should there be any credence given to an opinion that the migration of barrier islands will protect the bay from sea level rise and increasing salinity levels?

**A. I'm trying to think of a case where that has ever actually occurred. And I have seen a lot of cases -- a lot of situations, projects, where barrier islands migrated; but I have never seen where they strongly affected the salinity within the estuary behind them. So I don't think there's any particular reason to give credence to that speculation.**

**Q.** And, doctor, to your knowledge did Dr. Greenblatt or any other expert for the State of Florida do any modeling to support an opinion that sedimentation or migration of barrier islands will offset the effects of sea level rise on salinity in the bay?

**A. I have not seen anything that Dr. Greenblatt and Dr. Douglass did that would suggest or that they actually did any calculations at all on the subject of the effects of bay sedimentation or barrier island movement on salinity.**

**Q.** Thank you, doctor.

MS. DeSANTIS: I have no more questions.





RECROSS-EXAMINATION

BY MR. LEOPOLD:

**Q.** Dr. McAnally, just a couple more questions.

You just testified that you have seen the effects of geomorphic changes in other parts of the Gulf of Mexico. Right?

**A. I have.**

**Q.** And, sir, you agree that geomorphic processes exist. Correct?

**A. Geomorphic processes do occur.**

**Q.** Okay. And, yet, you didn't model any geomorphic processes other than the narrowing of the pass inlets that Dr. Douglass suggested. Right?

**A. That was the only geomorphic change that I modeled.**

**Q.** And you agree though that sedimentation has the effect of elevating the bottom of Apalachicola Bay. Right?

**A. No, I did not.**

**Q.** And there is published data that shows a rate of sedimentation in Apalachicola Bay. Correct?

**A. There is some very old data that shows the rate of sedimentation.**

**Q.** And because you thought it was old data, you made no assumption whatsoever for sedimentation rate.





You assumed a zero sedimentation rate in your model. Correct?

**A. No. That is not correct.**

**Q.** You assumed no sedimentation to the bottom of Apalachicola Bay; isn't that true?

**A. That is not -- that is not true.**

**Q.** And -- so you didn't address in your model, Dr. McAnally, what the effects of sedimentation are going to be in the bay and whether it would offset sea level rise. Correct?

**A. I did not model the deposition of sediment in the bay because I knew that it would occur up in the delta and have little or no effect on salinity in Central Bay.**

**Q.** Okay. And, now, turning to the remedy discussion regarding Dr. Greenblatt's modeling, the maps that Ms. DeSantis just showed you indicate the magnitude of change in salinity based on the remedy scenario. Right?

**A. That's -- that's what they show.**

**Q.** But those maps don't show the persistence of the change in salinity over time. Correct?

**A. Actually, they do because they show month by month what those -- what those changes are. So you can -- by looking at the month, you can draw**

**conclusions about persistence.**
**Q.** It has no analysis of residence time?
**A. Those graphics have no graphics of residence time.**
**Q.** And they don't show any changes that would be more than a thousand cfs of additional water into Apalachicola Bay. Correct?
**A. Again, I think I have answered this once. I don't know precisely what the flows were in Dr. Greenblatt's remedy scenario. But I know what was in mine.**
**Q.** And in your conservation scenario there was a thousand cfs; is that correct?
**A. That's correct.**
**Q.** And you're aware that Florida is seeking more than that in this case. True?
**A. I'm not aware of what Florida is asking.**
**Q.** And all things being equal, as we have discussed, more water equals lower salinity. Correct?
**A. All things being equal, more fresh water produces lower average salinity, but not by much.**
**Q.** Dr. McAnally, you also just testified that you believe that the IPCC's projections of acceleration in sea level rise will be greater than the 2013 report we discussed. Right?





**A. I believe the next update will increase that.**
**Q.** Okay. Although you haven't done any climate modeling yourself. Correct?
**A. I have not.**
**Q.** And you offered that opinion, sir, based -- because you believe you're qualified to read and interpret the literature regarding sea level rise. Correct?
**A. I would like to distinguish the sea level rise literature as being separate from climatology. It is -- it is more -- it's -- it takes the results of the climatological studies and then applies them to oceanographic studies, which I am much more knowledgeable in. And it's reading the literature on the oceanographic studies of ice sheet melting on land that leads me to believe the IPCC has seriously underestimated that component of sea level rise.**
**Q.** And you're offering that opinion solely based on your reading of the climate literature. Right?
**A. It's based on my reading of the literature.**
MR. LEOPOLD: No further questions.
SPECIAL MASTER LANCASTER: Any redirect?
MS. DeSANTIS: No questions, your Honor.
SPECIAL MASTER LANCASTER: Thank you





very much.
THE WITNESS: Thank you, sir.
MS. DeSANTIS: Your Honor, it's certainly up to the Court; but would this be the best time to break for lunch before we put a new witness on?
SPECIAL MASTER LANCASTER: Well, you're right about it being up to me.
Sure. Let's break.
MS. DeSANTIS: Thank you.
MR. LEOPOLD: Thank you.
(Time Noted: 11:40 a.m.)
(Recess Called)
(Time Noted: 12:48 p.m.)
MS. DeSANTIS: Good afternoon, your Honor.
SPECIAL MASTER LANCASTER: Good afternoon.
MS. DeSANTIS: Is the Court ready to proceed?
SPECIAL MASTER LANCASTER: Sure.
MS. DeSANTIS: We have Dr. Charles Menzie who we will call to the stand.
THE CLERK: Please raise your right hand.





Do you solemnly swear that the testimony you shall give in the cause now in hearing shall be the truth, the whole truth, and nothing but the truth, so help you God?
THE WITNESS: I do.
THE CLERK: Please be seated.
Pull yourself right up to the microphone and please state your name and spell your last name.
THE WITNESS: My name is Charles Menzie, M E N Z I E.

EXAMINATION

BY MS. DeSANTIS:
**Q.** Dr. Menzie, I have placed in front of you your written direct examination testimony in this matter. Do you adopt this as your sworn testimony in this case?
**A. I do.**
MS. DeSANTIS: I tender the witness.

CROSS-EXAMINATION

BY MS. WINE:
**Q.** Good afternoon, Dr. Menzie.
**A. Good afternoon.**
MS. WINE: Your Honor, as is our custom, may we approach just to hand out some cross

binders?
Thank you.
BY MS. WINE:
**Q.** Dr. Menzie, you offered opinions in this case regarding the ecological effects of water consumption by Georgia in the floodplain and forest of the Apalachicola River and on the productivity of the Apalachicola Bay. Is that correct?
**A. That's correct.**
**Q.** And you looked at Georgia's incremental increase in consumption between 1992 and 2011; is that correct?
**A. That is correct.**
**Q.** And by incremental increase, you mean that you considered only the additional amount of water consumed by Georgia between 1992 and 2011. Correct?
**A. For the modeling analysis that you're referring to; that is correct.**
**Q.** So you have not analyzed the impact of Georgia's consumptive use prior to 1992. Correct?
**A. I haven't used the modeling results to take a look at that; that is correct.**
**Q.** Okay. And you haven't analyzed the impact of





Georgia's total consumptive water use over time. Correct?
**A. I haven't modeled that particular use, no.**
**Q.** And you have mentioned the models that you have done in support of your opinions; and you have gotten these models -- or you have done this modeling work based on hydrological scenarios that you received from Georgia's expert, Dr. Bedient; is that correct?
**A. That's correct.**
**Q.** And these include a 1992 consumptive use scenario and a 2011 consumptive use scenario. Correct?
**A. That's correct.**
**Q.** And that 1992 to 2011 time period is the incremental time period that we're talking about. Correct?
**A. Yes. For the modeling purposes, that's correct.**
**Q.** Now, throughout your testimony, whenever you refer to consumptive use, you are referring only to this incremental consumptive use between 1992 and 2011. Correct?
**A. That's not correct. There are other parts of my testimony where I'm looking at longer time frames in response to some of the analysis that other experts for Florida have done.**





**Q.** For consumptive use are you looking at other time frames?
**A. I modeled the time frame that we're talking about using the information provided me from Dr. Bedient; but I have considered the influence of consumptive use that's reflected in the other -- Florida's experts for other time periods in my response to their expert reports.**
**Q.** Okay. But for the work that you did initially -- putting aside any responses to the work that Florida's experts did, for the work that you did it was limited to this incremental time period 1992 to 2011?
**A. That's correct. For the modeling work.**
**Q.** Okay. Now, you also analyzed two future or conservation scenarios from Dr. Bedient. Correct?
**A. I looked at the 1,000 cfs conservation scenario.**
**Q.** Correct. And I think you also looked at a 400 cfs conservation scenario?
**A. No. What I did was I -- separate from any work that Dr. Bedient has done, I independently looked at the influence of 400 and 1,000 cfs that would be applicable to any point in time prior to or after 1992.**





**Q.** Okay. But you didn't analyze how any additional flow beyond 1,000 cfs would benefit the Apalachicola River or Bay. Correct?
**A. I didn't include that in my modeling.**
**Q.** Okay. Now, sir, this case is the first time that you have ever analyzed whether consumptive use of water has caused harm on an ecosystem. Correct?
**A. That would be correct, yes.**
**Q.** And you certainly have not ever before analyzed whether a specific quantity of water consumed was the cause of harm on an ecosystem. Correct?
**A. That's correct.**
**Q.** But here, you're confident that Georgia's incremental consumption of water since 1992 had a minor impact on flows into the Apalachicola River and Bay. Correct?
**A. That is correct.**
**Q.** Now, in reaching this conclusion, you did not analyze the relationship between agricultural irrigation in Georgia and streamflow into the Apalachicola River. Did you?
**A. I examined that information, but I relied upon the scenarios that were developed and provided me by Dr. Bedient for the modeling of that -- of those differences.**

**Q.** You didn't analyze that relationship yourself?
**A.** **That's correct.**
**Q.** And you didn't analyze whether agricultural irrigation by Georgia compounds the impacts of drought on streamflow in the Flint River Basin. Correct?
**A.** **I didn't specifically look at that.**
**Q.** You also didn't look at the impacts of streamflow on the various microhabitats in the Apalachicola River. Correct?
**A.** **I didn't disaggregate or specifically look at micro habitats; that's correct.**
**Q.** And you didn't examine basin yield, meaning how much water the watershed yields per unit of rainfall. Correct?
**A.** **That's correct.**
**Q.** Now, you're aware that Georgia's consumption in the ACF Basin began increasing dramatically around 1970. Correct?
**A.** **I'm aware that use may have begun around that time. I don't have any sense of whether it was dramatic or not.**
**Q.** Okay. Sir, if you could turn to tab 1 in your binder that I handed you.

Tab 1 is a document marked FX-575. It's a





USGS publication entitled Georgia Irrigation, 1970 to '80, A Decade of Growth. Do you see that?
**A.** **I do.**
**Q.** And you may recall this was an exhibit in your deposition. Correct?
**A.** **That's correct.**
**Q.** And if you could turn to the page in the document that's marked page 1, but it's actually about nine pages into the document. And you will see that there's -- it says Abstract at the top of the page?
**A.** **I do see that.**
**Q.** And, sir, if you could just read the first sentence under Abstract to yourself.
**A.** **I have read it.**
**Q.** And, sir, do you see that the USGS is reporting here that irrigation use in Georgia increased by a factor of 12 between 1970 and 1980. Correct?
**A.** **That's correct.**
**Q.** And that that was the fastest rate of increase among the southern states?
**A.** **Yes.**
**Q.** Okay. But your analysis of the impacts on the Apalachicola River and Bay of Georgia's





consumptive use did not consider this 12-fold increase in agricultural irrigation. Correct?
**A.** **Going back to -- in earlier testimony, I looked at the period, specifically post-1992, using the scenarios provided me from Dr. Bedient. So I didn't specifically look at this 10-year period or this aspect of it.**
**Q.** Now, even though you did not evaluate the impact of Georgia's consumption prior to 1992, you did go back earlier than 1992 in assessing a number of other potential causes of harm. Correct?
**A.** **That's correct.**
**Q.** So, for example, you evaluate the potential impacts of road construction and other land use changes in Georgia going back to the 1950's. Right?
**A.** **That's right.**
**Q.** And you analyzed what you called natural and man-made stressors other than Georgia's consumption going back to the 1940's. Right?
**A.** **I did do that, yes.**
**Q.** So you did a modeling analysis and drew conclusions about causality that looked at other potential causes of harm prior to 1992, but limited your assessment of Georgia's consumptive





use to the incremental increase of water starting in 1992; is that correct?
**A.** **Well, the 1992 to 2011 period that we're talking about, that was for the purpose of modeling, using Dr. Bedient's models. And as I mentioned earlier, I looked at the entirety of influences on the -- on the system to the extent that information was available during that time and prior.**
**Q.** But, sir, you didn't look at the influences of consumptive use prior to 1992 on the system. Correct?
**A.** **Not directly. I looked at responses; that's correct.**
**Q.** And, sir, you cannot tell this Court how Georgia's water consumption between 1970 and 1992 impacted the Apalachicola River and Bay. Correct?
**A.** **I looked at -- as I said, I looked at biological responses. So, for example, I would have compared -- I did compare the fish community and their abundance post-1992 and even in more recent times to those that existed in the 1970's and 1980's. So I did that type of analysis to see if there was any influence.**

Q. But, sir, your report -- your prefiled direct testimony does not tell this Court has Georgia's water consumption between 1970 and 1992 impacted the Apalachicola River and Bay. Correct?
A. **That's right.**
Q. Now, I would like to talk about some of your specific opinions on the impact of streamflow on certain riverine species. Okay?
And you understand that riverine species are just species that live, for example, on the Apalachicola River. Correct?
A. **That's correct.**
Q. Now --
A. **I'll understand it as such.**
Q. Okay. Thank you.
Now, you claim that incremental water consumption by Georgia since 1992 has had at most a negligible impact on the Gulf sturgeon population in the river. Correct?
A. **That's correct.**
Q. And you conclude that anticipated future consumptive use by Georgia is expected to have a negligible effect on threatened and endangered mussel species. Correct?
A. **That's correct.**





Q. And in your direct testimony, you cite as the basis for both of these opinions the 2012 and the 2016 biological opinions of the U.S. Fish and Wildlife Service. Correct?
A. **Among other -- among other considerations; that's correct.**
Q. Now, you understand that for the biological opinions, the Service attempted to isolate the effect of reservoir operations and hold all other factors constant. Correct?
A. **I understood that they represented what they believed to be the flows that would be present in the river under all other influences, including consumption of water by Georgia, and then compared the differences in reservoir operations with that as an underpinning.**
Q. So Georgia's water consumption was one of those other factors that were held constant by the Service in its analysis. Correct?
A. **I think the Service represented the flows and, you know, the consumption history of Georgia within their analysis. It wasn't held as a constant number.**
Q. Sir, you don't recall that they were isolating the reservoir operations and holding the other





factors constant?
A. **What they kept the same between the comparisons were the underlying flow regime, which included Georgia's consumption of water. So what they were comparing, including Georgia's consumption of water, what was difference or what biological effect there might be associated with differences in the operation of the reservoirs to look at whether or not those changes in the operations might pose a -- some form of risk to the species that were in the river.**
Q. The Service wasn't analyzing the impact of changes in consumptive use on the ecosystem. Correct?
A. **That wasn't their focus. They incorporated that in their analysis.**
Q. Okay. Now, let's look at some of the things that the Service did find in the biological opinion. So if you could turn to tab 2 of your binder.
Tab 2 is JX-72, which is the 2012 biological opinion. You recognize this document. Correct?
A. **I do.**
Q. And, sir, if you could please turn to page 144.
A. **I'm there.**
Q. And, sir, do you see the section 7.1 at the





bottom?
A. **Yes.**
Q. If could you look at the last paragraph of the page which begins, take of listed mussels, and just read that to the end. It continues on page 145.
A. **I have read it.**
Q. Now, sir, you understand from that that the U.S. Fish and Wildlife Service found that mortality, either immediate or delayed, may occur when flows at Woodruff Dam fall below 10,000 cfs. Correct?
A. **Actually, this particular sentence needs to be understood in the context of what their full analysis is. And basically what this means is that there has been circumstances during which mussels have come to occupy areas during higher flows. And when those flows decrease, such as below 10,000 cfs, some of those mussels are stranded. And when they're stranded for an extended period of time, they can die. So that's the context.**
**It's not always the case, but it's the context by which this reference comes from.**
Q. Yes. And the Service says that the harm can occur at flows less than 10,000 cfs as a result

of reduced growth and/or reproduction due to high temperatures and low dissolved oxygen. Correct?

**A. Right. The causes of mortality in mussels that are stranded would either be direct exposure, they might be eaten by animals, or the dissolved oxygen in remnant pools might decrease. But this would occur under any circumstance where flows were changing from a higher flow to a lower flow.**

**Q.** Okay. Now, sir, if you could turn to page 151 of this document. Do you see the section 8 titled Conservation Recommendations?

**A. Yes.**

**Q.** And, sir, if you could read the paragraph that's numbered 3 in that section to yourself.

**A. Yes.**

**Q.** Now, sir, you understand from this that the U.S. Fish and Wildlife Service was recommending the reduction of overall streamflow depletions in the ACF Basin, particularly on the Flint River. Correct?

**A. Let me read that again with regard to your question.**

**You said recommending reductions?**

**Q.** Correct. This is under a section called Conservation Recommendations.





**A. Right. I read that as the Fish and Wildlife Service under Conservation Recommendations suggesting that the states work together to look for alternatives.**

**Q.** And one of those alternatives is reducing overall streamflow depletions in the ACF Basin, particularly on the Flint River. Correct?

**A. That's included as an example that water users and managers can work together to identify alternatives to agricultural use -- to reduce agricultural use of water in the Flint River Basin, yes.**

**Q.** So the answer to my question is, yes, that was one of the recommendations?

**A. Well, that's something they're recommending that the states consider. I don't think they're suggesting that with regard to their biological opinion.**

**Q.** Sir, do you see right there in No. 3 it recommends work in consultation with the states and other stakeholders to assist in identifying ways to reduce overall depletions in the ACF Basin, particularly the Flint River. Correct?

**A. Yes.**

**Q.** Okay. Now, sir, let's look at tab 3, which is





the 2016 biological opinion. It's JX-168. And if you could, sir, first, please turn to page 74.

And, sir, are you there?

**A. I am.**

**Q.** Okay. At the bottom of that page, do you see there is a section about juvenile sturgeon?

**A. Yes, I do.**

**Q.** And, sir, if you could just read that paragraph that continues onto page 75.

**A. I have read it.**

**Q.** Okay. So, sir, do you see that the Service there finds that very young juvenile Gulf sturgeon have a lower tolerance for saline conditions than sub-adult or adult surgeon. Correct?

**A. What's being reported here is from the literature; and, yes, what they are pointing out is that the younger sturgeon may be more sensitive to salinity. That's correct.**

**Q.** And they cite a study that observes 100 percent mortality of 72-day-old juvenile sturgeon when exposed to 10 ppt salinity. Correct?

**A. That's what the -- this particular experiment showed.**

**Q.** And then the Service goes on to say that conditions like lower salinity in foraging areas





may be vitally important to the growth and survival of young-of-the-year juvenile sturgeon. Correct?

**A. That's what they say. Yes, that's correct.**

**Q.** And, sir, you know that changes in streamflow can affect salinity regimes. Correct?

**A. I do.**

**Q.** Okay. Now, could you turn to page 86 of this document. And if you could, sir, do you see the section that says *Interpretation,* in italics?

Right under the figure.

**A. I got it.**

**Q.** Okay. If you could read those two paragraphs to yourself, please.

**A. I have read it.**

**Q.** And, sir, do you see here that the Service is saying that reduced floodplain inundation, even small reductions on the order of 4.7 to 6.3 percent, can have an adverse effect on Gulf sturgeon. Correct?

**A. I don't think that's a conclusion that they have reached. I think that -- when I read this, I read this as a -- populating a concern, because I know that there is no evidence that these have had effects on sturgeon in the Apalachicola**

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**River.**
**Q.** Sir, using your words then, the Service is at least concerned that reduced floodplain inundation, even in very small percentages, can have an adverse effect on Gulf sturgeon?
**A. My reading of these parts of the document is that it's incumbent upon the Service to identify aspects of the operation that could be an issue and to articulate what those are. It's when they reach their conclusions about the overall effects of operations that you get the -- sort of the net outcome of their deliberations and analysis. So --**
**Q.** Sir, I'm just asking if you see that concern stated there by the Service?
**A. I see that concern stated there, and I understand what it means and what it doesn't mean.**
**Q.** Sir, could you please now turn to pages 136 and 137 of this document.
**A. I'm there.**
**Q.** And, sir, do you see that on these two pages there's a discussion of fish hosts?
**A. Yes.**
**Q.** And, sir, fish hosts encompasses fish other than just the Gulf sturgeon. Correct?



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**A. That's correct.**
**Q.** And, sir, if you look at page 137 of this document, the paragraph that starts, although mussels. It's the second paragraph. Do you see that, sir?
**A. Yes.**
**Q.** Do you see that in the second line the Service is saying that reproduction of many fishes is intricately tied to the floodplain. Do you see that, sir?
**A. Yes.**
**Q.** And that flow regimes can affect reproductive success and other attributes of these fish?
**A. Right.**
**Q.** Now, sir, could you please turn to page 192 of this document. Do you see there there is a section on mussels. And we don't need to look at it in detail again, but you will see similar language that we looked at from the 2012 biological opinion. Correct?
**A. Yes.**
**Q.** Now, sir, lastly, if you could turn to page 201 of this document.
**A. Were you asking whether I agreed with what was --**
**Q.** No, no, no.



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**A. -- in the paragraph?**
**Q.** I'm trying to move quickly since it's similar language.
**A. Okay. All right.**
**Q.** I was just asking if it's similar language.
**A. It begins with a similar sentence.**
**Q.** So if you can look at page 201, this is the conservation and recommendations of the 2016 biological opinion?
**A. Yes.**
**Q.** And, sir, if you could turn to page 203, which is a continuation of the listing of these recommendations. And if you could read numbers 8 and 9 to yourself, please.
And --
**A. I have.**
**Q.** And, sir, do you see here the Service is recommending water conservation measures to avoid impacts to fish and wildlife resources by working with municipal, agricultural, and industrial water users to reduce consumptive uses. Correct?
**A. Yes.**
**Q.** And that the Service also recommends planning future water management to minimize consumption and thus minimize the detrimental effects on



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species from consumptive water use. Correct?
**A. That's what it says.**
**Q.** Thank you.
Now, sir, I would like to talk about your opinion on the impact of Georgia's water consumption on the inundation of the Apalachicola River floodplain. Okay?
**A. Yes. By inundation you mean flooding --**
**Q.** I was just going to ask you that.
**A. -- of the floodplain?**
**Q.** Are you referencing the water level of the floodplain that surrounds the Apalachicola River?
**A. I am.**
**Q.** And you testify in your prefiled direct that floodplain areas are connected to the river via sloughs or channels. Correct?
**A. That's correct.**
**Q.** And that during low flows, water levels can fall below the mouth of the sloughs. Correct?
**A. That's right.**
**Q.** And that that can be harmful to the floodplain and the floodplain habitats. Correct?
**A. Well, what that means specifically is that once that happens, the water is not flowing into the floodplain via that slough, yes.**

**Q.** And that can result in harm to those habitats?
**A.** **It could be a period during which there is dryness. But that happens -- you know, that would happen also under natural conditions. So it's -- it would depend on the matter of degree.**
**Q.** Sure. But those times of dryness can have adverse impacts on the habitats in those sloughs. Correct?
**A.** **That is a time when there's such a potential. But it doesn't necessarily mean that that has happened.**
**Q.** I'm just asking if it's a possibility?
**A.** **Is it a possibility?**
**Q.** Yes.
**A.** **It's a possibility, yes.**
**Q.** Okay. Now, to the contrary, when flow increases, the inundation expands beyond the boundaries of the slough stream beds; is that correct?
**A.** **That's correct.**
**Q.** And that can be beneficial to the floodplain and the floodplain habitats. Correct?
**A.** **Again, that provides the water that some of the plants in the floodplain require to continue to grow, yes.**
**Q.** And there are over 300 sloughs in the





Apalachicola River. Correct?
**A.** **That's my understanding.**
**Q.** Now, Dr. Menzie, if hypothetically all of the sloughs in the Apalachicola River were disconnected or cut off, that would decrease floodplain inundation. Correct?
**A.** **Under that hypothetical, yes. If you blocked all the sloughs with sediment or something of that nature, you would -- you would have that -- an adverse effect.**
**Q.** And that would have a harmful impact on the floodplain, including that it would contribute to the drying of the floodplain forest. Correct?
**A.** **Yes. Blockage of all the sloughs would have an adverse effect upon the floodplain.**
**Q.** And it would decrease habitat for species that depend on the floodplain forest?
**A.** **It would turn the floodplain forest from a wet forest to a dry forest.**
**Q.** Now, turning back to your prefiled direct testimony, you note that USGS researchers have found floodplain inundation has declined since the 1970's. Correct?
**A.** **I believe they -- that's correct, yes. It's been a long-term decline.**





**Q.** And the forest ecosystem of the floodplain is an important habitat for many species. Correct?
**A.** **It does provide habitat for many species.**
**Q.** And trees can be an indicator of changes in the ecosystem?
**A.** **In this particular case where we're talking about flooding, trees can be an indicator of changing from wetter to drier environments.**
**Q.** And you believe that there has been a shift in the Apalachicola River floodplain towards tree species that are characteristic of a drier, less inundated habitat. Correct?
**A.** **I do believe that has occurred.**
**Q.** And as an example, there's been a change in the abundance of tupelo trees and the production of tupelo honey from those trees. Correct?
**A.** **There's definitely been a change in the abundance of tupelo trees.**
**Q.** Okay.
**A.** **The production of honey is influenced by a lot of factors.**
**Q.** Now, you conclude that the changes in floodplain forest composition that have been detected since the late 1970's are linked to changes in the extent and duration of floodplain inundation.





Correct?
**A.** **Well, I believe that the changes occurred prior to the 1970's. So the 1970's changes continued; but they had begun well before that as -- as the U.S. Geological Survey has pointed out.**
**But, yes, those changes that have occurred since the construction of the dam are related to a decline in the flooding of the floodplain.**
**Q.** Well, you agree that riverflow and floodplain inundation are related. Correct?
**A.** **They are related.**
**Q.** Okay. And you didn't consider the impact of Georgia's consumptive use on riverflow until 1992 despite these changes in floodplain inundation that you know began in the late 1970's. Correct?
**A.** **I have actually looked at the influence prior to that. I think the earliest years I looked at were around 1996.**
**Q.** Okay.
**A.** **But not prior to 1970, no.**
**Q.** Okay. Now, do you recall that in the report you submitted in this case, you included a figure that showed changes in floodplain inundation between 1922 and 2015?
I can help you out if you don't remember.

**A. Yes.**
**Q.** I don't think it was in your prefiled direct; but if you could in the binder, turn to tab 9.
And what we have done in tab 9, just to try to save a little paper, we have just included some excerpts of your report, because it was quite lengthy.
So if you just turn, like, one page in here, do you see that we have got page 85 from your report excerpted here?
**A. Yes.**
**Q.** And it has a chart. Do you see that chart with the blue line that says climate year underneath?
It's figure 26.
**A. Yes, I do.**
**Q.** Okay. Now, in this chart you were showing annual acreage of floodplain inundation from 1922 to 2015. Correct?
**A. Yes. I have.**
**Q.** And you include a trend line here. Correct?
**A. That's correct.**
**Q.** And you state that the trend line of these data indicates that floodplain inundation has changed over time with a pronounced decline in annual inundated floodplain acres since the 19 -- since





the late 1970's. Do you see that that's right above the figure?
**A. Yes.**
**Q.** And that this decline is consistent of the period over which changes in floodplain forest and declines in tupelo honey production were observed. Correct?
**A. Correct.**
**Q.** And the decline continues through 2015 on your figure 26. Correct?
**A. That's correct.**
**Q.** And the post-1970's period includes both time of drought on the one hand and naturally wetter periods on the other. Correct?
**A. Right. So --**
**Q.** I'm just --
**A. At this point.**
**Q.** I just want to be clear that the years included all the years, whether they were dry years or wet years. Correct?
**A. Right. At this point though when you ask about the decline, you're looking at the trend line. And just so that the Court is clear about the trend line, it's an average over many years. So when you say going through 2015, it's**





**because it's averaged over the previous number of years. If we were to look actually at the most recent level of inundation, it would be, you know, not at that depth.**
**Q.** Well, sir, looking at this chart, the beginning of the decline in floodplain inundation occurred during a wetter period. Correct?
**A. Yes. There was a wet period in this region. From somewhere in the 1960's to 1970's, the amount of wetness increased in the region.**
**Q.** Okay. So something other than climate was causing the dramatic decline which began in the late 1970's. Correct?
**A. No. It was climate.**
**Q.** Sir, the decline began during a wet period. Correct?
**A. Well, as I just explained, the trend line is affected mainly by the droughts that are occurring. So the -- if you look at the seesaw in numbers that are going up and down, these sharp points that you see periodically occurring, one in the '80's and one in the late '90's, and then, of course, the more recent one, it's those low points that are dragging the line down. That's climate.**





**Q.** Sir, you don't know if the cause of this trend line had anything to do with Georgia's consumptive use; do you?
**A. I don't believe it does.**
**Q.** Okay. But you don't know?
You didn't do that analysis. You didn't analyze what was going on with Georgia's consumptive use starting in 1970 when their agricultural use also started to dramatically increase at this time. Correct?
**A. Can you reask me that question?**
**Q.** Sure. You didn't analyze the impact of Georgia's consumptive use starting in 1970 when we know that its agricultural consumptive use increased dramatically?
You didn't look at the impact of that consumptive use on the floodplain, at least not until starting in 1992. Correct?
**A. Right. I have looked at dates prior to 1990 -- to those periods of time; but you're correct that I did not try to separate out the influence of irrigation in the 1970's in any particular way.**
**Q.** Okay. Now, sir, I want to talk now about your opinion regarding the impacts of Georgia's consumptive use on species in the Georgia portion

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of the ACF Basin. Okay?
**A. Okay. I did not study that, but I would be happy to discuss it with you.**
**Q.** You didn't put it in your prefiled direct testimony, but you included discussion of that in your expert report. Correct?
**A. Insofar as Dr. Allan was talking about it, that's the first time I noticed anybody talking about resources in Georgia in a case that involved Florida. So I responded to Dr. Allan.**
**Q.** Okay. And do you recall stating in your report that factors other than the low flow were impacting species like mussels in the Lower Flint River Basin -- the Georgia portion of the Lower Flint River Basin?
**A. I don't recall saying factors other than the low flow.**
**Q.** Sir, if you could, please, turn back to tab 9, which are excerpts from your expert report. And do you se at the bottom of the paragraph on that page that is the continuation -- it's the first paragraph on the page. It says, clearly factors other than low flow events affect mussel distribution and abundance in the Lower Flint River Basin.



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**A. There are literature on the Flint River Basin; and I believe that the literature, in addition to low flow, talks about substrate type, all the types of things that would normally affect the distribution of mussels.**
**Q.** And, sir, have you reviewed the literature that looks at the impacts of the flow in the Georgia portion of the Flint River Basin?
**A. I haven't.**
**Q.** And, sir, if you could then, please turn to tab 4 in your binder. Tab 4 is a document marked FX-50. And it's an article titled Effects of Reduced Summertime Streamflows on In-stream Habitat in the Lower Flint River Basin, Georgia, U.S.A. Do you see that?
**A. I see it.**
**Q.** Are you familiar with this article, sir?
**A. I may have seen this in general reviews; but it's not something I used in my -- for my -- forming my opinions.**
**Q.** Do you see that the authors are affiliated with the Jones Ecological Research Center in Newton, Georgia?
**A. Yes.**
**Q.** And the National Park Service in Athens, Georgia?



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**A. Yes, I see that.**
**Q.** And do you see that this was part of a Georgia water resources conference in 2015?
It says that after where it says reference.
**A. Yes.**
**Q.** Now, could you please look at the abstract and look at the first two sentences of the abstract. Just please read those to yourself.
**A. I'm finished reading that.**
**Q.** And, sir, do you see that the authors are looking at the relationship between the increase in agricultural irrigation in Georgia and diminished flows in the Lower Flint?
**A. I see that that's what they're studying.**
**Q.** And they're looking at the impact of those reduced flows on the river habitat. Correct?
**A. That's what they're looking at.**
**Q.** Now, if you could review the paragraph just below the figure on that same page, the paragraph that begins, the Lower Flint River Basin. Please just review that and let me know when you're done.
**A. Okay. I'm finished reading that paragraph.**
**Q.** And do you see there, again, the authors are identifying the rapid expansion of water use for irrigation during the '70's. Correct?



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**A. I see that's what these authors are looking at.**
**Q.** And they state that the current levels of agricultural pumping are associated with reduced summertime flows, particularly in droughts. Correct?
**A. I see that's what they're writing about, yes.**
**Q.** Okay. Now, if you could turn to the next page and read the paragraph under Data Analysis.
**A. Yes. I have finished reading the data analysis piece.**
**Q.** Okay. And you see there the authors are looking at habitat inundation at a reach on Ichawaynochaway Creek in the Flint River Basin in Georgia. Correct?
**A. Right. I understand that this is all about the Flint River and its resources, and I did not include assessment of the Flint River as part of looking at the claims with regard to the resources in Florida.**
**Q.** Do you not think it's relevant what the effects of consumption are on the streamflow of the Flint River in Georgia?
**A. It may be relevant for our purposes. It wasn't relevant to my report.**
**Q.** You know that the Flint River flows down into the

Apalachicola River in Florida. Correct?
**A. Of course.**
**Q.** And you were looking at the impacts of consumptive use on the Apalachicola River and Bay. Correct?
**A. That's correct.**
**Q.** Okay. Now, sir, back to this article. They are comparing minimum flows and habitat inundation between a historical drought in 1954 and a more recent 2012 drought. Correct?
**A. That is correct.**
**Q.** And the authors found that the 1954 and the 2012 droughts were similar in duration and intensity. Correct?
**A. For those individual years.**
**Q.** Okay. Now, if you could please turn to the next page, page 3, and read the paragraph -- the first paragraph under Shoal Inundation.
**A. I'm finished reading that.**
**Q.** Okay. And, sir, do you see that there the authors estimated that under the minimum streamflow of the 1954 drought, which was 117 cfs, 82 percent of the shoal habitat remained inundated? Do you see that?
**A. I see it.**





**Q.** But during the drought of similar duration and severity in 2012, the minimum flow was only 5 cfs; and only 43 percent of the shoal habitat was inundated. Correct?
**A. I see that. Yes.**
**Q.** Now, sir, could you look at the right-hand column where it says Conclusions and Future Work, and just read those three bullets to yourself, please.
**A. I have read their conclusions.**
**Q.** And, sir, do you see that there the authors find that increased agricultural water demand is associated with increased frequency of extreme low flows. Correct?
**A. That's correct.**
**Q.** And that there's been a more than 20-fold reduction in the minimum flow compared to the minimum flow during the pre-irrigation era; correct?
**A. I think -- I see that's what they said. Obviously I have not analyzed any of this myself.**
**Q.** Okay.
**A. But that's what they're saying.**
**Q.** And they also found that the reduction in minimum flow caused a substantial decrease in the amount





of in-stream habitat that is available for growth and propagation of aquatic organisms. Correct?
**A. That's what they have said about this particular little stream, yes.**
**Q.** Okay. Now, sir, if you could, please turn to tab 5. Tab 5 is a document marked FX-51. It's another article. The authors are Smith, Golladay, Clayton, and Hicks. Do you see that?
**A. I do.**
**Q.** And they are affiliated with the Jones Ecological Research Center. Correct?
**A. Yes.**
**Q.** And you recognize at least Hicks and Golladay, correct, because you have cited work by them in your expert report?
**A. I have.**
**Q.** Okay. Now, do you see that this paper also was presented at a Georgia water resources conference in 2015?
**A. I see that.**
**Q.** Okay. And if you could, sir, please just look at the first two sentence of the abstract.
**A. I have read that.**
**Q.** And, sir, do you see that the authors attribute the declines in mussel populations in the Flint





River Basin with droughts and increasing water withdrawal for irrigation?
**A. I see that's what they have said in this sentence, yes.**
**Q.** Now, sir, I'm not going to belabor it by walking through the rest of that article. Let's just turn to tab 6. And here, now, instead of an article, we have got a document that's marked JX-21. It's the Flint River Basin Regional Water Development and Conservation Plan. Do you see that, sir?
**A. I see it.**
**Q.** And do you see that underneath the picture it says Georgia Department of Natural Resources Environmental Protection Division?
**A. Yes.**
**Q.** And, sir, is this a document that you're familiar with?
**A. I have seen this document.**
**Q.** Okay. Now, sir, if you could, please turn to page 21 of this document. Do you see it says Summary of Technical Findings?
**A. I see that. I see it, yes.**
**Q.** Okay. Now, if you could turn the page to page 22 and just read the numbered paragraph 3 to

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yourself.
**A. I have read it.**
**Q.** Okay. Now, sir, do you see that this document talks about the circumstances since the extensive development of irrigation in the Lower Flint River Basin?
**A. I see that, yes.**
**Q.** And do you see that the low flow criteria that the U.S. Fish and Wildlife Service established to protect aquatic habitats are not met more frequently and for -- sorry. I'm saying that backwards. That they are not met -- that they are met less frequently and for shorter durations than before irrigation?

I'm sorry for fumbling that. Do you want me to repeat that?

**A. I think I know what you're saying. And what I think you're saying is that post-irrigation that those are not met as frequently as they were pre-irrigation.**

**But what I notice in this is that they're being referred to as criteria, and I don't believe they are criteria. I believe that these were -- I think these were a set of guidelines that were developed, not criteria.**



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**Q.** You're familiar with those guidelines that the U.S. Fish and Wildlife Service put out in 1999. Correct?
**A. I am.**
**Q.** Okay. Now, do you see that Georgia EPD also finds that this is the clearest evidence that agricultural irrigation in Georgia compounds the effect of climatic drought on streamflow in the Flint River Basin?
**A. I really can't speak on behalf of the agency.**
**Q.** Well, do you see those words here, sir?
**A. I see those words here.**
**Q.** And you know this was written by the agency. Correct?
**A. I know it's -- going back, it is an agency document. But I don't -- I haven't had any conversation with the agency with respect to their views on this.**
**Q.** Okay. I would like to switch topics now and focus on the bay as opposed to the river.
**A. Okay.**
**Q.** Now, you analyzed Georgia's consumptive use on the Apalachicola Bay. And in particular, you look at submerged aquatic vegetation, or SAV. Correct?



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**A. It's one of a number of things I looked at. I would say that I made an effort to look at every biological community that's present in the bay for which there is information.**
**Q.** Well, you're --
**A. And that's one of them.**
**Q.** Your opinion, just to be clear, doesn't cover oysters. Correct?
**A. Part of my opinion does cover oysters. But I did not devote the type of effort to evaluating the oyster situation that was devoted to by another expert on behalf of Georgia.**
**Q.** Okay. So focusing on submerged aquatic vegetation, or SAV, that's just a fancy term for seagrass. Correct?
**A. I think what we're referring to here is probably the freshwater plants. So they would not be called commonly seagrasses.**
**Q.** Okay.
**A. It would be the freshwater plants.**
**Q.** My mistake. Seagrass is a saltwater SAV?
**A. Seagrass is more referred to as a saltwater plant.**
**Q.** Okay. And as you said, we're more concerned here with the freshwater SAV. Correct?



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**A. All the plants in the Apalachicola Bay are important ecologically. These particular plants are present at the mouth of the Apalachicola River and in what's called East Bay, and they're valuable as habitat. And then they transition as it gets saltier into seagrass beds. So both seagrass beds and freshwater grass beds are important.**
**Q.** Okay. And this vegetation is important because it's a source of food for many species in the bay. Correct?
**A. It's eaten by a lot of species, including the manatees.**
**Q.** Okay. And would you say in the East Bay nursery area, it's essential habitat for the species that are in the East Bay?
**A. It's an important component of the habitat, yes.**
**Q.** Okay. Now, one of the important submerged aquatic vegetation species associated with East Bay is Vallisneria americana. Correct?
**A. It's one of several species of freshwater plants that are present in this area.**
**Q.** And -- okay. And can we just call it V americana, so I don't keep screwing up the V?

Is that how people refer to it sometimes?

**A. Probably the best thing to call it is either -- water celery. That's kind of a common name that would be very familiar.**

Q. Okay. Let's use that. Much easier for me.

Now, this water celery -- let me just -- before I agree to that, I just want to make sure it's -- are water celery and Vallisneria americana completely coextensive; one doesn't include something more than the other?

**A. No.**

Q. Okay.

**A. That covers it pretty well.**

Q. Okay. Now, this water celery serves as a food source for birds and other mammals; and it provides habitat. Correct?

**A. Birds don't eat it too much, but mammals like manatees would eat it; and lots of little animals in the -- like, fish -- some fish will eat it, yes.**

Q. Okay. And this water celery is more sensitive to salinity. Correct?

**A. Yes.**

Q. Okay. And it doesn't grow particularly well in high salinity environments. Correct?

**A. That's correct. The saltier the water gets, you**





**transition from freshwater plants to marine plants. So you will find -- in Apalachicola Bay you won't find any of these plants in the outer bay; they will all be the seagrasses. But as you go into East Bay, as you get closer to the river, the seagrasses disappear; and the freshwater plants appear.**

Q. Okay. And in your evaluation of how changes in streamflow affect salinity in the bay, you were looking at average salinity values on a weekly basis. Correct?

**A. I was looking at that along with the variation among weekly values. So I looked at the variability in salinity as computed by weekly averages.**

Q. Okay. Now, you cite in your direct testimony a paper by Ken Moore. Correct?

**A. I do.**

Q. And if we could just turn to that, it's tab 7 in your binder.

Tab 7 is JX-32, and this is the paper by Ken Moore that you referenced. Correct?

**A. That's right.**

Q. And if you could please turn to page 9-5. And do you see there is a section on Salinity Effects on





Wild Celery. Correct?

**A. Yes.**

Q. And if you turn to page 9-6, the last sentence on that page begins, the duration of exposure. Do you see that?

**A. I do.**

Q. And if you could just read that to the end of that paragraph that continues on 9-7.

**A. I finished reading that.**

Q. Okay. Now, in this paper -- is it Mr. Moore or Dr. Moore; do you know?

**A. I don't know.**

Q. Okay. Hopefully, we don't insult him if I say Mr. Moore.

He writes that the duration of exposure to high salinity is very important in determining plant survival and possible recovery. Correct?

**A. That's what he says, yes.**

Q. And then he goes on in that paragraph to say that with salinity increased to 15 ppt for just one or two days, growth of V americana, which is wild celery, is reduced.

**A. That's right. And it's important to understand that he's doing a set of experiments.**

Q. Okay. And he says on that same page that





exposure to salinity of 25 ppt for just one day can kill the plants?

**A. Yes.**

Q. But your analysis used only a weekly time scale. Right?

**A. That's correct.**

Q. So in a week that is close to the parameters identified by Mr. Moore, the weekly average salinity value could obscure -- it could be obscured if salinity exceeded 15 or 25 ppt for a day or two. Correct?

**A. I think what you're asking me is if one of my -- let's say a weekly average value of 10 parts per thousand might have had a value of 15 in it that was part of the average. And it could.**

Q. Okay. Now, let's talk about what you did with these average salinity values in your SAV analysis. You calculated salinities for three of the ANERR monitoring station in Apalachicola Bay. Correct?

**A. That's correct.**

Q. And that included East Bay. Correct?

**A. It included what's called the East Bay station, which is not a location that I consider representative of East Bay; but it's the only**

**station internal to East Bay.**

**Q.** Okay. And your direct testimony presents your salinity analysis for only one of those stations, and that's Cat Point. Correct?

**A. Oh, in the direct? You mean the most recent?**

**Q.** Correct. In your prefiled direct testimony --

**A. Correct.**

**Q.** -- you only present the salinity data for Cat Point?

**A. That's correct.**

**Q.** And Cat Point is further from the mouth of the Apalachicola River than East Bay. Correct?

**A. That's right.**

**Q.** And has a higher salinity than East Bay?

**A. It's definitely higher than the East Bay regions where the plants occur. And it is, I think, also higher than what's recorded at the East Bay station.**

**Q.** And wild celery, which does not like the higher salinity conditions, typically does not grow around Cat Point. Correct?

**A. That's the part of Apalachicola Bay around the edges where you would find the seagrass beds like eelgrass and plants like that.**

**Q.** Right.





**A. So they do very well.**

**Q.** You find more of the saltwater plants as opposed to the freshwater plants?

**A. Right. Lots of saltwater plants out there.**

**Q.** Right. Now, you rely in your testimony on a Florida Fish and Wildlife Conservation Commission report on seagrass in Franklin County coastal water. Correct?

**A. I include that in my testimony, yes.**

**Q.** And you note that that document shows a net increase of 159 acres of submerged aquatic vegetation between 1992 and 2010 in the regions of Apalachicola Bay. Correct?

**A. To put that in some context, there were two surveys that were done that mapped out grass beds, either freshwater or saltwater grass beds throughout the entire region. And then calculations were made of area and subtractions and -- were determined in terms of areas of loss, areas of gain. And over the entire region there was a net gain of 100. But there was -- in certain regions like East Bay there was a reduction that occurred.**

**Q.** Okay. And we'll look at that in a moment. But you created this report to say that SAV in the





Apalachicola Bay has been steadily increasing since Hurricane Dennis. Correct?

**A. I don't think that's the basis for that opinion. I base that opinion on two things. One is the monitoring that's been going on by the research station since Hurricane Dennis as well as my observations in East Bay. But I don't believe that what you just referred to would be -- would be the basis for a steady increase.**

**Q.** Sir, if you could, please, turn to page 69 of your prefiled direct testimony. It's on page 31.

Do you see there that you referenced GX-1254, which is the document that you're looking at?

**A. I'm on page 69. Correct?**

**Q.** Paragraph 69.

**A. Oh, paragraph 69. Thank you.**

**I'll get used to the fact that it's over here on my right, but -- let's see. Okay. I'm at 69.**

**Q.** You're at paragraph 69. And do you see there, sir, that you cite GX-1254, which is the document we're looking at, and other reports that similarly suggest that SAV in Apalachicola Bay has recovered following Hurricane Dennis?

**A. Let me -- let me reread 69.**

**Right. So that includes what we were**





**referring to earlier as the Franklin County coastal waters for the entire system. And then that's followed by some sentences from other reports from Florida that were -- that was what I was referring to.**

**Q.** Okay. Now, sir, let's look at GX-1254, which is in tab 8 of your binder.

**A. I have it.**

**Q.** So, sir, can you turn to page 4. Do you see table 1?

**A. Yes.**

**Q.** Sir, do you see the line that says Apalachicola Bay?

**A. I do.**

**Q.** Do you see the column on the far right that says change 1992 to 2010?

**A. Yes.**

**Q.** And, sir, do you see that instead of showing an increase in SAV in Apalachicola Bay, it actually shows a decrease of 2,000 acres of SAV during that time periods?

**A. Right. And I addressed this in my expert report as to the kinds of reliance you should place on this table.**

**Q.** Okay. I will let you address that; but you see

that that is what is shown right here, a decrease of 2,000 acres of SAV in Apalachicola Bay. Correct?

**A. I don't believe that's what the agency thinks it represents.**

**Q.** Okay. But that's what is here in this table. Correct?

**A. That's -- that's the number.**

**And to explain that somewhat, that's the number of mapped acres from aerial photographs between these two points in time.**

**Q.** Sir, you don't have any evidence to contradict that statement as it relates to the wild celery, the freshwater SAV, for Apalachicola Bay. Correct?

**A. What I'm -- what I was pointing out is that my -- my report is much more detailed than this. And it points out the significance of the fact that wild celery and other plants were growing and increasing in the bay since 1992. They were much more abundant in 2005 than in 1992. And it was the hurricane that occurred that year that decimated them. So that's a really important point.**

**And then since that time, the research agency**





**has gone out and documented the return of the plants. And then I went out to see whether they had returned, and they had.**

**So I think that the agency that developed this table recognizes the limitations of being able to judge what was present. And it was largely affected by the turbidity of the water; what can you see from the sky?**

**So they point that out.**

**Q.** Sir, do you have an analysis of how much of the wild celery has returned in Apalachicola Bay of freshwater SAV?

**A. I can speak to my observations.**

**Q.** Sir, other than your observations, do you have an analysis that would contradict the numbers that we see here?

**A. I don't think these numbers have anything to do directly with wild celery because they can't tell that from the sky.**

**Q.** Okay. Sir, you don't have an analysis of how much wild celery or freshwater SAV is in Apalachicola Bay. Correct?

**A. Other than my observations?**

**Q.** Correct.

**A. Right. I have my observations.**





**Q.** Okay. Thank you, sir.

SPECIAL MASTER LANCASTER: Redirect?

REDIRECT EXAMINATION

BY MS. DeSANTIS:

**Q.** Dr. Menzie, to assist the Court and to put yourself and your area of expertise in context, what is your precise area of expertise?

**A. I specialize in an area known as causal analysis. It's kind of like an individual that provides diagnoses of what's ailing an individual or patient. But I basically do that with respect to environmental matters, causal analysis, what causes something to happen. And my broader area of expertise is in marine ecology, riverine ecology.**

**Q.** And so are you an ecologist?

**A. That's by training and by my career, which began in the early 1970's.**

**Q.** Have you previously done work on estuaries and estuarine systems like the Apalachicola Bay?

**A. I have worked on estuaries in the Gulf of Mexico, but my early years I began in the Northeast. And I have experience working on estuaries ranging from the Penobscot, through the Gulf of Maine, through the Hudson River, through the Delaware**





**River, all the way around the coast to San Francisco Bay, San Diego Bay, Puget Sound.**

**Q.** And what is the scope of the work that you were asked to do in this matter by the State of Georgia?

**A. It was pretty narrow. I was specifically asked to look at the claims that were being made of harm to the Apalachicola Bay, to the Apalachicola River, and the floodplain, and to make a determination as to the relative influence of Georgia's consumption of water on any changes that may be occurring within those systems.**

**Q.** Now, counsel for the State of Florida has questioned you about the years that you analyzed. Why did you focus your analysis on the years 1992 forward?

**A. Well, my understanding at the very beginning of my involvement in this case was that there was a claim -- a prayer for relief, if you will, on the part of Florida to have waters -- water consumption returned to the levels of 1992 because there had been harms that had been experienced since that time as indicated by the loss of oysters and other effects.**

**Q.** Did you in the course of your work, Dr. Menzie,

though also consider data and information from years prior to 1992 to inform your opinions?

**A. I did.**

**Q.** And, Dr. Menzie, in the course of your analysis, did you work alone; or did you work with others?

**A. I worked with a team. Typically for these causal analyses approaches that involve bringing together a variety of types of information such as hydrology and whatnot, it's helpful to bring a team together to look at various aspects and then kind of combine that into a whole, a whole analysis.**

**Q.** All right. I would like to ask you and ask the Court to please look at your written direct testimony on page 8. And I know we handed your written direct testimony to the Court; and I know it is also in the very front of Florida's binder, although it's not behind a tab number. And there is a chart. And we'll put this up on the screen, as well in your direct testimony on page 8.

What does this chart show, Dr. Menzie?

**A. These are the primary members of my team. It shows their names and their degrees. And then the areas that I felt were important for answering the questions I was asked to answer are**





**listed across the top. So the methodology I have just mentioned is something called causal analyses. But the technical fields that need to be called upon to answer the questions include marine ecology, freshwater ecology, statistics modeling, and GIS -- geographic information systems -- and whatnot.**

**So while I'm familiar with all of these areas and have deep expertise in some, I felt it wise to bring together a team that could share knowledge so that we could collaborate in putting together our assessments of what was claimed and also the extent to which Georgia was contributing to any changes in the bay or in the floodplain.**

**Q.** Separate and apart from this team that you assembled, did you look at the work of other experts for the State of Florida and the State of Georgia in order to develop your opinions and analyses in this case?

**A. I did. One of the things I wanted to be able to do is have as complete an understanding of the technical issues in this case as I could. So on the biology side with respect to Georgia's experts, I spoke with the expert on oysters to understand what that individual was looking at**





**and to share some of my thoughts. And I talked to and read the reports of Georgia's experts on modeling. And we -- you heard earlier from Dr. McAnally, as an example. I reviewed Dr. Bedient's reports. I had conversations with their staff so that I was clear about what they did.**

**And then I also looked at all the work that was done by Florida's experts. So I wanted to make sure that I had a clear understanding of where the differences lied and to help me feel more confident about my results.**

**So I began with Dr. Flewelling who assessed consumption of water, to Dr. Hornberger who translated that into flows, to Dr. Lettenmaier and then all of the biological consultants that Florida has employed, in particular Dr. Allan who looked at floodplains, and Dr. Glibert who looked at the base of the food web, and Dr. Jenkins who looked at the fish.**

**Q.** Did you also review and analyze literature as part of your work on this case?

**A. I did. It was important to get as -- as broad an understanding of what individual researchers in Georgia and Florida had been discovering over the**





**many years. And so I made a careful examination of those literature to broaden my understanding.**

**Q.** Now, doctor, you have talked about the causal analysis that you did for this matter. And you have spoken of your expertise in causal analysis. I would like to turn to page 22 of your written direct testimony and particularly to look at demonstrative 6 on that page to assist in an understanding of what a causal analysis is. Can you please describe what you are showing in demonstrative 6 in your written direct testimony.

**A. Yes. So, you know, recognizing that this is a very complex problem and that ecosystems are complex, it's important to approach this in a -- you know, in a step-wise manner so that you can -- you can bite off pieces and look at them and then move on to the next.**

**So I use a three-step process. And the first, really, is to look at all of the available information to see whether there is evidence of change.**

**This case really is about change in the bay and change in the floodplain. And so the first step before going any further was to see whether that premise that changes were occurring was**

**supported or not.**

**Then move to tier 2, which in this case is asking the question of whether or not Georgia's consumption of water was sufficient and of a nature that could bring about these types of changes or contribute to them in some way.**

**And so, for example, that would involve the modeling work that I referred to upon cross that looked at the relative influence of Georgia's consumption of water on the floodplains or on changing the salinity in the bay. And then finally, depending on the answer from that step, or to confirm what I found in that step, I consider all the possible causes that may be at play.**

**And there are -- for example, in the case of the river, I was aware, as everybody is aware, I think, that the dam was built; the bottom of the river is decreased. There's been sedimentation that may be blocking some of the sloughs. There's been road construction. There's a variety of things that have happened.**

**And before pointing a finger at one cause and saying, aha, I found the answer, it's important to kind of look across everything to make sure**





**that that's a correct answer or to perhaps identify the things that may be most at play.**

**So that's the nature of the analysis.**

**Q.** And why specifically did you choose to do a causal analysis in this matter?

**A. Well, it has become the state of practice to do causal analyses. And it -- the logic behind it is that it really helps avoid jumping to conclusions. By considering all the possibilities and by taking a step-wise approach, an analyst such as myself is forced to think about what's going on in the system and to consider everything, and after that careful consideration, to be able to identify the things that are most important.**

**So it's a deliberative process that's been developed for that purpose, very much like in the medical community.**

**Q.** When did a causal analysis approach become recognized as best practice in your field?

**A. While this had been well recognized in the medical community for some time, in the 1990's, because of the clean air -- Clean Water Act and the observation that there were many rivers and streams throughout the United States that were**





**biologically impaired, that is, the fish were off; they didn't have the right types of benthic invertebrates, or whatever it might be, states came to recognize that they needed some way to figure out what was going on.**

**So interestingly enough, Maine served as the first step and --**

**Q.** The State of Maine?

**A. The State of Maine. And around the corner we have the Presumpscot River, and that became one of the first case studies for applying causal analyses. They had -- they had been gathering data throughout the '90's. There were a number of issues. And the State of Maine got together with the Environmental Protection Agency and began thinking about how to organize information and how to think about it. And that actually became the first case study.**

**Q.** Did your approach for assessing the ecology in the ACF Basin differ from the approach of experts for the State of Florida?

**A. I think it differed in an important material way. I had the impression, anyway, when I read the expert reports that -- of Florida, that they started by presuming that the harm did -- any**





**harm that was seen must be related to Georgia's consumption of water. And so beginning with that conclusion, at least as it struck me, information was marshalled to prove up that, to kind of help explain how it could be that Georgia's consumption of water was the cause of whatever change that may be occurring or may be seen within either the bay or the river.**

**So that is exactly what the causal analysis method was designed to avoid, jumping to a conclusion like that on figuring out what a cure was when you don't know what the nature of the disease is. And so I had begun with the causal analysis before I saw any of Florida's expert reports. But the most striking difference was that.**

**Q.** And, Doctor, does the approach of Florida's experts to assessments of the ecology in the basin, does that approach render your conclusions unreliable?

**A. I think it must be recognized that the approach that was taken was the one -- was as I just described. And I know of many instances where you can reach a false conclusion if you don't carefully think about the problem and if you**

**don't look at what the alternative explanations might be. So for that reason I would consider it unreliable.**

**Q.** And, Doctor, we're going to go into some of your specific conclusions from your causal analysis; but can you please briefly summarize for the Court your conclusions resulting from your causal analysis here.

**A. Well, in brief -- and I mentioned this three-step process I took. I really didn't see anything happening in the bay that would be considered or be a material change biologically. I did see in my first step changes in the -- in the floodplain. When I looked more deeply at the relative contribution of Georgia's consumption of water to changes, I concluded that while not zero, the influence of Georgia's consumption of water is minor, very small. And then beyond that, for certain aspects of my analysis, I pointed out where some other factors were playing an important role in influencing the changes in the bay or in the river and floodplain.**

**Q.** All right. Now, doctor, moving away from the specifics of your causal analysis and the framework for your causal analysis, I want to





move on to talk about your analysis of the historical hydrological regime. And can you please describe for us what is a historical hydrological regime and why was it important to your analysis and, as a backdrop, your causal analysis for this matter?

**A. Sure. Well, we -- I think we all know that this past year has been a year of drought. So Maine has had a moderate drought. And Georgia, unfortunately, has got an extreme drought. And we have fires spreading across the Appalachians. So we have been in a period of drought for some time.**

**And in thinking about this ecosystem, it's important to understand whether this is an especially unusual event. These are bad droughts, But also -- so, therefore, to look back in time to see what the history of the system is -- and that's known as the historical hydrological regime -- to gain an understanding of what formed the ecosystem.**

**Q.** And in evaluation of the historical hydrological regime of the ACF Basin, what did you conclude?

**A. Well, I looked at three things. You know, we have the gage data that are available for the**





**river, and that shows the flows going up and down at different periods. And we're able to take that back to, you know, the 1920's.**

**And then we have, as a second source of information, information that's collected and maintained by the U.S. Government, National Oceanic and Atmospheric Administration -- NOAA -- on droughts. So we can look at that information and know what kind of drought occurred here in the Northeast, what kind of drought has occurred in the South. And that information can be looked at going back in time as well.**

**But those sources of information take us back only so far. So the third type of information I looked at were tree rings or studies about tree rings.**

**There's a lot of published literature on tree rings. And any kid that has looked at a stump has been able to count the age of a tree. But the tree rings also carry information on the past hydrological regime. And by putting sets of trees together, the scientists in this field can go back hundreds of years, thousands of years. And so I looked at that information to discover what the long-term historical hydrological regime**





**was in the -- in this basin.**

**Q.** And what did you find?

**A. I found something that has been well known to people that have been working in this field -- particular field, and that is that the system periodically flips from wet to dry. And it does that at a cycle of every 20 to 60 years or so.**

**This is -- this has a meteorological understanding to it. And that's -- that's reflected in the people that study the tree rings. Tree rings are very tightly packed when it's dry; and they spread apart when it's wet, and they pack up. And it's possible to see that. So that helped me understand that the Apalachicola River system -- ecosystem was one, as we look at it today, that has come -- has persisted, has moved through this period of time of dryness and wetness.**

**We're currently in a dry period.**

**Q.** And, Dr. Menzie, separate and apart from the historical hydrological regime, did you look at other factors that have historically influenced the ACF Basin and its ecology?

**A. Yes, I did.**

**Q.** And I would like to turn in your written direct

testimony to page 25 and particularly to your demonstrative 7.

MS. DeSANTIS: And, your Honor, this is a rather complex graphic. Would it be acceptable to the Court for Dr. Menzie to move to the screen to explain this demonstrative?

SPECIAL MASTER LANCASTER: Certainly. Please keep your voice up. She has to take down everything you say.

THE WITNESS: Okay. I think I may be on a mike. Does that sound clear?

BY MS. DeSANTIS:

**Q.** Dr. Menzie, as you go to the screen, I would like to just ask you to please describe what this figure shows.

THE WITNESS: I'll point at this, but the Court might also find it helpful to look at the document.

**A. In thinking about what's influenced the bay and the floodplain over the last many decades, I started by just laying out over time the things that people did. And we already recognize that we're talking about consumption of water by Georgia, so that's a given. You know, that's a**





**given from around the 1970's onward. But I wanted to know what the various other things were that were going on in the system.**

**So we had the dams constructed in the '50's. We had various dredging activities that have gone from the '50's into the 1990's. We have changes in the river that we have heard about as a result of the dam and dredging, straightening the river, things like that. And that's what -- so I get these in my mind in terms of when did they occur. And then, of course, we had logging that was focused on the cypress trees.**

**And then the second panel then lays out things that are natural in occurrence. So there are really two big things that happened. One are the periodic occurrences of hurricanes, so these are in these blue bars and red bars. And you will hear about two major hurricanes, one in the '80's and one in 2005 -- this is Hurricane Dennis -- that literally destroyed large portions of the natural resources in the bay.**

**And then the next set of natural events are the occurrence of droughts. And they're shown here.**

**So -- and then in this bottom panel are**





**simply biological events that have occurred such as low points in oyster landings or losses of these plants that we were talking about, listing of species and things, changes in the forage community.**

**So recognizing that we are focused on the consumption of water, it's important to put that into a broader perspective by looking at all the things that might have gone on that might have also influenced that that could confound the analysis and that we need to try to separate out.**

**Q.** Thank you, Dr. Menzie. And based on your analysis of various factors, including those shown on the demonstrative on the screen, what have you concluded historically the impact has been of these various factors on the Apalachicola Bay and floodplain?

**A. Some have short-term influences that are -- seem catastrophic. So, for example, the hurricanes, big impact; and then you will have a recovery from that.**

**Some have had longer-term influences, such as the construction of the dam. It's hard to take the dam away once the dam is there. And that's**





**changed the bottom of the river. And so that's -- that's a condition that exists as a result of that.**

**The dredging activities, I think as we have heard, the dredge materials were placed on the banks; and to varying degrees they continue to block the sloughs.**

**And those are some of the major things that are affecting it.**

**Q.** Has the system recovered from historical periodic episodes of stress?

**A. Well, if we look -- if we think back over the hundreds of years, the system has gone through periodic droughts and wet periods; so what we're looking at today is a system that's resilient in terms of passing through those kinds of conditions. And as I just mentioned, there probably always have been large hurricanes that have occurred periodically; and it does recover from those.**

**Q.** Is the Apalachicola unique in its resilience among other estuaries?

**A. I think one of the unique features of estuaries perhaps is that they have to be resilient. They're in this in-between place between land and**

**freshwater and the ocean and saltwater. So they are forever being pushed upon by forces of nature that are conflicting with one another in their type.**

**So if you look around and think about just for a moment the -- some of the major estuaries in the world. Even starting up here if we were thinking about the Penobscot, for example, that would be a system that is resilient or has, you know, developed with periodic influences of large amounts of fresh water, ice melt, snow melt, all that sort of thing, temperature changes, extreme temperatures.**

**If we go to some other part of the world, if we go to the Amazon, we don't see those extreme temperatures; but we get tremendous changes in flow, very wet seasons, very dry seasons. So if you wanted to fish in the Amazon, you would go there in the dry season because it concentrates the fish; and you have a better chance of catching them.**

**If you look at the Apalachicola, it's somewhere in between that. But, again, it does experience the Gulf of Mexico on one side and the river on the other and this mixing of the two.**





**And so estuaries need to be resilient in order to basically maintain themselves estuaries.**

**Q.** Dr. Menzie, you mentioned in your testimony under examination by Florida that you had visited the Apalachicola Bay recently. Is that right?

**A. That's right.**

**Q.** And I don't want to spend a lot of time on this particular visit, but when did you visit the estuary?

**A. I went in April of this year.**

**Q.** And what was the purpose of that visit?

**A. I try to visit every system that I might be asked to look at. So that was important. But there were particular pieces of information that I wanted to confirm for myself. I had read about them and I wanted to see if they were true, and basically to ground-truth my analysis, to feel much more comfortable to be able to talk about the system than if it were just an abstract.**

**Q.** And in the course of that visit, what did you do and what did you find, if you could just summarize it for us briefly?

**A. There was a lot that I saw, but I distilled it down to a couple things that I think are worth sharing. One -- for me, one of the most**





**important things that I had read in the expert reports developed by Florida's experts, Dr. Glibert and Dr. Jenkins, was that -- the impression was that these plants that we were talking about were absent from the East Bay, which is an important nursery area.**

**So that's an easy thing to check. And I thought -- and I have done a lot of work in that in many different estuaries. So I knew that if I just went down there, got a boat with a person that was knowledgeable, and went over to where the plants were supposed to be and see if they were there. They were either there or they weren't. And they were there. And so I kind of got a sense of how extensive they were.**

**There was another feature of the system that was really interesting, which was that parts of the system are fed by rivers that are known to carry black water. This is water that is deeply stained by draining through forest systems and stuff. It's tannins and things like that. And I had read that this had a strong influence on conditions at this one station, the East Bay monitoring station. So I went to see whether those conditions existed, at least during the**





**time of my visit. And they did. You could take a sample of water; it looks like a cup of coffee.**

**And then, finally, I wanted to visit the heart of the tupelo honey area. So there is a little family, the Lanier family, they make honey and put out bees and stuff where they come off the tupelos. So I visited their place. And as I was driving around through there, I noticed that because of the road construction up along the side of the river, that the roads were blocking the flow of water from the river to the floodplain. That doesn't exist everywhere, but it does exist along stretches. And so for that reason I wound up analyzing roads in a little bit more detail.**

**Q.** All right, doctor. I want to turn now to your causal analysis and conclusions regarding the ecology of the river and the floodplain. And you were asked a number of questions about this floodplain by counsel for the State of Florida. Can you please describe for us briefly the causal analysis that you performed regarding the river and the floodplain.

**A. Sure. So the first step was to see if there were changes. That's step No. 1. And so I reviewed**

**the literature and I, like others whom you have heard from, saw that the literature was pretty sound on the fact that the floodplain forest has changed from a wetter type system to a drier type system. And so, indeed, there had been a change.**

**So then the second step was to try to get an understanding of what was causing that change and, more particularly, what might be the relative contribution of Georgia's consumption, at least to river flows, because that's what Georgia would affect.**

**And so I did a series of analyses where I was comparing the amount of areas that were flooded without that incremental consumption by Georgia, to flooding with that incremental consumption, and looked at that difference to see how big a footprint that was on the various habitats in the river.**

**And then, finally, I took a look at some of the other major factors that may be influencing the flooding to get a handle on how important they were.**

**Q.** And as a result of your analysis, what did you find were the primary factors affecting floodplain inundation?





**A. The biggest one turns out to be climatic differences between years. Not climate change per se, but this variation that occurs between wet years and years in which you have droughts. If you go from a -- sort of an average year to a year in which you have a drought, that difference can account for 68 percent or 60 percent change in the amount of flooding of the floodplain. Just that one factor.**

**The second most important factor was the change in the river -- physical features of the river, which were deeper through the upper portions of the river. And in looking -- and now holding climate the same, looking at what the depth of the river was before the construction of the dam and what it is in the most recent measurements, that accounts for about a 20 percent change in the flooding. So the -- not as much water gets into the floodplain because it's now -- remains within the river. And then looking at the incremental influence of the consumption of water, that came out to be a couple of percent.**

**So the biggest one was the climate. The second biggest was this change in the bottom of**





**the river. And then the third was the consumption of water.**

**Q.** And, again, the percentage that you're assigning to Georgia's consumptive use in terms of a factor that influenced floodplain inundation is what?

**A. For the region that is the swamp region where the tupelo trees and the cypress grow, it's about 2 percent or less.**

**Q.** And today, are the river and the floodplain still affected by these factors?

**A. Yes. These factors will remain important. Climate itself, you know, from year to year is going to change. The bottom of the river will largely be what it is. It may change slowly. So I -- I would expect that what we're looking at is what we're going to see into the future.**

**Q.** Will there be any opportunity for the river or the floodplain to recover?

**A. I think the river and the floodplain have essentially recovered within the constraints that exist as a result of construction of the dam and the management of flows and stuff. So the system has recovered in that degree. It's a resilient system. The bay, as I mentioned or will talk about in a moment, is a system that really hasn't**





**been influenced to any great degree.**

**Q.** While we'll still on the floodplain, doctor, I want to look at a document that was shown to you by counsel for the State of Florida, JX-168, which is behind tab 3 in the binder that was given to you by Florida's counsel. And this is the 2016 biological opinion.

And I am going to ask you to turn to a few sequential pages and paragraphs in the biological opinion. Beginning with page 3 of the BiOp, and I would like to ask you to look at the last sentence of the first paragraph and to read that to yourself.

**A. Okay. I have read that.**

**Q.** And, doctor, I would like to ask you what does this particular sentence tell you in terms of population of Gulf sturgeon?

**A. Well, in this case the Fish and Wildlife Service is considering whether the operations of the reservoirs, given everything that's going on, including Georgia's consumption of water, would jeopardize the ongoing populations or the recovery of the populations of Gulf sturgeon. And they conclude that it would not, and that it would not -- these -- neither would it affect the**

**critical habitat for that species.**
**Q.** All right. I would like to ask you to look at the last sentence of the next paragraph, also on page 3, and to read that to yourself.
**A. Okay. I have finished.**
**Q.** And what does that sentence indicate to you about the population of mussels?
**A. With respect to the ongoing subsistence and existence of the mussel populations, the sustainability of the mussel populations, given the proposed operation of the reservoirs and everything else being considered, including consumption of water, the Service reaches the opinion that they would not be at risk.**
**Q.** All right. And I would like to ask you to now please turn to page 63 of the biological opinion.
**A. Yes.**
**Q.** And particularly, to look at the first sentence of the last paragraph, and please read it to yourself.
**A. Okay. I have read that.**
**Q.** What does that sentence indicate to you about the condition of Gulf sturgeon in Apalachicola?
**A. The Fish and Wildlife Service evaluates these species in terms of their populations and whether**





**they're stable or not, which means are they ongoing. And -- and in this case the -- the Service reaches the conclusion that that population of sturgeon utilizing the Apalachicola River is, indeed, stable.**
**Q.** Let's turn now to pages 124 and 125 of the biological opinion. And I am particularly looking at the second paragraph. And could you please read that to yourself.
**A. I have finished reading that.**
**Q.** And what does that paragraph tell you about the condition of the fat threeridge mussel species in the Apalachicola River?
**A. Okay. This is -- this happens to be the species of mussel that the U.S. Fish and Wildlife Service thought might be most at risk because of it getting stranded. And what they're finding here is that there's abundance of these animals present, much higher than was previously thought. And they made an estimate of the percent of the population that might be adversely affected by the new operations. And that -- that's a percentage of 0.07 percent.**
**So my reading of this and other aspects of the document is that the U.S. Fish and Wildlife**





**Service have come to the conclusion that this species is doing pretty well in the river.**
**Q.** And on page 125, the third paragraph that begins with, considering the recent information, may I ask you to read that paragraph to yourself.
**A. I have read that.**
**Q.** And what does that paragraph indicate to you about the fat threeridge?
**A. That the U.S. Fish and Wildlife Service has concluded that it's stable and may be increasing in population size, and that they're going to do some additional studies to -- to refine their estimates.**
**Q.** Now, let's page back through the document, please, to page 119. And under section 9.1.1 I would like to ask you about the sentence that begins with the status of. Can you please read that to yourself.
And what does that indicate to you, Dr. Menzie?
**A. It looks -- as this is written, it says the Service is going to review and re-evaluate the status of the species.**
**I know from reading this document and other literature -- some of it is cited here -- that**





**there's a general sense that the species is one that could be taken off of the list or delisted because it seems to have -- be quite abundant now.**
**Q.** And before we leave the river and the floodplain, you are familiar with the opinions of one of Florida's experts, Dr. Allan; are you not?
**A. I am.**
**Q.** And can you please provide the Court with a brief assessment of your views on Dr. Allan's opinions.
**A. I think the most notable thing to mention is that Dr. Allan really looked for differences in the amount of flooding or amount of presence of water under certain flows. He was comparing difference scenarios that he had been provided. But my feeling when I looked at that was there's a little bit of apples and oranges among those scenarios. They're not quite equivalent.**
**Nevertheless, the work largely involves looking at the potential of things to occur such as the potential number of days that things might be drier versus wetter. So none of the work really involves looking at populations of any of the species. So there's no population considerations in the work. And I -- I think**

**that's an important aspect of thinking about these species and these ecosystems.**

**As for example, in the biological opinion we just read or looked at, that's what the Service thinks is important to look at is populations.**

MS. DeSANTIS: Your Honor, Dr. Menzie has been testifying for a little under two hours. I probably have about 20 minutes left. I'm happy to proceed; but if the Court would like to take a break, this might be a good time.

SPECIAL MASTER LANCASTER: We'll take a break.

(Time Noted: 2:25 p.m.)

(Recess Called)

(Time Noted: 2:38 p.m.)

MS. DeSANTIS: Good afternoon, your Honor.

SPECIAL MASTER LANCASTER: Good afternoon.

BY MS. DeSANTIS:

**Q.** So, Dr. Menzie, a couple of last questions on the river; and then we're going to move on to your causal analysis regarding the bay.

You were shown some documents by counsel for





the State of Florida, particularly FX-50, FX-51, JX-21. They are documents behind tabs 4, 5, and 6 of the binder that was handed to you by the State of Florida concerning certain findings pertaining to the Flint. Do any of the findings in these documents pertain to the ecology in the State of Florida?

**A. These documents don't pertain to the ecology of Florida as I was looking at it, no.**

**Q.** And does the Flint run in the State of Georgia rather than the State of Florida?

**A. The Flint River is in Georgia.**

**Q.** If we could turn now to your causal analysis and conclusions regarding the ecosystem of the bay, I would like to publish a demonstrative that the Court has seen before to assist your testimony. And we will distribute copies.

Dr. Menzie, does what we have published as demonstrative 1 on the screen, does that represent the very basic structure of the food web in Apalachicola Bay?

**A. Yes. This -- this is really the basic structure. And I think what this demonstrative conveys is that it may be useful to think about the food web in three layers. At the very bottom of the food**





**web are the plants. And then in the middle region of the food web are animals that eat plants, whether they're large plants or very tiny plants. And then in the upper level of the food web you would have fish and some other types of shellfish like crabs and shrimp that feed on these animals.**

**Q.** And are you aware that Dr. Glibert was shown this demonstrative during her testimony?

**A. Yes.**

**Q.** And, doctor, if you look at the lower food web on this demonstrative, can you please use that demonstrative to guide us through your conclusions as a result of your causal analysis concerning the health of the lower food web?

**A. Yes. So if you recall step one of the approach is to look to see if there was any evidence of changes. And that requires looking at information that's available.**

**So at the top of the food web, for example, we have fish and shellfish, like blue crabs and shrimp. And so, for example, I look at that information to see if there were any evidence of long-term changes and saw that there were none.**

**And then at the base of the food web, we have**





**information on submerged aquatic vegetation; that's SAV. These are the plants that we're talking about, the wild celery and other plants that are rooted. And then on the right, we have the algae.**

**And there are changes that occur periodically for algae, but they don't cause there to be changes in the overall structure of the food web. There have been periodic losses of the submerged aquatic plants as, for example, following Hurricane Dennis; but they recovered after those events, as I have discussed earlier.**

**So the -- so this is a good representation of the basic structure of the food web. And I -- my conclusion was that the food web has remained relatively similar to what it was back in the '70's and '80's.**

**Q.** And so if I understand your testimony correctly, did you find changes in the composition or the types of phytoplankton present at lower flows?

**A. Yes. During the summer months when low flows occur in this river, as they do in many rivers around the country, there is a change that occurs in the types of algae that are present. So in the summer you will get certain species of algae.**

**Some of them are -- they go by the name Dinoflagellate, which is sort of after dinosaurs. Some look like dinosaur heads. And you get little tiny plants present in addition to some that are present during the spring. So you see that kind of shift that occurs.**

**I did studies on this in the '70's back on the Hudson River in the early part of my career. And this is what you see. You see this in every estuary.**

**Q.** Did these changes in composition at the base of the food web have any ramifications for species in the higher levels of the food web?

**A. The only way to really judge that is to think about the -- whether these plants, whether they be the submerged plants, these big plants, or these little plants, continue to serve as food for the upper food level -- the levels of the food web -- and they do -- and then to check to see whether the animals that would be dependent on this food web sustain themselves.**

**Like, there's a fish called the sand trout or the flounder or the various species that live here. Are they continuing to be in similar population abundance over time?**





**And that is direct evidence as to whether or not the food web is sustained.**

**Q.** All right. Doctor, I would like to ask you, please, to turn to page 50 of your written direct testimony, and particularly to demonstrative 20 that is shown on page 50. And we'll also put that up on the screen.

MS. DeSANTIS: And, your Honor, may I ask again if Dr. Menzie may go to the screen to help explain this demonstrative?

SPECIAL MASTER LANCASTER: Sure.

BY MS. DeSANTIS:

**Q.** Doctor, can you please describe what that demonstrative shows.

**A. Sure. So this is a very simple picture of these little tiny plants that are at the base of the food web, the animals that are in the middle of the food web, and then an example of the fish at the top of the food web. And you will find this present in estuaries pretty much around the country.**

**But just a little bit of biology, on the left here are these interesting shapes. These are diatoms. And they're very important all around the coastline. And they -- and they're an**





**important source of food. They're a little bit bigger than these plants here, and they can be eaten directly by these copepods.**

**These are little shrimp, little tiny shrimp-like animals. And these in turn are eaten by this fish, the bay anchovy. This fish, the bay anchovy, is probably one of the most important fish in the bay. It swims through the water with its mouth open and just basically takes in all these little tiny copepods and eats those. And then the bay anchovy is the source of food for all these other fish like the Menhaden that are well known all around the country. They're sources of food for all kinds of other fish and birds and mammals. So this fish can be supported by eating these little tiny shrimp-like animals in between that eat these diatoms.**

**The other way that they can be supported is that during the summer months, there is an increasing amount of these little tiny plankton, little tiny green spheres. And these are eaten by little animals known as ciliates, little tiny animals that you can see in a microscope. They're very tiny. And they in turn are eaten by these copepods, these shrimp, which in turn are**





**eaten by the bay anchovy. So there's two ways in which the bay anchovy continue to be supported in Apalachicola Bay.**

**My check on this was to see over all kinds of conditions since the 1970's, through droughts, through wet periods, whether the bay anchovy continues to be abundant -- it's almost like a barometer -- and it does. So that tells me that one way or the other the grazers exist, and the bay anchovy continues to be supported, sometimes by diatoms coming up this way, as in the spring, or sometimes by a combination of diatoms and little tiny plankton, as in the summer.**

**So it's just an interesting biology piece.**

**Q.** Dr. Menzie, I'm actually going to ask you to stay at the screen because we are going to put up another demonstrative as we move on to the upper levels of the food web from page 65 of your written direct, demonstrative 27. And as we move on to talk about the upper food web and about the fish, including the anchovy that you just testified about, can you explain to us, please, what is shown in demonstrative 27.

**A. Sure. It turns out that the most extensive data on biological and ecological organisms in the**

**bay, aside from oysters, which, you know, you will hear about, is fish. And fish have been studied in the bay since the early 1970's.**

**What you're looking at here are all the locations where either the State of Florida, the Research Laboratory, or the national government has been studying fish.**

**This is the Apalachicola River, so fish have been studied all through here. This region -- this region right in here is the nursery area known as East Bay. That's a central part. Then out here in Apalachicola Bay are all the rest of these stations.**

**Why I felt it was important to share this picture is that there's an extensive amount of information available on fish, and fish tell us a lot about how the food web is structured. The fish can only be there if the food is there. So looking at the fish that are there, they're abundant. And how that abundance changes from year to year or decade to decade gives me direct information on how the overall system is working.**

**Q.** Dr. Menzie, did Dr. Glibert, the expert on the ecology for the State of Florida, analyze this data?





**A. Dr. Glibert did not look at this information.**

**Q.** Did you look at this data?

**A. I looked at this information. It's -- I asked and chased after this information until I could get as much of it as was available so that I could --**

**Q.** And what were your conclusions based on all of this data?

**A. That the fish community of the bay, those are the plants that depend on those little tiny -- I mean, the fish that depend on those little tiny plants, the fish that eat other fish, that they're all present and still in the bay as they were back in the 1970's, and that their populations continue to be sustained regardless of whether it's a little wetter or a little drier.**

**Q.** Okay. Dr. Menzie, in the course of your work and analysis in this particular matter, have you seen any evidence that any fish species in the Apalachicola Bay is being harmed?

**A. I have seen no evidence that these changes in flow have harmed any of these species.**

**Q.** Have you seen any evidence of any harm to the blue crab population in East Bay or the rest of





the bay?

**A. Information on the blue crab was present in these collections. And I see no evidence that the blue crab populations have declined or changed in any way.**

**Q.** Have you seen any evidence of any harm to the white shrimp population at any place in the bay?

**A. I have not.**

**Q.** Have you found any evidence of any harm to the nursery function of East Bay?

**A. I looked into the nursery function in terms of the presence of the plants and in terms of the abundance of the fish that live in that area, and I specifically looked for baby fish. And I found no evidence that they had been harmed.**

**Q.** Doctor, have you found any evidence of any harm to any species in the Apalachicola Bay?

**A. I have not.**

**Q.** You have assessed some of the work of Dr. Glibert, an expert for the State of Florida. Correct?

**A. Yes.**

**Q.** And can you please provide the Court with a brief summary of your opinions regarding Dr. Glibert's work.

**A. I think Dr. Glibert, as I mentioned earlier, saw**





**changes that have occurred during the summer months in algae, for example, and then presumed that those changes would cascade up through those upper levels of the food web causing there to be changes in the upper levels of the food web. But it was based on a presumption that that would occur.**

**Q.** And, doctor, are you aware that Dr. Glibert also suggests that there have been changes in nutrition at the base of the food web that have affected species at upper levels of the food web?

**A. One of her hypotheses is that there might be less nutritive quality in a little tiny plant at the base of the food web as they change, and that that could cause a cascading effect up the food web. So I know she has said that.**

**Q.** Have you seen any evidence of impaired nutrition for any species in the bay as a result of the low flows?

**A. No, I have not.**

**Q.** Doctor, I now want to talk about particular remedy scenarios and additional flow scenarios, including the one that you analyzed. And counsel for Florida referred to a 1,000 cfs scenario that you looked at. And I want to first talk about

the bay.

To assist your testimony regarding the remedy and additional flow scenarios that we're going to talk about, I would like to ask permission to publish a demonstrative; and we will distribute the demonstrative.

Now, Dr. Menzie, can you please describe for the Court what this demonstrative shows, and distinguish between the two columns.

**A. On the left is the remedy scenario that was computed by the State of Florida. And it presumes a -- as I understand it, a 50 percent cut in water consumption by irrigation and perhaps some other factors. So that would result in more water basically entering the system that wasn't used in agriculture within Georgia.**

**And on the right, the 1,000 cfs additional flow scenario was one I looked at. And also, I believe it's largely consistent with a scenario that was put forward by Dr. Sunding on behalf of Florida. And it basically adds -- simply adds 1,000 cubic feet per second of water to the river and looks at -- in either of these things looks at resulting changes in salinity.**

Q. Now, looking first at Dr. Greenblatt's 50 percent





cut scenario on the left-hand side of this screen, are you aware that Dr. Greenblatt modeled this scenario for different years?

**A. Yes. 2011 and 2012.**

Q. And particularly, the results of Dr. Greenblatt's modeling for this remedy scenario for the years 2011 and 2012 showed what with respect to salinity changes?

**A. The changes were, depending on where you were in the bay, in the range of near zero to 2 parts per thousand or psu's of salinity. There were some locations near the mouth of the river, which is more sensitive to changes, if you will, in freshwater flow where the salinity change was 3 parts per thousand.**

Q. And were 2011 and 2012 low flow years?

**A. Yes. These were the drought years that got a lot of attention.**

Q. Dr. Menzie, would you expect a change in salinity of up to 2 ppt in most areas of the bay, if the 50 percent cut remedy were in place, to have any effect on the ecology of the bay?

**A. Yes. No, I don't. And the reason I hold that opinion is twofold. First, I have looked at the ecological conditions of the bay going back in**





**time. So I have looked at the data from the most recent times into the '70's, and there doesn't seem to be any evidence that the variation from year to year or in salinities of this magnitude have brought about any change.**

**The second reason is that we're looking at kind of an average salinity here. And it's helpful in an estuary to put that into perspective. So I know that at low flows, for example, the salinity at any of these points in the bay or at East Bay or at Apalachicola Bay will fall within a range that could be as much as 15 parts per thousand. So that small changes in that range are simply swamped; they're not noticeable.**

Q. All right. And, doctor, turning now to the right-hand on this demonstrative, you ran an analysis of a flow scenario that involved the addition of 1,000 cfs of fresh water. Correct?

**A. Yes.**

Q. Could you please explain what your analysis showed with respect to salinity changes of that additional 1,000 cfs of flow?

**A. Yes. So I believe this is for the Apalachicola Bay. And my analysis looked across all the data**





**that were available and recorded. And based on a change of a thousand cfs in flow in the river, you would expect something in the order of almost a nondetectable change in salinity up to perhaps around 1.2 parts per thousand salinity.**

Q. So, Dr. Menzie, would the change in salinity in the bay attributable either to the 50 percent cut remedy scenario or to the 1,000 cfs additional flow scenario have any effects at all on the ecology of the bay?

**A. No. These -- these changes within the type of variation in salinity that occurred in estuary areas are extremely small.**

Q. You're aware that Dr. Glibert has suggested that even minor changes in salinity could impact the ecology of the bay?

**A. No, I don't think she's correct.**

Q. And why not?

**A. Because of the variation that exists within the bay, the animals and plants in the bay are adapted to that kind of variation. So any tiny change on the order of what we're talking about here would essentially be unnoticeable.**

Q. Now, with respect to the additional 1,000 cfs of flow, you also looked at the impact on the

floodplain habitat. Correct?
**A. Yes.**
**Q.** And what specifically did you look at?
**A. The degree of flooding that would occur as you increase the flow by certain amounts.**
**Q.** And would the additional 1,000 cfs of flow have an impact on the ecology of the floodplain?
**A. No. It wouldn't have any impact on the ecology. It would result in small amounts of additional flooding of areas, but not really on the ecology of the system.**
**Q.** All right. Dr. Menzie, we're getting close to the end here.

Florida has maintained, as you know, that Georgia's consumptive use of water has harmed the ecology of the bay, the river, and the floodplain. First of all, setting aside the concept of harm, has there been change in the Apalachicola ecosystem over the time period that you examined?
**A. Okay. I think of changes in different amounts of time. So every year there are changes that will occur in the system. In the bay, for example, the changes in fish communities are large. Fish swim into the bay, reproduce, spend time, and**





**then leave. In the summer months, there's a change in the composition of the phytoplankton. So these changes we see every year. And they're not unexpected.**

**Over long periods of time we look at something that would be meaningful in terms of a change in the population of fish. Let's say over a decade, there have not been changes in the population status of the fish community of the bay. On even longer time scales, for example, on the forest, there have been changes. And as I discussed earlier, those relate to some systematic changes in the flooding of the floodplain that have occurred since the construction of the dam.**
**Q.** Looking back at harm, the concept of harm rather than change, have you found any harm in the bay, the river, or the floodplain attributable to consumptive use of water by Georgia?
**A. My analysis very specific to that question did not indicate harm as a result of -- to any of those ecological components as a result of consumption of water by Georgia.**
**Q.** Doctor, regardless of whether or not there is harm, would the 50 percent cut remedy or the





1,000 cfs additional flow scenario have any effect on the ecology of the bay, the river, or the floodplain?
**A. No.**

MS. DeSANTIS: I have no more questions.

SPECIAL MASTER LANCASTER: Recross?

MS. WINE: Just very briefly, your Honor.

Mr. Walton, could we pull up demo 7 that Georgia's counsel just asked Dr. Menzie about.

RECROSS-EXAMINATION

BY MS. WINE:
**Q.** Dr. Menzie, you testified about this demonstrative which, according to your prefiled direct testimony, shows the natural and man-made stressors on the ecological system of the river and bay. Correct?
**A. Yes.**
**Q.** Sir, where is consumptive use on this diagram?
**A. As I introduced this diagram I mentioned that consumptive use is one of the primary stressors that we're looking at. So these are the stressors that we need to consider in evaluating the role of consumptive use.**





**Q.** Okay. You don't show consumptive use on this diagram. Correct?
**A. No; that's right. This is a background piece to indicate what other stressors we need to consider.**
**Q.** And if we were going to draw in consumptive use as a factor that starts influencing things here, where would you draw it in on this diagram?
**A. I would place the beginning of it, as I understand it, from around 1970 to the present.**
**Q.** Okay. Thank you.

Now, sir, I think you just testified that you have seen nothing happening in the bay that could be considered a material change and that you have seen no evidence of any harm to any species in Apalachicola Bay. Correct?
**A. I did say that, yes.**
**Q.** Sir, you're aware there was an oyster crash in 2012. Correct?
**A. I was thinking of that very question as I answered that yes. I did not -- I did not look at the oysters.**
**Q.** Okay. So you're not trying to say that that wasn't a material change in the bay during the recent time period. Correct?

**A. No. The oysters are a managed fishery, and another individual will be talking about that.**

Q. Okay. Now, I want to make sure that I understand the import of your testimony overall. Are you saying that there is no basis whatsoever for limiting Georgia's consumption in the Flint River Basin?

**A. I am providing the results of the causal analysis. I recognize that the states are discussing these issues and all the policy that may be related to that, and that's not something I'm weighing into.**

Q. Okay. And you realize not just the states, but the U. S. Fish and Wildlife Service and Georgia itself in many of its documents have recognized the need to limit consumption or suggested ways to limit consumption on the Flint River. Correct?

**A. I certainly realize that all of those discussions are going on and focused my analysis on providing technical information that could be used to inform those kinds of decisions.**

Q. Okay. Thank you, sir.

MS. DeSANTIS: I have no further questions, your Honor.





SPECIAL MASTER LANCASTER: Just a couple, doctor.

THE WITNESS: Yes?

SPECIAL MASTER LANCASTER: Have you visited the Penobscot River?

THE WITNESS: Oh, yes.

SPECIAL MASTER LANCASTER: Will you get to visit it on this trip?

THE WITNESS: No. Unfortunately, I was able to get out to see -- drive myself up and down the Presumpscot, which was very interesting. Interesting history. But I have to head back home. My son is running a huge race out on the West Coast, and I have got to get myself there. But I will be back.

SPECIAL MASTER LANCASTER: Good.

So if I understand your testimony correctly, as Maine goes, so goes the nation?

THE WITNESS: There's a couple of things that are unique in that respect in Maine. And Maine cares a lot about the environment and the Gulf of Maine and everything that goes with it. So some of the earliest research on coastal environments have been prompted by activities here in -- Bigelow Lab





and others. This is one of the places where the people look to to learn a little bit about estuarine ecology, coastal ecology.

SPECIAL MASTER LANCASTER: You may not be aware of this, but counsel for Georgia and counsel for Florida have given us summaries for each expert. And your summary says that with respect to Apalachicola Bay, Dr. Menzie's analysis shows that Georgia's incremental consumption of fresh water has had a minor incremental influence on salinity in the bay and that Georgia's water use has not caused harm to oysters, et cetera.

Now, you just said, if I understood you, that you're not testifying about oysters.

THE WITNESS: That's right.

SPECIAL MASTER LANCASTER: So they're wrong?

THE WITNESS: Well, I -- the part that I looked at was related to nutrition for oysters. And that was an important aspect of looking at the -- what Dr. Glibert was talking about with respect to this poor nutritive quality and whether that food was going to be made available to oysters. And





that's the limit of it. I -- I did not look at other aspects of the oyster story.

SPECIAL MASTER LANCASTER: So you don't know, for example, how male oysters become female?

THE WITNESS: I know it's an intriguing question; and I -- since that question was recently raised, I have explored it a little bit.

There's a number of species in the animal life that change sex for one reason or another as part of their survival. And I know someone that you will -- you can ask that question of who will come later --

SPECIAL MASTER LANCASTER: Okay.

THE WITNESS: -- who really knows the answer to that question.

SPECIAL MASTER LANCASTER: Who?

THE WITNESS: Dr. Lipcius.

SPECIAL MASTER LANCASTER: Thank you. I'll tell him you recommended him.

Now, at the risk of oversimplification, do I understand you to be saying that underwater plants that are tolerant of salinity thrive well where salinity is high

and that those that are intolerant to salinity don't thrive well there?
THE WITNESS: That's right.
SPECIAL MASTER LANCASTER: Thank you. Redirect?
MS. DeSANTIS: No questions, your Honor.
SPECIAL MASTER LANCASTER: Recross?
MS. WINE: No thank you, your Honor.
SPECIAL MASTER LANCASTER: Enjoy your son.
THE WITNESS: Yes, thanks.
SPECIAL MASTER LANCASTER: Oh, I have one more question. I'm sorry.
You were shown this USFIG piece dated, I think, May 22, 2012. And you were asked about work in consultation with the state to identify alternatives to agriculture use or incentives to reduce agriculture use of water. That was one of the conservation recommendations?
THE WITNESS: Yes.
SPECIAL MASTER LANCASTER: Would you tell me, please, how two states who cannot even agree on the number of cases -- I'm sorry, on the number of games that the Gators





and the Bulldogs played can possibly agree on something like this?
THE WITNESS: They have to put aside parochial interests.
SPECIAL MASTER LANCASTER: Do you think that would be possible?
THE WITNESS: I think that's the challenge.
SPECIAL MASTER LANCASTER: Do you think they would be here if they could?
THE WITNESS: No.
SPECIAL MASTER LANCASTER: I don't either.
Thank you.
Any other questions?
Okay.
MS. DeSANTIS: No, your Honor. Thank you.
MR. PRIMIS: Your Honor, the next witnesses are going to be two witnesses by video, Dr. Pine and Dr. Havens, who have written a number of the oyster-related documents that we have discussed, and then our oyster expert, Dr. Lipcius.
Given the time and the fact that the





parties need to hash out a few logistical issues about the video and the sequence in which it's played, I would suggest that we recess, play those first thing in the morning, and then turn to Dr. Lipcius. That would then only leave our economist, Dr. Stavins. And the question would be whether he could get on Thursday afternoon, probably on the later side, or start first thing Friday morning.
I think for scheduling purposes, Dr. Stavins Friday morning would probably be best. And I think that that would ensure that we finish on Friday.
MR. PERRY: That's fine with us, your Honor.
SPECIAL MASTER LANCASTER: Is Dr. Stavins in the area?
MR. PRIMIS: Not just yet. But he teaches at Harvard, so we can get him here.
SPECIAL MASTER LANCASTER: I'm just suggesting that he be available. Just in case I'm not long-winded and we could get to him, it would be very nice.
MR. PRIMIS: Okay. We'll make sure that





happens.
SPECIAL MASTER LANCASTER: Let me just finish by thanking you again, all of you, for the rain. The weatherman's prediction for tonight and tomorrow is driving, driving, driving rain. I told my wife about it and she said what, can you do? And I said, great Scott, nothing. But we'll have to deal with it.
We'll recess.
MR. PRIMIS: Thank you, your Honor.
(Time Noted: 3:15 p.m.)
(Proceeding adjourned to Thursday, December 1, 2016, at 9:00 a.m.)
(End of day)
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CERTIFICATE

I, Claudette G. Mason, a Notary Public in and for the State of Maine, hereby certify that the foregoing pages are a correct transcript of my stenographic notes of the Proceedings.

I further certify that I am a disinterested person in the event or outcome of the above-named cause of action.

IN WITNESS WHEREOF, I subscribe my hand this 13th day of December, 2016.

/s/ Claudette G. Mason
Claudette G. Mason, RMR, CRR
Court Reporter

My Commission Expires
June 9, 2019.

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