Attachment 3

Initial Study Report Meeting Transcript

March 24, 2016

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Initial Study Report Meetings
March 24, 2016
Transcripts

Cook Inlet Region Inc.
725 E. Fireweed Ln.
Anchorage, AK 99503

SUSITNA-WATANA HYDRO
Clean, reliable energy for the next 100 years.

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Agenda and Schedule

Initial Study Report (ISR) Meetings

Ice Processes in the Susitna River (Study 7.5)
Fish and Aquatics Instream Flow (Study 8.5)
Riparian Instream Flow Study (Study 8.6)
Riparian Vegetation Study Downstream of the Proposed
Susitna-Watana Dam (Study 11.6)

(CIRI) Cook Inlet Region Inc.
725 East Fireweed Lane
Anchorage, AK 99503

March 24, 2016

Reported by: Accu-Type Depositions, Inc.;
Sunny Morrison CSR #7575 and
Sydney Hamilton CSR #3166

ATTENDEES

Julie Anderson, Denali Management Services
Laura Arendall (phone), R2 Resource Consultants, Inc.
Greg Auble (phone), United States Geological Survey
Matthew Birch, Louis Berger
Ron Benkert, Alaska Department of Fish and Game
Bryan Carey, Alaska Energy Authority
Woohee Choi, Federal Energy Regulatory Commission
Monir Chowdhury, Federal Energy Regulatory Commission
Douglass Cooper, United States Fish & Wildlife Service
Matt Cutlip, Federal Energy Regulatory Commission
Jeff Davis, Aquatic Restoration & Research Institute
Wayne Dyok, H2O Ecopower
Sean Eagan, National Marine Fisheries Service
Kevin Fetherston (phone), R2 Resource Consultants, Inc.
Bill Fullerton, Tetra Tech, Inc.
Mike Gagner (phone), R2 Resource Consultants, Inc.
Hal Geiger, St. Hubert Research Group
Jerry George (phone), R2 Resource Consultants, Inc.
Dan Healy, Northwest Hydraulic Consultants
Leanne Hansen (phone), United States Geological Survey
Jeanne Hanson, National Marine Fisheries Service
Phil Hilgert, R2 Resource Consultants, Inc.
Bill Hogarth, Nat'l Oceanic & Atmospheric Admin.
Ken Hogan, Federal Energy Regulatory Commission

Chris Holmquist-Johnson, US Geological Survey

Joe Klein, Alaska Department of Fish and Game

Jan Konigsburg (phone), Hydropower Reform Coalition

Matt LaCroix, Environmental Protection Agency

Bjorn Lake (phone), NMFS

Heide Lingenfelter (phone), Ahtna, Inc.

Becky Long, Susitna River Coalition

Matthew Love, Van Ness Feldman LLP

Kate Machata (phone), R2 Resource Consultants, Inc.

Betsy McCracken, U.S. Fish and Wildlife Service

Betsy McGregor, Alaska Energy Authority

Thomas Meyer (phone), NOAA

Bill Miller (phone), Miller Ecological Consultants

Jason Mouw, FRC

Jim Munter, J. A. Munter Consulting, Inc.

Sarah O'Neal (phone), Fisheries Research & Consulting

Doug Ott, Alaska Energy Authority

Steve Padula, McMillen Jacobs Associates

Dirk Pedersen, Stillwater Sciences

Kathryn Peltier, McMillen Jacobs Associates

Bob Prucha (phone), Integrated Hydro Systems, LLC

Daniel Reichardt (phone), ADEC

Dudley Reiser, R2 Resource Consultants, Inc.

Tim Ruga, AKRF, Inc.

Tyler Rychener, Federal Energy Regulatory Commission
Terry Schick (phone), ABR, Inc.
Dan Smith, Alaska Energy Authority
Jay Stallman, Stillwater Sciences
Marie Steele, Department of Natural Resources
Cassie Thomas, National Park Service
David Turner, Federal Energy Regulatory Commission
Sue Walker, National Marine Fisheries Service
Aaron Wells, ABR, Inc.
Fred Winchell, Louis Berger Group, Inc.
Cameron Wobus (phone), Stratus Consulting Group, Inc.
Whitney Wolff (phone), Talkeetna Community Council
Mike Wood, Susitna River Coalition
Lyle Zevenbergen, Tetra Tech, Inc.
Jon Zufelt, HDR Alaska, Inc.

(On record)

8:32:01

INTRODUCTION

MR. PADULA: Good morning. My name is Steve Padula with McMillen Jacobs, and we'll be your facilitator for Day 3 here. I seriously really appreciate the good attendance here on Day 3.

We'll start again. Just a few notes. Again, we are in the Susitna-Watana integrated licensing process. And we are at that step in the process of the ISR meetings, which will be followed by the comment and response comment opportunities. And ultimately the office of the director's decision at FERC in October and what remains from their perspective in terms of the study program.

Logistics, bathrooms haven't moved; they are in the same place. Again, exit up here if we have any sort of safety-related emergency in the building, and meet in the parking lot.

I'd appreciate everyone identifying themselves. I think we are doing a great job when you make comments.

Let's see. In terms of folks on the phone, again, please mute yourself if -- unless you are ready to make a comment. And please don't put us on hold. Thankfully we haven't had to deal with that this week.

Please silence your cell phones, for folks in the room. And watch your sidebar conversations, again, as we have microphones and speakers throughout the room. And most everything will be captured on the record.

And there is a sign-in sheet outside the door. If you haven't, please, over the course of the day, get back there and make sure you are on our sign-in list.

So with that -- and we have the agenda up in the room here. It's the same one that has been posted online. It shows our plans for today, to wrap up the fish and aquatic and water quality and geomorphological aspects of the project this week. A reminder for folks who are interested in the other subject matter, there are two days.

So with that, let's, again, go around the room first and do introductions, and then we'll move to the phone.

(Participants in meeting room introduce themselves)

MR. PADULA: Okay. So now folks on the phone, let's see if we can not overlap; I know it is a challenge. But if folks would start with their introduction, name and affiliation, please.

(Participants attending telephonically introduce themselves)

MR. PADULA: Okay. I think that is everyone for now. Appreciate it.

Again, a reminder, if you want to make a comment, just identify yourself again on the phone or in the room, when you make your comment.

Most everybody has been here for a couple of days, so I'm going to try and move through these introductory slides quickly.

Again, this just summarizes where we are in the ISR process. And the purpose of this set of meetings is to provide the opportunity for exchange of information, questions, concerns, regarding the work that has been done to date to implement the approved study plan for Susitna-Watana.

And AEA is making an attempt here to be clear about its progress; any variances or modifications that have previously been made as they have gone forward with their work; as well as identifying their plans, which may also include proposed modifications for completing study elements that have not been (Indiscernible - lowered voice).

And the opportunity for everyone else in the room is to, again, comment or question on those materials and also offer their thoughts about what they view as potentially a need for modifying the study plans, as the process moves forward, or identifying the need for new studies.

I think we've been really good at that for a couple of days. I really appreciate it, folks. You have stayed on task, on substance, and I think the exchange has been very good.

Just a reminder, again, there have been a series of documents proposed or essentially prepared and put on the record that make up the (Indiscernible - lowered voice) of the initial study report. The three -- first three parts were issued back in June. And there have been a variety of supplemental technical memoranda that have gone in over time. And then the last large supplements for the ISR Part D, which included that road map. So to help folks essentially connect the dots through all of the documents over time, a description of variances and modifications to date. And there were, again, some changes in the transmission and access corridor plans, which were identified and described in those materials.

And finally, the series of study implementation and study completion reports that were filed late last year, and bring us current in terms of the information that we are all discussing and wanting to receive comments on.

Here is the schedule that I alluded to earlier. The meeting summaries, opportunity for filing, disagreements on those meeting summaries, or recommendations for modified or new studies. And then an opportunity for reply comments and, ultimately, for making the study plan determination.

You have seen this before, the five days of meetings. We're here on Day 3. And there are the two meetings covering more the dry side of the project, as we tend to talk about it internally, next.

So the basic approach will be the same. We are going to try to keep the formal presentation relatively short. Again, highlighting this material, a lot of material in the presentations, we are going to highlight certain elements, highlight some of the important aspects of the work that has been done to date, and plans for completing each study component, any proposed modifications. And again, a summary of variances or modifications that have occurred to date.

But we really want to get to the engagement, the interaction, which, again, I think has been great over the last couple of days.

That's it.

Any comments or questions from anybody about today?

And lots of -- Becky? I see Becky in the back.

MS. LONG: These are just process questions. There was a number of times yesterday when consultants would -- is this on? -- okay -- when our consultants would ask for more information, and presenters would say they would get it to them. And I just want to make sure, will that information be gotten to those people, like in the meeting summary, or how will that happen?

And the reason why I bring this up is, laypeople like me really need them to get that material so they can make good comments.

And then my second question is, is when are the transcripts going to come out?

Thanks.

MR. PADULA: Betsy, do you want to --

MS. McGREGOR: Hi. This is Betsy with AEA.

That is a good question, Becky. I was actually trying to think about how we would get the information to people, that they have requested, because we want to make it available to everybody. And it would probably be better if it was provided before our meeting summary is due, because that is in about a month. So we'll think about that, and I will try to get back to you before the end of the meeting.

With respect to the transcripts, probably in about a month.

MR. PADULA: Thanks.

Anything else?

Great. Well, let's get started with the first presentation. Jon?

ICE PROCESSES IN THE SUSITNA RIVER STUDY
(Study 7.6) - J. Zufelt

MR. ZUFELT: Everyone is here to hear about --

Okay. Good morning, everybody. I am Jon Zufelt. I am with HDR in the other CIRI building, the old CIRI building. It is sort of nice that they moved over here, because we got to move up to the top floor where they were, where CIRI was.

I'm going to talk about what's been going on in the Ice Processes in the Susitna River Study, which was Study 7.6.

Following the format that we've been going along for the last couple days, I'm not going to read everything on these slides. We'll just get through these and get to the question-and-answer part, which has been really nice.

Again, the status, we have got the ISR documents, ISR Part D, Section 4. And then just going through here, we have got some of the status listed.

We did have the tech memo that came out in September of '14. And then the -- basically, the SIR, the study implementation report (Indiscernible - lowered voice), is the big one that came out in November. And this just runs through the general objectives of the study, which was, more or less, to observe the river system during the winter, during freeze-up, during break-up. Get an idea of, more or less, how the -- how good it works from an ice standpoint under existing conditions. Look through all the '80s data, compare if there is any changes that we are noticing between the '80s observations and the observations now. Interact with the other studies, especially in-stream flow, fish and aquatics, riparian, geomorph. And another one of these objectives was to look at other large hydropower systems in cold regions to see if there is -- that we can glean anything from those past studies, especially in terms of modeling in -- modeling of the ice systems.

Components, these just follow the objectives, more or less. There was a lot of aerial reconnaissance, time-lapse photography, some ice measurement data. And then the modeling, the one -- both 1D modeling in the entire middle rivers and then 2D modeling of the focus areas.

Variances, you know, there is a lot of little teeny variances mainly to do with camera locations that were specified originally that had to change due to there is no access allowed or we found a better site that would give us a little bit more information.

Just going through the summary of results, this was from ISR -- the ISR Part A, the original stuff that came out, basically, that we reported on ice observations, both break-up and freeze-up. And mapping of open leads, both thermal and velocity open leads, during the -- during the -- more or less the mid-winter and prior to break-up conditions.

General model, River1D model development. And we made an assessment of the lower river water elevations in terms of what we felt would occur with an increase in discharge in the lower river in terms of winter conditions. And then a -- there is a white paper, Appendix C of ISR Part A, which is the review of past other hydro facilities in cold regions.

And then in the TM that came out in September '14 and also the SIR from last November, we finished our reporting for other break-up and freeze-up observations that were done in late '13 and '14. More information on open leads, velocity thermal leads, and then just continued with our modeling, both River1D and River2D models.

We had -- in Part D, ISR Part D, there was some proposed modifications. The -- one of them we have decided it's not really a proposed modification, because it's something that's already taken place. So it is considered more of a variation, a variance. And that was dealing with camera locations and where we could actually get on the ground and do -- do observations.

One thing that came out in ISR Part D was development of alternative visualizations of the freeze-up progression in open light -- open lead survey data. There was some comments before, in the last -- the last time that we had a meeting like this, that it was difficult to -- from the documents that were presented, it was difficult to really see what was going on with freeze-up progression and where all the open leads were. Because in some places there is quite a few open leads. So we came up with an alternate visualization. I will pop one of those up in a minute.

And then we proposed for some additional field measurements -- ice thickness, snow depth, water surface elevation -- during the wintertime to help us in finalizing the 2D models at some of the focus areas.

So our steps to complete Study 7.6 are really pretty much the modeling efforts, the River1D ice processes model; just continuing to finalize that and finalize the validation of that model. That is the one that is being modified by the University of Alberta to include some of the more dynamic issues with the ice progression and during freeze-up.

And then we have got the River2D models, which is more of a -- it is a two-dimensional model, but it is a static ice cover that can move up and down, but it's not dynamically moving in response to changes in water flow.

So we have got the focus areas. So we have to -- I think we have to create a couple more of the River2D models. And then, of course, when we are done with modeling, conduct our -- when we are done, the calibration and validation, we'll be doing the error analysis of the models.

So I think at that point we might as well open it up to the questions and back and forth.

STUDY 7.6 QUESTION AND ANSWER SESSION

MR. PADULA: Have a question here in the room?

MR. RUGA: Hey, I will start it out with that -- that alternate visualization thing. Maybe it is just too early in the morning.

MR. PADULA: (Indiscernible - lowered voice).

MR. RUGA: Sure. Tim Ruga.

Was it -- no, that is not it.

UNIDENTIFIED SPEAKER: Uh-oh, we are heading there.

MR. ZUFELT: Okay. So one of the things

that we had issue with was the -- this whole idea of visualization on the freeze-up. So what we did is we came up with a -- using the GIS of the entire system and came up with sort of a simplified view of the river system.

And here you can see that we have got, you know, a general shape of the river, from the mouth all the way up to the Oshetna. And there is actually three lines on here. And this actually corresponds to three different dates here: October 26th, 29th, and November 1st. And what we did is we filled this in so you could see where the solid ice cover was and where you had flowing open water with frazil ice.

So like on -- on the 26th, we had solid ice cover from the mouth up to not quite Susitna station. By the 29th, it had progressed up past Willow Creek and above Mile 55. And then by the 1st, it had progressed a little bit further. And you can see at the same time we had small ice covers that were developing upstream in the Middle River here by the dam site.

So it was just a nice way to be able to, you know, look at how it changes with time, by just flipping a few pages rather than going to some massive table. Or like what we had before, we had a couple Excel charts that showed various lines and bar graphs. So this was just a nice way to be able to see a bunch of different dates.

And also we -- we went back and looked at the '80s as well. So like you can see that in the '80s we had similar type of reports. And we can glean the data from the '80s and see how progression looked during the '80s. So --

There, I knew that would start some questions.

MR. RUGA: Tim Ruga, AKRF, contractor to FERC. And I guess, first off, I want to say thank you for those plots. They were very helpful.

My question has to do with schedule here and not the dates. I understand everything shifted, the sequence. And I know that in the RSP, the schedule had the open lead surveys, ice thickness over three years. But the 1D model development was to occur prior to the last year of data collection, which would have allowed us the chance to see the results of that 1D model prior to going and collecting that last data set.

And my question is: Are you still planning to do that modeling, present the results, and then go and collect that data, so that we have the opportunity to see whether the data collection needs to be adjusted, whether additional data may be needed that could help in refining that 1D model?

MR. ZUFELT: Okay. The original River1D model, a decision was made to make some modifications to it. One was to go from a simple rectangular or trapezoidal cross-section, to being able to use the full, like, 1D or HEC-ResSim, you might say, cross-sections. And so we could use the same cross-sectional data as the open water model and some of the data that the geomorph model is using. So that was one of the modifications we made.

There was another modification to try to combine all of the pieces of the 1D model, which is -- which is the thermal processes, thermal processes, such as the water cool-down and generation of ice, and combine that with the dynamic portion of the model, which is the ice transport and the ice collection and buildup in -- in -- for surveillance.

And so combining the thermal and the dynamics, that took much longer than what the University of Alberta had thought it would originally. And as such, we didn't meet that schedule of having the model fully developed by the time that the last year of data collection was done.

But what we did in the meantime was, as we collected data, we made sure that we were -- or we felt we were making sure that we were collecting the data that would be needed for the model or could help us in analyzing the model and the model performance.

So I think we are pretty good on the data that we have, and especially combined with the '80s data, which really has shown hardly any changes in the processes. It was amazing to see how many -- oh, like, in the open lead survey data, that the numbers of open leads collected during the '80s and then in '13 and '14 was really very similar in terms of velocity versus thermal open leads and also their locations. So it was quite good to hear that.

MR. RUGA: Okay. Do you have any model results yet from the ice model?

MR. ZUFELT: Not from the ice model, per se. We are finalizing the calibration of the ice progression and validation of that right now. So that has not been recorded yet. And it was not -- in the ISR, there is one appendix -- I think it was Appendix 2 or B -- that had the -- that had the water temperature cool-down part of the model, and it showed -- I think it was in a September or October time frame. So it -- in that really -- you know, part of the year where it really cools down for about 12 to 15 degrees C down to -- down to zero is when we have ice first appearing (Indiscernible - cough). It is tracking really, really well.

MR. RUGA: Okay. Thank you.

MS. WALKER: Hi, Jon. This is Sue Walker with NMFS. I have a question about the predicted ice-free zone below the dam due to increased temperature -- temperature, velocity, and volume of water. I believe we are predicting a lot of 30-mile-long ice-free area. I am wondering how we will be able to predict the vegetation changes in that area given that ice is so far from vegetation. You may not cover that here, but our fluvial geomorph -- I mean, that that -- the right (Indiscernible - lowered voice).

But do you have any ability to predict how the channel will change in that ice -- new ice result?

MR. ZUFELT: What the River1D model will be able to tell us is -- will be that effect of, you know -- right -- right now at the dam, we have -- you know, ice is passing by the dam site right now. Because it is coming from, you know, a hundred miles upstream. But if there is a dam at that location, we won't have any ice coming in. So there is one reduction of ice coming to the downstream areas.

The other is, like you said, we are going to have the potential to have a variety of water temperatures coming out of the dam, which, again, is going to reduce the ice in the river downstream of the dam, and hence, make that ice-free zone downstream of the dam. It could be -- could be longer, depending on what we have for a water temperature release from the dam.

Getting back to your question here. So I have been working with Kevin Fetherston, and we've been talking a lot about the impacts of where -- well, in particular, two things: One is the -- where is the ice going to be in terms of open water downstream of the dam?

But also, Kevin and I have been having a lot of discussions on if we can -- say we see or predict an ice jam to occur at this location. Maybe it is, you know -- I'll just throw out -- River Mile 112 we are going to have an ice jam form, because we have seen, over the years, one always forms there. And with the reduced amount of ice supply to that jam, because now instead of, you know, 150 miles upstream of that point we can have ice contributing to that jam, now we may only have -- may only have from Gold Creek down to 112 to contribute to that jam.

So from there we can see the effects of that -- the length of the jam, the thickness of the jam, and, of course, the water bubbles. So that is the --

MS. WALKER: I think my question was more about the channel change in the ice-free zone below the dam, the actual change in the channel for -- (Indiscernible - lowered voice).

MR. ZUFELT: And that I am going to have to leave to -- like the geomorphs, and -- and Kevin for the riparian.

You know, the ice model will be able to tell us where we have ice, where we have moving ice, and the potential for the impacts of the moving ice.

MS. WALKER: Thanks, Jon.

MR. AUBLE: Jon, this is Greg Auble from USGS. I am also intrigued by this -- your sort of novel ice-free zone because of main channel temperatures. But that's all got to be a 1D model. I mean, are you going to be able to say anything about how much ice there is in the features away from the main channel? Like the side channels and sloughs. I mean, presumably there is still going to be ice somewhere, aquatic ice in that reach.

Do you have any idea -- or, I guess I am having a hard time visualizing exactly how much -- how ice is going to work in what's presumably an ice-free zone, especially with, you know, meters of in front daily stage variation.

MR. ZUFELT: Right. And there will be -- well, with one -- the 1D model will be able to give us the presence of ice and, of course, the water levels associated with the variations in discharge coming out of the dam. There -- to -- to extend that to the off-channel areas and the side-channel areas, we may have to make inferences on what would occur based on what occurs now at some of the focus areas that are modeled with 2D, which would be, you know, 104, 128, 113, -15.

MR. AUBLE: Right. Go ahead.

MR. ZUFELT: Whereas those -- those areas will likely still, you know, be -- they won't be ice-free at 128, 104, 113, and 115. So it, you know, it will be a -- you know, we'll have to make some inferences on what that means in terms of water levels at the -- you know, at the higher up. Like, say, what did the one focus area -- what is it? -- 173? Yeah. Which I --

MR. AUBLE: Yeah. Yeah. I am interested just -- it's not one of those impacts that is a little more or less of something you have got now. I mean, you are potentially creating a completely novel situation.

MR. ZUFELT: Yeah, it definitely will, I would suspect, especially, say, like at 173. You know, right now during the wintertime, that is pretty -- that whole area is pretty much dry. You know, there is some groundwater flows or seepage flows that are coming down those channels. But the whole focus area is generally dry and frozen in the wintertime now. So with much larger flow rates in the wintertime, that is going to be very different.

MR. LaCROIX: Jon, this is Matt LaCroix, U.S. EPA.

So I am curious as to how the models will be able to -- or if it will be able to address the question that -- stage changes in elevation. So are you going to be able to model shorefast adhesion? So, you know, you've got shorefast ice and then the stage comes up. Will that ice be then released? And then when the stage goes down, will it readhere to the shoreline? Will that contribute to ice jamming? Will it reduce ice jamming? Is that a factor that is going to be able to be addressed in the modeling, either the 1 or the 2D?

MR. ZUFELT: Yes, the 1D. Not so much the 2D model. Because I mentioned the 2D models are -- it is more of a static ice cover that, you know -- with discharge variation that will move up and down. But to make changes to that ice thickness, you know, we would to have say, okay, it is going from 2,000 cfs, now it is gone to 10,000 cfs.

The 1D model may tell us that once we go to 10,000 cfs, we do have a thickening. And then you just have to make those changes in the 2D model. And then, of course, you are not -- once you thicken the ice, you are not going to thin it by discharge variations.

So getting back to the 1D model results, though, yes, it will be able to. But what we have seen in other cases -- an Idaho Falls one on the Snake River, it is really -- there is less movement or collapse of the ice cover than you would normally expect in terms of -- it has to be really, really large increases in discharge to cause the destabilization of some of the shore ice.

You know, we may see some of that going from -- if we go, you know, 2,000 to 10,000 cfs, we may see some consolidation of the cover, primarily in the main channel.

MR. LaCROIX: Yeah, I guess I am just curious how the model is going to address the issue. Are -- are you looking at a single sheet of ice that is held -- that is rising with increasing stage? Or are you looking at -- you know, are you separating mid-channel ice that might float versus ice that is adhered to the shoreline?

I mean, we heard yesterday -- and we are going to hear again today -- more about the important influence of the interaction between the ice and the shore. Not just from jamming, but from, you know, essentially bank adhesion. And I am just wondering how the model is going to be able to address it or if -- or if it is.

MR. ZUFELT: The model basically does like a dynamic force balance. So it would -- and again, it is a -- the 1D model has to make some assumptions. So, yeah, you do have a single ice thickness across the channel, but you do know the shape of the channel. And with water elevations, you can predict where that thickness is greater than the depth to float that thickness. And that would be your shorefast ice zone.

Yeah.

MR. LaCROIX: Are increases in shear stress associated with stage increase able to be modeled, not necessarily in your model, but in the sediment transport potentially? Do you know? Or in the (Indiscernible - lowered voice) modeling?

UNIDENTIFIED SPEAKER: Say that one again.

MR. LaCROIX: You have got -- you have got fixed ice cover and, potentially, capacity to expand or to rise in the mid-channel, but less capacity up against the bank. Increase the stage, you would increase the under-ice velocity and shear force. Is that being able to be captured, not necessarily in your model, but perhaps in the bed elevation model?

MR. ZUFELT: Yeah, typically what happens when we do have those stage increases and increased shear on the bottom of the cover, there is a -- you know, there is a shear ice-on-ice zone near the banks that is where the failure occurs. It's not that it fails along the trapezoidal bank. It is an ice-on-ice shear. And that is -- it is typically where that -- you know, you end up with your shorefast ice (Indiscernible - lowered voice) one and moving ice (Indiscernible - lowered voice) out in -- out in the channel.

But, yeah, you know, that is -- that is one part of the dynamic force balance in an ice model, is where -- that is, how do we -- how do we reach that balance of thickness versus shear on the underside of the cover?

MR. LaCROIX: So it sounds like it is built in.

MR. ZUFELT: Okay. Yeah.

MR. LaCROIX: Thank you.

MR. ZUFELT: Dan?

MR. HEALY: Hi, Jon.

I'm not sure if you -- okay. It is Dan Healy with Northwest Hydraulic Consultants.

I had, first, a comment on the visualization of the freeze-up progression. And it does help, you know, to better understand what's happening throughout the system.

I might offer a suggestion that you could also look at ice-front progression plots. There's been a number of other studies; they use that, where you can superimpose different conditions or other years as a way of capturing, basically, just the progression and recession of the ice cover by season.

So visualizing is just another tool to visualize, and it is also a way to present comparisons between your computed ice-front locations. That is one thing that kind of is a good indicator of your model performance and how well you are tracking the ice progression.

MR. ZUFELT: Yeah, Faye had a lot of comments on -- suggestions on -- Faye Hicks, a retired Professor Emeritus, University of Alberta, on how they had presented ice progression and recession on Lac La Biche (ph).

MR. HEALY: And the Peace River is a good example of, you know, the types of visualization that people might typically use. And this is really a valuable one, too.

And I think maybe getting into study modifications. It seems as though there is quite a reliance on the model's ability to assess project effects. And -- but there is limitations that come with these models. And I think that is where the -- if I was to suggest study modifications, it relates to the risk of not adequately assessing the impacts, if we are relying just on the model outputs.

And there is a lot of tough questions

coming today that I think are -- it is difficult to answer. We are trying to ask questions of our tools that we really -- we need some strategy for extending what the model can tell us to -- answering these questions. And I don't know if that is a study modification, but if -- there is -- there is some ice processes that, you know, the models have been proved to show -- demonstrate that they can simulate yet.

The first step, in cooling the water, it looks like it is doing quite a nice job. And I don't know what stage the River1D model is at. But that is the only tool you have for really simulating evolution of an ice cover at any -- you know, during the ice-affected period.

The River2D model is really just a -- you prescribe the ice condition entirely correct. It could never predict anything about ice -- you tell it what the ice condition is, a static condition, and then it tells you what the hydraulics are or predicts the hydraulics, basically.

MR. ZUFELT: Correct.

MR. HEALY: So some of the processes, even with the 1D model that you -- and I think this is state of the art. I'm not saying it's something that they can do, but at least acknowledge -- we need to acknowledge that the model can only -- it can only prescribe the location of initiation of a cover or a jam location.

And so you have strategies for dealing with that. Like looking at the observations and saying that we know that -- like you mentioned earlier, that a jam typically forms here, and we can expect that to be the same after the project, say.

MR. ZUFELT: Or likely.

MR. HEALY: Or likely, yeah. And -- or border ice. It is -- you know, people are looking at ice and the direction at banks. And border ice, to my understanding, is not a process that is -- that you are attempting to simulate.

And then the processes in the back channels are largely -- they are going to be different than in the main channel. And the 1D model is looking at simulating processes in the main channel.

So I think it is, for study modifications -- and I can't put it into words right now, but it relates around these -- you know, the -- trying to develop strategies to answer or to integrate with the other studies and help provide them information that they can answer their questions that they feel are related to ice processes.

So I don't know if you can comment on that. It is a very big, general kind of comment. And it is hard for me to -- you know, you'll have to, you know, get it into words, I guess. But that is -- when I am thinking of study modifications, that is -- it is around that topic of the limitations of the models themselves and strategies for meeting the needs of other studies in -- without having a direct output from the model, per se.

MR. ZUFELT: I just had a couple ideas I -- if that might be the right word -- or observations from the models so far.

When we were doing the proof of concept, where we took the 2D models for FA 128 and we were looking at the River2D model, since we didn't -- at the time we did not have the River1D model working to be able to provide us with what's the ice thickness in the main channel from a 1D sense. So we made observations and made test runs with the model, looking at, okay, we have observations of what the ice in FA 128 looks like from the air at different discharge levels during the freeze-up conditions.

So as freeze-up just begins, you know, we might have -- I don't know -- I am just going to pull these numbers out of my hat -- out of a hat --

5,000 cfs running down the river. Of course, most of it is in the main channel. There is frazil ice forming in the main channel. All the little side channels and sloughs are still open.

A couple days later, we have another observation: The discharge level is clearly lower, as we can see now, more bars that are open. And we can see some of the side sloughs are now covered with ice. It looks like a nice static lake-type ice cover, so it's not rough. From that, we had an idea of that and the open water runs on River2D, where we had the velocities in those little side channels. Now we have got an idea of, oh, look at that, there was a side channel that froze up with a smooth cover. And prior to that time frame, the velocity was like two feet per second.

So now we can say, okay, for those areas where observation has told us that we have got a smooth ice cover on side channels or side sloughs, we now know that we should characterize those in River2D with, you know, like maybe a foot thick of ice with the Manning's N of 0.02 versus the main channel, which was still open and running.

So, you know, we sort of stepped through the freeze-up process to try to determine what the conditions should be. And then once we get that, you know, final freeze-up -- of course, you know, the water level's coming up by five or six feet and now everything is flooded and things are different.

But we are using the models, as well as the observational data, to try to come -- you know, further the capabilities of the 1D and 2D model. It's not just, you know, throwing numbers into a black box.

MR. HEALY: The other thing I wondered, if you could comment, is if you -- how successful is the 1D at the River1D ice process model? Have you had a -- even just a test run, that's -- you know, can it model the full ice-affected period? Like the production of ice, the advancement of a cover, the subsequent melting of the cover, and recession of the cover at multiple front locations?

Or is it still kind of a -- in a -- it has -- there is part -- there is separate modules that can do different processes, and you have to link them all together? Or --

MR. ZUFELT: Yes, I would say it is more there are separate modules that model different processes, such as water temperature cool-down, frazil ice generation, ice transport during freeze-up. And then, of course, the dynamic freeze-up process of forming a cover. Mid-winter, it is just a thermal ice growth based on the air temperature.

And, of course, mid-winter we have got the issue of -- there is the 1D idealization of what's going on. But what's really going is, we have got an ice cover that is formed. Now the discharge is continuing to recede, and we actually have the ice cover set down on the bed in a lot of places. And we end up with -- oh, it is much more of a two-dimensional situation. It is more like we have channels of -- or conduits of flow through an ice field.

And that is what -- you know, we see that all the time at the focus areas, 104 especially. Mike can, you know, attest to that, that, you know, it's not an ice cover. And there is water underneath everywhere. It is -- there is -- there is water-bearing channels and grounded ice.

And that is the real test of the 1D model, is if we can correctly model water levels with the 1D model, you know, in a situation like that.

And then, of course, you mentioned throughout the winter. So then when we get to the break-up period, it -- there is some melt of the cover, but it more or less -- what happens is, the ice cover begins -- you know, as discharge increases, the ice cover begins to move up again. And we fill those channels. We get overflow on the tops of those little conduits of flow. And then pretty soon, once the ice cover lifts off the bed, it just all goes.

It's not a -- it is -- in discussion with Alberta, it is a lot different than on the Peace, where the Peace tends to, you know, start at way downstream and the ice cover progresses upstream. And it gets to a point. Then over the next few months, it recedes back down.

This is more of a freeze-up process. And then when things start going, you know, it may go in -- it may go in pieces or it may just -- it may just all go like it did over a couple days in 2013: Massive jams and a surge, then it would stop, and then it would blow off the next -- the next reach.

It is a -- it will be a test for the one -- for the 1D model to properly model past events, like 2013. It will -- I don't want to say it will be easier, but there will be less dynamics to model the situation of, you know, variable releases from the dam. Because we are not talking of going, you know, 4,000 cfs to 30 or 40 or 50,000 cfs over the course of a day; much less.

MR. HEALY: So would your strategy, then, be to look at specific processes and isolate, this is something that is characteristic for this reach or this section of the river, and use the model as a tool to assess that particular process as opposed to the continuous and -- simulation of the ice progression and recession throughout the winter?

MR. ZUFELT: For existing conditions? Yeah, I think we have a -- I'd say for existing conditions, we probably have a better handle on how the model will do freeze-up progression. And then, you know, discharge is going to go down. And everything is just going to sit on the bed for the winter, more or less.

For the operational scenarios, whether it is run the river or the maximum -- maximum-allowed peaking, over the course of the day I think we'll have to glean data from the modeling of the existing conditions, such as how the ice progresses through an area, to determine at what point in the peaking would that result in a -- in a, you know, consolidation of the cover or a movement of the cover. And again, then, just from force levels, shear -- shear on the underside of the cover. And we can do that.

It is interesting. On the one hand, modeling the existing conditions are a little more difficult. Because in terms of observational data of what's coming from upstream, you know, above the dam, above our modeled section is unknown. You know, we have got it by visual observation based on frazil thickness, frazil concentration, a velocity of the river; that is how we are -- we are assessing what's coming into the system. That and, of course, model (Indiscernible - cough).

But for the with conditions -- with dam conditions, it almost becomes easier, because you are starting your upstream bend as open water at a temperature and at a prescribed discharge level and a prescribed temperature. So -- and let the model decay the water temperature and create (Indiscernible - lowered voice).

I know there is more.

MR. HEALY: So as a study modification, would there be any value in the future in looking at -- there is a bit of an interim process. You are not developing a model in the sense that there's a existing model and you are constructing it for your system. You are developing a model in the sense that you are looking at, you know, working with the University of Alberta to develop -- to advance an existing hydraulic model to include ice processes.

And it's not fully integrated where it can simulate -- do a continuous simulation of a season, necessarily. It can -- it could do parts of processes, and you can piece them together, or look at a specific ice process.

I don't necessarily think there is any issue with that. It is just, I am wondering if when you get to a post-project condition, it would be convenient to have a model that could do the --

MR. ZUFELT: It could continue, yes.

MR. HEALY: -- do the continuous simulation. And there are tools out there that can do that.

And the performance of a model is -- you know, some of the numerical issues that could come out of maybe even natural channel geometry versus a simplified section, you know, you may not know that till you start trying to use it and put it to task.

So is there any value in maybe reassessing at some point? Maybe there is another tool, and that -- that you might use. I think there are other models that, you know, would -- would you consider looking at other tools down the road if the current approach doesn't meet your anticipated needs for assessing effects?

MR. ZUFELT: I would imagine, yeah.

What we are doing currently is, there are some cross-sections that appear to be troublesome, let's say, in terms of the model allowing progression of the ice cover. Some of the issues that have been dealt with so far are -- always seems like there is too much ice generation. It is going too fast. The progress -- the progression of the cover is too fast, or it seems to be getting too thick.

And we look at these -- putting our mind in the 1D versus what's actually out there, we see, well, you know, there is -- here is a real cross-section that may have a deep spot in the cross-section.

So if that is where all your flow was concentrated, that really represents what the true width and shear on the underside of that cover would be at that location.

But if we have cross-sections -- and there are some cross-sections that, you know, based on where cross-sections were surveyed, they are more like a glide section. So it is a very uniform, you know, shallow, uniform wide piece. And if you try to simulate, like, lower flows in, you know, maybe 2,000, 5,000 cfs, we may have something that is a thousand-foot wide and a foot deep. And that is just not going to cut it.

It's not going to be correct from a 1D sense, trying to simulate what that ice thickness would be. It is going to end up with too thick of an ice cover and will likely, you know, cause issues with the -- with the water levels and the progression of model.

So we are, you know, looking at those issues as we go along with the 1D model.

I agree that this is -- you know, it is state of the art. --

MR. HEALY: What's different maybe for your ice process modeling is, there is some uncertainty in just the expectation that you can have of your tool and how well it is going to perform and what it can tell you.

Whereas other tools that are being used, like HEC-RAS or something that is well established, you can reasonably expect that it's going to perform. And the output from that -- you can have a good understanding what kind of output you are going to get and how you might use that.

Whereas with your ice processes, you are developing the tool itself. And then there is a lot of -- you know, it is just difficult to simulate a lot of these processes, so it is -- and answering a lot of -- a lot of the difficult questions that people from other -- you know, others have other -- coming from different perspectives.

So are the strategies for managing that, is that a modification to the study? Like, it seems to me that you have a lot of expertise, so you can -- you can use the whole suite of tools and observations. And over time, you come to know your system. And you combine all of that to -- you know, your -- your -- a good understanding on, let's say, project effects.

MR. ZUFELT: Uh-huh.

MR. HEALY: Is that -- should those strategies form part of the study?

MR. ZUFELT: I think where it is coming from is a concern where -- I don't know how to put this, but we can't -- we know that is an issue, but our model doesn't tell us, so we can't answer. So, you know, shoulder shock.

And so what are the -- you know, I'm not saying that is -- that -- that it's not happening. It is just sort of forward, looking ahead, of try to anticipate how you are going to answer some of these questions that the models simply can't provide answers to.

Does that form part of a -- an element of the study itself? Strategies for assessing effects you know people are wanting to be assessed. And the tools themselves, they are not a direct output from the tools you are using.

MR. HEALY: To be able to say that we understand that the model cannot do this or cannot do that, but it can provide an indication of a change?

MR. ZUFELT: Right.

MR. HEALY: And then based on observations or experience.

MR. ZUFELT: You mentioned HEC-RAS, and I constantly -- I have a HEC-RAS model also in the middle -- middle reach and -- of the Middle River reach. And I am constantly picking up that and going, okay, if I had a jam from here to here, you know, and the discharge was 8,000 cfs, what would my water level look like? Would I have ice out on the banks?

So I am, you know, using alternate -- I am not just relying on River1D (Indiscernible - lowered voice).

MR. EAGAN: Sean, National Marine Fisheries.

I like the way you visualized the progression of the ice front. And it's easy for my mind to figure out how you are going to model the ice going up. And if you have different temperatures and different flows, it will go at different rates. It is fairly easy to understand how your modeling break up at the end.

But having stood at 138 in February on a day when it is above freezing, you know, and you have got -- you are standing on a gravel bar, and you have got a jumble of ice about eight feet thick to your right. You have got a slough with six inches of nice ice on it. You don't know if the jumble ice got pushed down by a tributary or formed in -- it's not a solid sheet; it's every which direction.

How will the model deal with the -- in January and February, as X number of times the jam forms and backs water up four or five feet for a couple hours. And that seems to be important to creating juvenile fish habitat. It is way more complex than this progression that happens in the fall or the break-up in the spring.

Will you be able to tell us if there will be more ice jams or less ice jams in a dam scenario? And will they stay in place for longer or shorter?

MR. ZUFELT: I'd say the model should be able to tell us a better idea of the response to discharge, the ice response to discharge changes in break-up. So you can compare, okay, if we have maybe 10,000 or whatever daily, a couple times a day, how that compares to a normal season break-up. And you should -- you should be able to tell where or how bad that break-up is going to be.

In this -- in this ice cover progression, it is, you know -- these plots are nice and clean. They show, okay, it is going upstream, you know, by a mile a day or three miles a day. It's not clean, you know, by any means.

You know, it is -- you can stand -- you know, you can stand on the shore one day and look out there, and there is big thick frazil pans moving down, you know, 100 percent concentration, and just cruising by at, you know, four or five, six feet per second. And something happens downstream. Now we have got a backwater condition.

All of a sudden, you know, the water level is up six feet, seven feet, eight feet. You flooded all of your shore ice. You know, you were at 250 feet wide. Now you have got a river flowing a lot slower; but it is now at, you know, 500, 600 feet wide. So it's not a clean situation.

But the 1D model should be able to tell us, okay, based on those conditions, that is a -- that is now a jam thickness -- a freeze-up jam. You know, I say jam, but it is a freeze-up accumulation thickness that might be five or eight feet thick. And you know, looking at the cross-section, you can say, okay, well, now I know it is probably grounded here or it is probably grounded there.

I think that one of the more difficult parts is -- mid-winter is that discharge then decreases down. Now we have got definite grounded ice in a lot of places. I don't -- I don't know that there is -- there may be a model out there that can deal with grounded ice, you know, in a dynamic sense.

MR. MUNTER: This is Jim Munter, J.A. Munter Consulting, a contractor to NMFS. And you partially answered my question, actually, right there.

But, you know, we have talked about open water going down 30 miles, whatever it is, and then below that, assuming the water is colder.

Now, this is an environment where, recent winters notwithstanding, it's -- potentially to get really cold. You know, 30, 40 below is not at all unusual. And with the current situation, a lot of that water is thermally protected by ice and snow cover across much of the river.

And in the future when it goes up and down, it seems like you might have the potential for that flooding process that you just described, where you've got shorefast ice or ice in the channel that, for whatever reason, doesn't move or the stage goes up.

And with water flowing over the top of the ice, my question is, is it viable to consider that the project naturally increase ice formation significantly -- my mental lull here is, the classic interior giant icings from ground water, where if water is always seeping out, freezes, builds up, backs up, seeps out -- I mean, you know exactly what I am talking about. And you can get pretty substantial ice formations.

And so is this a viable process to include in the analysis somehow that the project may result in more ice, a lot more ice, in certain places? And then how do you deal with that?

MR. ZUFELT: Here is my vision of what would happen with a diurnal peaking from a -- from a dam. And let's say it is a -- we are going to average 20 degrees Fahrenheit. We are going to have some ice that forms up near the upstream end of the cover. And over the course of the day, you will have two rises in water elevation. And then it is going to set back down.

The cover will basically -- oh, I have got one technician that talks about the ice breathing. But it will be, basically, the cover will rise as the discharge increases. And you might have some water moving along the shore cracks, coming out of the shore cracks. But generally, in the channel you will have a rising in the cover to accommodate that flow of water.

And then as the discharge decreases on the peaking curve, of course that cover is going to set back down on the bed again, and remaining -- you know, with the remainder of a conduit of flow area in maybe several channels as opposed to -- let's talk of the 30 below.

So now we have got massive amounts of frazil. As the water temperature cools down from the dam, we are going to start creating frazil and we are going to have a lot of frazil moving down. And as the water temperature is -- or, as the discharge is low, you will start to build up a lot of frazil. You know, maybe it will be, you know, a couple feet thick upstream. And then the discharge comes up to 10,000.

Well, all of that new ice is going to compress and thicken quite a bit, but at 10,000 cfs. So you will have this float capacity going underneath the ice cover again. And then the discharge goes down, it will drop down again, set on the bed.

The potential is of week-long of 30 below and you could, more or less, see the progression of the cover or maybe, you know, do something like an accordion thing. And then as the temperature warms and you receive the benefit of warm water out of the dam again, you will see that gradual melt coming down, as my -- that is the model in my head.

MR. MUNTER: And a really quick follow-up. This is Jim Munter again. You can also get four or five feet of snow. And you can get potentially an effect like you see on lakes, where the ice is depressed and the water comes in, partly because of the weight of that snow.

Is that part of anything you are

simulating?

MR. ZUFELT: We do not have snowfall in the model. But, yeah, it is a -- it is a factor. It can be a factor, especially if you have a -- you know, a heavy snowfall on the river that sort of makes like additional frazil ice. It's snow ice, but it is -- you know, it acts similar to frazil ice, so it can contribute to an ice cover, yes.

MS. WALKER: Hi, this is Sue Walker with NMFS. I have had the opportunity this winter to spend five days up at 138. And the river this year is almost possibly like a post-project year. In fact, open leads extending for miles upon miles, which is highly unusual. And then miles of massive jumbled ice jams.

Have you been looking at the river this year? And do you consider it as almost a proxy or a post-project year? Because it is highly unusual.

And then I also ask, you just described the scenario. We have got frazil ice coming down the river, cooling, discharge decreases. It consolidates and forms. And then when flow increases, you suggest that that ice is lifted.

How definite is that versus the ice overflowing -- I mean, water overflowing on that ice?

Because that does look like what happens during winter. It looks like you are very capable -- or you will be capable of modeling freeze-up and break-up. But it's these mid-winter changes that are really expected to be project impacts and most concerning.

And studies in the '80s did demonstrate that this was a major concern, was that a lot more ice be formed in winter, jamming and overflow. So we have had two years of mid-winter warm conditions. Very, very warm conditions. We got rained on. There were mosquitoes out there.

So do you have any comments on that?

MR. ZUFELT: Yeah. Yeah, we were out at 128 and what appeared to be 104, when we were having some of that wonderful weather a couple -- few weeks ago. And, yes, we can have warm-ups or rain, like we had at Thanksgiving, at Christmas this year. And we do get water on top of the ice.

The dis -- the discharge levels that we are seeing, like, say, this winter, the discharge increases, they are not going to be -- they aren't as great as what you might see with a -- with an operational scenario.

Yeah. '13 -- '13? Yeah, '13 freeze-up was -- it started out nice and cold. And then it sort of -- it wimped out a little bit. And it took quite a while to get the ice cover past 140 -- past Gold Creek. So that was a year where we had a long time (Indiscernible - lowered voice). There were still things going on in January up above -- up above Gold Creek.

This year, yeah, it was really wimpy, wimpy in terms of ice cover progression. We -- you know, and it is evident when you see those -- those big jumbled areas, and then you have, more or less, your conduit. And up above the dam site, that is how the river -- that is how the river freezes up almost every year. You know, you end up with -- looks like the entire width of the river is one big jam. But then you can see these little impressed areas where it is like, well, that is where the waters flowing.

Well, how do you -- how do you -- so getting back to your question, getting back to your question, yeah, it is -- there is potential for greater ice. There is potential for less ice. I just -- I just have the mindset of less overall ice, just looking at the impacts of a dam is going to cut off -- you know, we are going to have 20, 30 miles of open water normally. So in terms of the entire middle reach of the river, I just see that as less ice.

So it -- it could be that in local areas, for sure, there is probably going to be more ice. I would think that the Gold Creek to Curry is going to see probably the most significant changes.

But, you know, hopefully we'll find out after we model all the, you know, variations of water temperature coming out of the dam, the cold year, the warm year, the average year, which maybe now our average year should be changed.

MR. PADULA: Jeff and then Mack.

MR. DAVIS: Yeah, okay. I'm glad to hear there's not going to be overflow in mid-winter. Is that what you're saying? So I won't worry about it when I'm driving on the river. That's a good thing to know.

MR. ZUFELT: I'm not saying there is not going to be overflow. You know where to go when there's overflow.

MR. DAVIS: But anyway, I am trying to get this in context. I mean, I'm hearing this discussion about ice modeling, and it is all very interesting and a good science project, for sure.

UNIDENTIFIED SPEAKER: Jeff Davis.

MR. DAVIS: Sorry. Jeff Davis.

Thank you. Thank you.

But I mean, we're talking about a time period here, you know, where we have salmon eggs in the gravel and we have got basically four or five months of, you know, at least three species of anadromous fish that are rearing in these off-channel habitat and side sloughs, et cetera, that have really pretty small ranges of physical habitat characteristics, hydraulic characteristics, as we'll hear about more recently.

And, you know, you are talking about -- I am just picturing myself as a juvenile coho sitting in there and I think, I'm screwed, you know.

You know, the ability of you to model accurately in order to have these instream flow models running accurately model hydraulic conditions during winter seems to me very low to get it right. It seems like you are just, you know -- you know, you are working on it. You are doing what you can. Like Dan said, you know, the models can only do too much. But I feel like we are in big trouble as far as modeling project effects.

And so I guess I'm wondering what, if anything, we can do. I mean, can we run an instream flow analysis during winter? You know, because one -- you know, one time period if you have a velocity in a side channel, it goes up to three feet per second, you know, all juvenile fish out of there are pretty much probably going to be flushed out, unless there is a lot of really good refugia and may not move back in. That habitat may be pretty much gone for all winter.

So I guess, I mean, how -- I mean, I guess, how confident are you that you are going to be able to model conditions that we can really use to evaluate post-project effects or should be looking at a different alternative for analyses during winter?

MR. ZUFELT: Like I said before, you know, we are looking at trends. You know, if we think we are going to take a 1D model and be able to, you know, say at every ten feet we know what the velocity is, or even be -- to say, with the 1D model we are going to give you the velocity in the main channel and the velocities in the sloughs, you know, that is -- that is crazy. You know, you can't do that with a 1D model. Hence, the 2D models that we are using for the focus areas, which can give us a better idea of the potential for velocities and thicknesses and what the effects are in those focus areas.

MR. DAVIS: All right. But better doesn't give you much confidence if you have got just a small range on the end of the -- you know, velocity change of a foot per second is a big deal, or a depth change, you know, drying out for even a little while at, you know, minus ten is a big problem for your fish.

So I guess that was, in essence, more of a statement than it was a question, because I think the question has already been answered.

MR. ZUFELT: And we have -- you know, and then we have the questions of where? Where should we be looking? You know, where are the fish? We know where the fish are in the winter. We assume they are at the -- at the -- the ground water outflow sections, upwelling sections, in those -- the nice areas, the warmer areas, the gravel areas.

MR. DAVIS: Yeah, but that isn't actually the case. Because, you know, based at least on sampling we've done, that is not the case. So I think that really -- that really drives the importance I think, too, of, you know, really doing intensive winter sampling studies to see where those fish are located now. Because that place that looks all clear and open right now might have had five feet per second of water during ice development, you know, just a month earlier.

So it might look good mid-winter, but that doesn't mean it was good habitat. So it might be some kind of -- really identifying where those important places are may become more critical than trying to base everything on an ice (Indiscernible - lowered voice) that is not accurate.

MR. LaCROIX: This is Matt LaCroix, EPA. And I do have a question rather than a comment. And hopefully it will be a simple question.

Looking at the visualization that you still have on the screen, I agree with everyone here that is a handy approach. And I am curious about the upstream independent ice cover initiation locations and wondering whether or not when you were doing your data collection if you focused on those areas to try and be able to identify the specific factors at those locations that initiated -- that caused the independent ice cover initiation.

And I am curious whether or not those specific factors are consistent in those different locations due to the velocities and temperature. Is it ground water contribution or lack thereof? Is it -- is it jamming? Is it shallow channel? You know, cross-section that allowed ice to ground out.

I am just wondering whether or not you were able to collect that data, whether you are using that data to calibrate, in a sense, the 1D model so that -- you know, because those are independent cover formation locations, you could have multiple calibration runs.

Just how those -- how those locations and the identification of those locations, including back in the '80s, contributes to our understanding of the cover formation process and then to the calibration and validation of the model.

MR. ZUFELT: Okay. They are primarily geometric hydraulic-type locations. Constrictions in width, you know, island splits where we -- where we would expect things to -- the ice to stop moving.

Before -- before my first flight over the river, I looked over the mapbook. And I made marks on all the spots where I thought there were going to be issues. And then the first frazil flight, also did the same thing. And it was interesting. They sort of corresponded. You know, where we expected there to be issues because of -- you know, looking at the mapbook, oh, that -- there is a constriction and a big old bar here, you know, so --

And those are the -- they are consistently the locations where we see these alternate jams forming.

Of course, you know, the Devils Canyon area here, that -- that is -- that is a -- all bets are off on modeling in Devils Canyon. You know, we have got probably super critical flow and freeze-up jams that are 20 to 30 feet thick, you know. And then they consistently form and blow out, form and blow out. So it is a -- it is just an interesting -- it is a real dynamic spot.

But, yeah, and the other spots where we -- where we sort of -- I don't want to say predicted covers to begin forming, they are -- they all tend to be sort of geometry hydraulics-type related, you know, where you see a riffle and then a pool type of thing. And they are going to vary with discharge level, too, so --

MR. LaCROIX: Okay. So just as a follow-up. So the conditions at those locations, you have enough information about those locations so that when you are modeling future effects so -- to reservoir discharges, where things like, you know, just the stage and the temperature, for example, you are controlling its input, you will be able to determine whether or not those changes to those inputs affect the initiation of the cover?

MR. ZUFELT: Right. So it is a combination of, like, surface concentration of frazil, the velocity, depth, width, constrictions. And those will -- you know, in the model, those combine to determine shear on the underside of a cover, if it will stop there and stay there. You know, there is -- there is rules of thumb on (Indiscernible - lowered voice) number, you know, where you can have a cover initiate or not. Concentration versus open water width -- you know, there is lots of rules of thumb.

And those are the things that we are identifying for these locations. And so hopefully for with-project conditions, we can say, okay, at 2,000 or at 10,000 cfs, what are the conditions at that point? Will we have a cover initiated? Or is there likelihood that a cover would initiate there? Or is the velocity too high? Or is the width now too great that it would just pass it through?

MR. WOOD: This is Mike Wood, SRC.

Hey, Jon.

MR. ZUFELT: Hey, Mike.

MR. WOOD: I don't even know where to begin. There is so much. And I feel like my thoughts are as jumbled as the ice is in the fall. So I will just throw a few things out there.

I think for your modeling, you almost need a paint brush more than a shovel. Because it is going to take an artist to be able to put this all together. It is a different -- it is a tool, right? And you may need a different tool to be able to paint this picture.

I think -- I was talking with Spiros this morning. He said to say hello to you. And he said: Don't joust with that guy. He has got a (Indiscernible - lowered voice).

Nah, you are good.

But I just want to throw out a few things. I agree with you that the hydrograph with the dam would be much simpler to figure out than what's out there naturally right now. And that is what he said, as well.

He also confirmed that being able to model break-up is darn near impossible. So I don't think we should throw break-up into the modeling situation, because it is -- it can't happen. And so we are just waiting to see the models for just being able to freeze-up and then what happens throughout the wintertime.

I don't -- I'm not sure if I -- if I am really catching this breathing idea with the ice, okay? From what I've seen. And at 30 below, there is a lot of overflow, especially the few days after. So there is -- at any rate, I just think there is -- that is open to judgment there.

I am -- I think what's important to me is, is that your understanding of what happens naturally is incredibly important, because it -- in my mind, it defines the entire river system. Summer and winter, it has the most impact. It is why I think you got the best job on the -- here.

And, you know, I just -- I guess to best illustrate this is, I want to -- I just tell a short story, that in 2012 there was a huge flood in the fall. And we went out with Jerry George and Dave Bruen (ph) and Adam and Mike Gagner. And we went areas outside of the study area. And because they couldn't find fish in the small -- in these areas of Whiskers.

And I said: You are not going to find fish here. There was a huge flood. But let me take you where I think there is fish.

And we went way back into the woods, into these sloughs. And sure enough, they threw traps in there and they got a lot of fish and different fish. And then, but they are surprised. How do these fish get out of here? Like, how in the world is this going to happen? And there is no way in and there is no way out.

Well, then all of a sudden, in the -- in the winter we have this incredible, you know, break-up period. And the river just goes right through the woods, just where it has forever. And those fish were gone. No more fish there. It was outside of their study area. But then the fish made it back into the system.

And what happens with -- with this jamming process in the fall is just -- it is a reverse process of break-up, all -- all winter, all fall. And the ice that ends up vertical was attached to the sides at some point, like you are saying, Jon. And there is really such -- it is so hard to explain how that works. And it moves and it moves and it moves for weeks afterwards, creating a jam that in the end will very much affect what break-up is like, especially if we get really hot days and it's been a real snowy winter.

So I don't -- I don't really know where I am going with this, but -- but basically, if you can't have a break-up and you narrow the flows for the project, like a big dam at the top, and you have don't have that flooding and that capacity, it is arguable whether it will be flowing water or ice jams in the middle of winter. I mean, it is -- I think you know what that -- what it would look like for the dam.

So -- but at any rate, the big picture on this is, what does this river look like when you don't have these massive ice-jamming processes and break-up processes? We had a thermal break-up two years ago, three years ago. And it was still kind of exciting, but it was wimpy, you know? Trees were still standing. But --

UNIDENTIFIED SPEAKER: No new (Indiscernible - lowered voice).

MR. WOOD: It wasn't fun.

But I think we can expect a lot more of that with a -- with a project. And being able to simulate break-up with a project, talking with Spiros, he's like, pretty hard to do.

UNIDENTIFIED SPEAKER: But it is hard to do.

MR. WOOD: So I am just -- at any rate, I will -- I will leave it -- I will leave it at that, I guess.

I just want to ask one thing about one -- focus area 173 being dry. I don't know much about -- where is that? Is that just below the dam site?

UNIDENTIFIED SPEAKER: Oh, what do we call that one?

UNIDENTIFIED SPEAKER: Stephan Lake?

UNIDENTIFIED SPEAKER: Stephan Lake.

MR. WOOD: Okay. So that -- this fall I was there in -- in just at -- on December 21st. It was pretty cool. I have never seen the river look like this. It was all just frozen to the bottom, and the river was just flowing across the top of it. And I often wonder about -- I have got a great video that I tried to send you last year of this ice frozen to the bottom, or frazil frozen, which lifts the whole river and creates waterfalls in typically calm places.

Anyhow that was -- when you said it was dry up there, it just made me wonder. Because it certainly was too much water to be on when I was there. But -- but I think the -- the study area is probably in a different place than right in the river.

MR. ZUFELT: Yeah. When I say dry, I mean like --

MR. WOOD: (Indiscernible - lowered voice).

MR. ZUFELT: Yeah we have got like, as you are looking down the river, the main channel is more like on the left. And then there is a really wide area with some side channels --

MR. WOOD: Gotcha.

MR. ZUFELT: -- and (Indiscernible - lowered voice) out, which when the river is flowing high, you know, that is all wet.

MR. WOOD: Okay. Thank you.

MR. ZUFELT: And we are not even talking about anchor ice yet. That -- that is -- that is another -- that is another issue that is fun to try to model.

MR. PADULA: We're a little bit over, but I have one more comment or question here. And then we'll move to a break.

MR. HEALY: It's Dan Healy, Northwest Hydraulics. And just to follow on Mike's comments, while you may not be able to predict an ice jam with the model, you do have -- you would be able to -- or, do you think you would be able to comment on the relative frequency and severity of jams, given that they do occur with and without the project?

MR. ZUFELT: I think you could easily -- well, let's not say easily. I think that you could say -- and we've done this many, many times, many, many places along the river already -- if we have a jam here, what is the water level going to be?

And knowing the discharge and our ice supply, we can come up with an estimate of what the extent of the effect in that jam is. If we then say with project, if we have that same jam here and a controlled discharge, now we can say: What's the effect of that jam there? So we do have that ability to compare impacts of a jam, you know, at a location (Indiscernible - lowered voice) HEC-RAS or River1D or simple (Indiscernible - lowered voice) water.

MR. PADULA: Sean has bribed me for one more -- Sean's got one more. Okay.

MR. EAGAN: In your experience with rivers of this size in these climates, for the main channel, do the processes in the middle of the winter create significant incision or aggradation? Or does most of these processes happen up at the surface and the form of the bottom of the main channel will look pretty much the same in June as it did in September just on rivers of similar size?

MR. ZUFELT: For this river -- for the middle reach, it seems to not be changing the general channel characteristics. There's other rivers where it is more of sand bed systems that you can have significant changes in the shape of the bed over the course of the year. You know, going around an island, you know, two channels around an island, if one freezes up first, that puts more of the flow in the other channel. And you can have degradation during the winter.

But then during the springtime, it may fill in the -- you know, it may fill back in. And we see a lot of bed changes during winter, just because of the ice cover. Usually on rivers this size or for this case where we have got such a gravelly, you know, rocky bed in the river, there is not much of a change.

MR. EAGAN: Thank you.

MR. PADULA: No intent to ignore the folks on the phone. So does anyone on the phone have a comment or question that has not been covered by someone here in the room?

MR. KONIGSBERG: Hi, this is Jan Konigsberg.

Well, I am wondering -- and I have to say, I haven't read through all the ice-processing study. But have there been -- has there been information on the relationship between ice processes on the major tributaries in the -- and the Susitna? You got the Yentna, the Chulitna, the Talkeetna. And what the post-dam impacts would be, if any, to the -- to those tributaries in terms of both ice formation and break-up, as well as jamming at the confluences.

MR. ZUFELT: Okay. There is potential, I suppose, for the Talkeetna and the Chulitna, only because of the changes in what you might see in the mid-winter discharge regime being a little bit higher during the peaking events. So you might have a higher water elevation at the mouths of the Talkeetna or the Chulitna.

But as far as the ice processes on any of those tributaries, I don't see that they are really going to be affected hardly at all. You won't even be able to tell the dams there by the time you get down to the Yentna.

Some of the -- you know, there is probably some tributaries in the middle river section that, again, at their mouth you might see a little bit of a change with project operation. Definitely the ones where you are going to have generally open water conditions in the winter versus what it is now: Portage Creek, possibly.

But all those tribs are fairly steep. And the impacts of the Susitna River on their ice processes are probably like non -- nondetectable.

MR. KONIGSBERG: So just one quick follow-up. On the Talkeetna and Chulitna, the progression of the ice cover upriver, the Susitna doesn't affect ice cover development on either one of those tributaries?

MR. ZUFELT: The -- well, the Chulitna starts freezing up. And, you know, once the ice cover passes the three rivers area, you know, the ice cover progresses beyond the three rivers area, that -- you know, that basically locks in the Susitna. And if the other two rivers haven't begun to progress upstream, they will at that point. So that -- I guess there is a -- there is a chance for a change, you know, based on the progression past Talkeetna.

MR. KONIGSBERG: So is there information on it? Again, that wasn't part of the study objectives. But it may be, in terms of understanding habitat, changes on those other tribs, if that's the case, there may be an impact. Correct?

MR. ZUFELT: I would imagine, you know, from habitat standpoint. I will leave that one to Dudley.

MR. PADULA: So we'll get to that in the next presentation, Jan. Hopefully you can stay with us.

MR. KONIGSBERG: I think so. Yup.

MR. PADULA: Great. Thank you.

Let's move to a 15-minute break. It's been a long run here. So let's try to start up again at 10:30.

(Off record)

10:14:11

(On record)

10:33:11

MR. PADULA: So we are going to get started, folks, if you could take your seats.

For folks on the phone, has anyone new joined us since the break? If you could identify yourself.

(Additional participants attending telephonically introduce themselves)

MR. PADULA: Thank you.

Betsy McCracken actually has a follow-up question on ice. So I know we are waiting on Betsy

McGregor to join us. So we will take this opportunity and spend a few more minutes.

(Off-the-record discussion)

MS. McCRACKEN: Betsy McCracken with Fish and Wildlife Service. And I just wanted to ask Jon was, where -- I wanted to ask him about, I know the ice in the reservoir. And I know it wasn't -- you know, we are only modeling the middle reach. But I did want to bring up the reservoir ice. And, you know, we have talked previously about the potential for sediment deposition, increase sediment deposition at the head of the reservoir.

And I'm just wondering if we have any information about the ice formation in that location and whether it would be more -- we can expect it to be more rapid or what the changes would be.

And the reason I'm asking is, I'm trying to identify if there might be a potential fish passage concern for fish -- winter fish migration. So if you could just briefly tell me what you -- what you think that's going to look like.

MR. ZUFELT: Okay. The quick answer, the quick answer is, that wasn't part of our study; the reservoir wasn't part of our study, but --

MS. McCRACKEN: (Indiscernible - telephonic speech).

MR. ZUFELT: In a general answer, I know that is it -- the water quality one looks at ice in the reservoir mainly from a temperature standpoint. Looking at the operation of the reservoir, we start with the winter at a high level and sort of end the winter at a lower level.

So from a -- just throwing it out, in general, if we freeze over at a high level and then that -- that water level and ice level drops over the course of the season, your -- your tribs coming in may be less affected, because there might be some ice accumulation at the -- you know, at the initial ice formation in the reservoir. But, you know, it's going to keep going down all winter.

MS. McCRACKEN: And do you expect it would be the same over a variety of operational flows, you know, or is it just the low (Indiscernible - telephonic speech).

MR. ZUFELT: Oh, geez, I don't know. I don't think I've seen any reservoir elevation versus time for anything other than the one scenario that we have --

MS. McCRACKEN: Okay.

MR. ZUFELT: -- looked at.

MS. McCRACKEN: So we haven't looked at that at all?

UNIDENTIFIED SPEAKER: 401.

MS. McCRACKEN: Well, that was --

UNIDENTIFIED SPEAKER: (Indiscernible - lowered voice).

MR. DYOK: Yeah. Unfortunately, the guys with the EFDC model were the ones that you should have asked the question to yesterday, because that model does have that ice cover. And that is exactly what they're going to be, you know, looking at in the winter aspects of how the ice comes down. Because I think, you know, you hit the nail on the head.

And the scenarios probably don't change all that much from one to the -- one year to the other, because you're going to be drawing that reservoir down, you know, gradually over the course of the winter. Some winters it may be a little bit more during a colder period than another. Because you need more, you know, water downstream.

But load following does not really affect how that reservoir goes down. Because it doesn't go down, you know, very much on a daily basis. So quarter of a foot or so a day. Probably not much more than -- you know, than that. And it will just gradually go down.

So they'll be looking at how the ice on the shoreline goes down and then in the tribs how it goes down. And I think the good news here is, pretty much most of the northern, you know, reservoirs that have large variations, that have ice covers, you're probably going to see virtually the same thing.

So we can look at some examples of other reservoirs. So, you know, verify the results in the EFDC model. And that's, quite frankly, how they put some of those readings. In other words, the EFDC model, what's going on in other reservoirs and know what the processes are, they'll be able to verify that.

MS. McCRACKEN: So (Indiscernible - telephonic speech)?

MR. DYOK: Well, they have to look at that, too, yeah. You'll have to see what happens as the water level goes down. But you have to get the water coming in, as well (Indiscernible - lowered voice). But they'll be looking at that. And I have flagged through as an action for that as, at some point, a response.

MS. McCRACKEN: Yeah. Thank you. I was just curious to know a little bit more about the

(Indiscernible - lowered voice).

MR. DYOK: Yeah, I'm not sure that they're there yet with the (Indiscernible - lowered voice) desk, but that will be a note for the fall.

MS. McCRACKEN: Okay.

MR. PADULA: Thanks, guys. Appreciate that.

And just a follow-up on ice, Mike?

MR. WOOD: Sorry. I'm going to create an ice jam.

I just -- I'll be really -- I just wanted to -- on the record, three things. One is the discussion of ice in the reservoir, I think, is very important. Secondly, and how that forms and how that affects wildlife especially up there. The next -- the second thing would be: I have read a lot of literature recently about problems with ice jamming in the turbines in -- within the dam itself in Norway. And I'm curious -- and their solution to it, in fact, is to wait for global warming. So they're counting on it in order to use their turbines.

So I'm curious about how you you'd potentially deal with ice jamming in the turbines themselves in this northern latitude.

And then the third thing is, is when you release so much water in the winter downriver, how -- what are the effects of all that fresh water that's typically not there going to affect the rest of the environment all the way down to the mouth of the river? Those three things is it. Thanks.

MR. PADULA: Thanks, Michael. We will get those noted. Again, I don't think those are directly related to the ice study, but we have got them noted so that the appropriate folks can follow up.

Dudley, you and Phil going to tag-team this, take us forward on instream flow?

MR. REISER: We are.

MR. PADULA: Great.

FISH AND AQUATICS INSTREAM FLOW STUDY
(Study 8.5) - D. Reiser/P. Hilgert

MR. REISER: All right. Can everybody hear me okay? Last -- yesterday we had a little bit of sound check on this. But everyone okay on the sound?

All right. Well, we will get started on the instream flow piece here.

I think it's, you know, probably by design that we are talking about fish and aquatic instream flow sort of on the last day of the discussions.

Over the course of the project, we have always been looking at instream flow as sort of the coordinating, integrating studies that would take the results of these other studies that have been presented in the past two days and bring those together in -- and looking at trying to evaluate project impacts over the resource areas and how does that translate into fish and fish habitat.

So that's the basis for what we are trying to do with the instream flow study. And a number of you have participated in many of the meetings that we have had over the last two or three years. I think we have made great progress on that, and we are going to provide an update on that today.

I'll say that we have got Mike Gagner, and Alice Shelly is on the phone with us. If there's questions as we circle back after the presentation, we can -- they'll be available if there's any comments and specifics to those aspects, what they have been involved in.

And right up front -- where's Steve? Steve, you -- basically, the last time I was looking at the transcripts, you had a clock. You had a stopwatch?

MR. PADULA: I wasn't going to do that to you this time.

MR. REISER: Well, I brought my own.

MR. PADULA: Oh, good.

MR. REISER: So the way we are going to work this, I'm going to -- I'm going to lead off with a couple of slides here, summary slides. And then I'm going to have -- turn it over to Phil. And he's going to make sure that we proceed through these slides in a rather quick pace. And then we can come back and open it up for questions.

So I have got -- you know, this is a stopwatch right here.

MR. PADULA: Fantastic.

MR. REISER: All right. So let's get going.

I'm going to go over couple slides here real quick. These are -- just like Jon did in the last one, these are the things that we've been working on over the past three years, actually since 2012. So that's -- are we talking four years? I guess it is. A total of -- you know, going on four years of studies.

And there's been a number of documents that have been generated, this -- leading down to the -- wait a minute here. The pointer doesn't show up here. Anyway, down at the end, down in here, we have got the implementation report, which was filed in November 9th, 2015. We have got a couple of appendices there, I'll just make note, that replace parts of ISR Part C. Appendix K was replaced by Appendix B in the SIR. And Appendix D replaces ISR Part C in Appendix M. So a couple of changes there.

And then the status. I'll go over this briefly. And Phil is going to get into a little bit more detail on some of these concepts, some of these different elements that we have here.

The conceptual framework, that was the foundation. Hal mentioned this yesterday. Sort of that framework of how we are taking the information from representative studies and bringing that together and marrying that with open water flow routing model, the reservoir operations model, and trying to bring that together and figuring out potential impacts.

Field data has been collected at eight Middle River focus areas below Devils Canyon. We have collected data at half of the Lower River 1-D habitat modeling sites. And main stem and tributary hydrology data has been completed for the Middle River below Devils Canyon. I don't need to go through each one of these things.

The winter studies, a follow-up on Jon's ice processes, we've had physical and biological data. Sort of a pilot study that was conducted in 2012/2013. Followed up with a more detailed study in 2013/2014 that included both physical and biological data collections. Between -- in the winter of 2014/2015, we continued with physical measurements over that winter period. And then those instruments have been redeployed and are continuing to collect data over 2015/2016 wintertime period.

The big thing that I -- that I want to point out is, the proof-of-concept meeting -- and Chris mentioned it yesterday, you know, referenced it -- we had actually two meetings that serve to try and demonstrate how we are tying these different studies together.

We started off with a riverine modelers meeting in November of 2013, came together for a three-day meeting -- sets of meetings then. And then we ended up with a proof-of-concept meeting in 2014. I thought those were very useful in sort of giving you the conceptual framework of how these different models would be integrated into this analysis in terms of instream flows. But there's more work to be done on that, for sure.

With that, I'm going to turn it over to Phil. See, I'm trying to jump through this quickly. And he will get us through the rest of it.

MR. HILGERT: Well, that's too bad. Because I was kind of hoping if I talk long enough and Dudley talk long enough, we'd minimize all these questions. But we understand that that's kind of the purpose why we're here.

So those of you who have looked at the -- this PowerPoint presentation that was on the public website, there's kind of a black text and blue text. This is the same presentation that we gave in -- October of 2014. What I did is, I went ahead and we added blue text where we have updates and new stuff.

So we are going to kind of roll through stuff that you've already seen before, and you'll just be able to highlight those things that are in blue.

The study objectives, we discussed them back in October 2014, so I'm not going to go through those. Kind of whiz through these.

The study components, again, it kind of matches the study plan that we sent out, for the

FERC-approved study plan.

Study variances, we have kind of updated some of the study variances. The study plan indicated that we'd have 13 main stem water-level recording stations. After we finished the 2013 data collection, we developed Version 1 of the open water flow-routing model. We kept eight of the main stem stations. We added three new ones and had eight tributary recorders.

In 2014, we added even more water-level recorders in 24 main stem sites. So although we didn't have 13, well, we actually have more main stem water-level recording stations than what was in the study plan.

Continuous gauging of Fog Creek and Portage Creek: Gauging instruments were installed at Fog and Portage in 2014. We couldn't develop a rating curve for Fog Creek. The hydraulic control kept moving on us. Has kind of a gravel bed. And so we ended up with spot measurements for that. Other than that, the variances are pretty much the same as what we described in the October meeting. So if you guys have questions, we can circle back around later on after the presentation.

So kind of more detail on the summer

results, of the open-water hydraulic data collection. Again, –we added the main stem gauging stations. We also added 11 tributary gauging stations. We had one in Fog Creek, but that one didn't work out. We had nine tributary spot measurement stations.

In some cases, some of these tributaries, like Dash Creek, the hydraulic control is really loose gravel. And so you need a stable hydraulic control in order to develop a rating curve. So we ended up with multiple spot measurements in order to develop an analysis of what the inflow is for those tributaries.

We had ten focus areas identified in the study plan. We measured seven of them in 2013. We measured one in 2014. And then in -- this thing working -- in here, (referring to laser pointer) in the fall of 2014, as we're developing the 2D models, one of the things that came out of the proof-of-concept meeting was, we -- we needed some more additional hydraulic measurements and stage measurements at specific features within these focus areas.

So the instream flow along with fluvial geomorphology team, we kind of put our team together to go out and measure additional features, get data at those areas.

Open water flow-routing model you've seen before. We had Version 1. Version 2 was in the ISR Part K. Version 2.8, which is in the SIR appendix, Appendix B. Version 2 went from the proposed dam site down to River Mile 29.9.

When we took a look at the results of Version 2, we needed additional transects in order to do a better calibration of the model. We started at the upstream direction and in 2014 concentrated on getting those transects in the Middle River. So Version 2.8 is kind of the final for -- from the dam site down to USGS gauge at Sunshine. From Sunshine down to 29.9, it's still Version 2.

So we put off measure -- calibrating it to Version 3, the final calibration for that lower river, pending collection of some additional transects in that lower river. And we have had some questions about the open water flow-routing model, and why do we have multiple flow-routing models?

Well, first of all, this is the open water flow-routing model, so it's not designed for wintertime periods.

We also looked at this model, and we concentrated on the in-bank area. So it -- we try to calibrate it so we could predict stage up to about 43,000 cfs, which is kind of the bank full flow.

Now, geomorphology tends to look at higher flows. But from a fish habitat standpoint, most of the post-project flows and pre-project flows that we're concerned with fish habitat are going to be in this lower flow range.

Fish habitat modeling: Dudley talked about the November modelers meeting and proof of concept.

Winter studies: We have additional information. We had the technical memorandum in September 2014. That provided a summary of data through March of 2014, pre-spring breakup. The September TM, we included data through spring -- through break-up, as well as the June and July and August period.

Summary of results, 2012/2013. You've seen this before. The 2013/2014 through September are in the SIR Appendix A. Let's see what I can --

(Off-the-record technical adjustments)

MR. HILGERT: One of the questions -- yesterday? These things go so fast -- is the dissolved oxygen data that are being collected. And in addition to water quality, we also have water quality data being collected under the Study 8.5.

And this is FA-128, Slough 8A. Let me step out around.

We have got continuous dissolved oxygen reported here. So in addition to the water quality data, we also have dissolved oxygen and water temperature data that we can provide to the water quality team to help them calibrate their model.

Habitat suitability curves. You guys can read this as well as I can. I'm not going to go through all these. But essentially we have two years of data collection in the Middle River below Devils Canyon, up to Portage Creek. We have got one year of data collection in the lower river and one year data collection in Middle River above Devils canyon.

The study implementation report Appendix D has expanded HSC models for a combination of 12 species life stages. And then proposed future data collection and alternate HSC, are steps to be conducted also in that Appendix D.

This is giving an example of the information in Appendix D. If you have questions about HSC, we can ask that afterwards. Description of the 12 species life stages that are in Appendix D.

I want to point out one thing. We had this figure here. And what this looks at is, this is the area that has been modeled. And then we ended up -- and based on mostly literature values, we have an end point. And so as the -- we modeled it out to here and then drew a straight line here.

The reason I'm pointing this out is, because if you go to the Appendix D that's on the AEA website, these figures don't quite look like that. Somehow when they were translated over into Adobe Acrobat, the figures kind of got messed up a little bit, so we are trying to get those -- working with Dan to get those fixed and have him upload the better figures.

So this is a list of the number of micro habitat measurements. And then which species, we have the multivariate HSC. We will go through those.

Again, I'm trying to go through this quickly so you have time to ask questions at the end.

One of the things we also added in the SIR, this is Appendix E. And there's actually a Part 1 and a Part 2, of Appendix E. And that's because these figures are so intensive, as far as the data, we split it up into two separate files. So it's just Appendix E, Part 1 is half the figures; and Appendix E, Part 2 is the other half of the figures.

But what we ended up doing is we have a substrate and cover for each of the focus areas below Devils Canyon. They are GIS overlays. Those are in that Appendix E.

We also included GIS overlays of salmon spawning. So the blue was information that was gathered from the 1980s studies as to where they observed salmon spawning in the area around FA-128. We supplemented that with information from the HSC, and other field people on the ground, as to where they observed salmon spawning in 2013/2014.

We did an aerial survey September 10th 2014 and another aerial survey on September 26, 2014, to attempt to try -- try to identify where are we observing these concentrations of salmon spawning. We can then look and compare our weighted useable area results and see about the predictions for spawning habitat versus where we are seeing them.

Proposed study modifications: One thing, we assume that -- that there's been a delay and -- and that affects the schedule, that this change in schedule won't affect our ability to meet the study objectives. Given that assumption, we had no modifications to the analytical framework, no modifications for the river stratification study area selection.

The hydrologic data analysis is, as Lyle mentioned the other day, is that we have got three instead of five representative years. We haven't -- we proposed IHA and EFC metrics, but we haven't worked out the final details. We want to wait until after the open water flow-routing model is completed so we can start evaluating those metrics.

The reservoir operations, a study plan identified that they'd use HEC-ResSim for the reservoir operations. And instead they're using MWH-ROM model for reservoir modeling. John Haapala's the person for that.

HSC are going along as planned. The model development, we didn't collect the -- we collected the data for 1D modeling on LR-1 in the lower river. We didn't measure yet LR-2. We discussed that at the last meeting. And those are the transects down at river mile -- near Mile 67; Sheep, Caswell, main stem transects, as well as side channel transects.

Temporal and spatial analysis, we're looking at both 1D and 2D modeling. Our general approaches were discussed during that November 2013 meeting. We got a little bit more detail during the river -- during the proof-of-concept meeting in 2014.

And the final approaches, we are still in discussion with those. We figure we need to get confirmation on exactly the -- the DSS results and how all these models are going to be integrated, as we get into that spatial and temporal analysis.

Steps to complete the study. In the lower river we have main stem and tributary gauging yet to do. We have got some main stem transect bathymetry to collect. And then measuring the lower river Segment 2.

1D transects, you can see we have transects and side channels. And then Caswell and Sheep creeks. Second season of HSC measurements.

Middle River. This is this FA-173 that you were mentioning, Mike. We haven't collected the hydraulic data for FA-173 or 184. We haven't collected stage, flow, substrate, or cover. We will put in an ESS station above Devils Canyon to support those measurements. Second season of HSC measurements above Devils Canyon. We have got continuous water level and water quality data that's being collected. We haven't analyzed that yet or -- that's from September 2014 to September 2015.

As Dudley mentioned, we have recorders deployed right now. We will pull those in September and download the data. And we are proposing another season of combined fish sampling and water level and water quality monitoring at FA-104, at Whiskers Creek, FA-128, Slough 8A, and FA-138. We've been collecting physical data because it's -- we can put those recorders out. But we also think we need another season of -- a winter season of meshing those physical data along with the biological data.

Reach scale modeling. Finalize the open water flow-routing model. We need to integrate the ice cover flow-routing model with the open water flow-routing model during those fall and spring transition periods. And then finalize reservoir operations.

Lower river transect modeling. That's the 1D modeling. Middle River, we need to complete the SRH-2D sites for open water and the River2D hydraulic modeling at the focus areas. And finalize the HSC. Develop varial zone.

Bill had mentioned we need the breaching flow. The plan is not only do we have the 2D morphology and SRH-2D results for the focus areas, but we are going to go out and collect the inlet elevations of the various side channels and sloughs, the major ones as you go up and downstream in the Middle River, to check and see at what flow those inlets are inundated under both pre- and post-project conditions.

Complete the effective spawning analysis and then calculate the remaining fish habitat metrics both for existing conditions proposed operations as well as years 25 and 6 50.

Decision support system. We had a -- in the FERC-approved study plan, we have a description of a -- an integration procedure using a matrix approach that has been successful on other projects. At this point, we are thinking that's the process that we will use. But we are also open if a -- a better tool becomes available that's usable within the time frame and the budget we have, then -- then we'd consider that.

I think I raced through that quickly enough that we'd have some time for questions.

MR. MOUW: Yes. This is -- this is Jason. Can you hear me? Jason Mouw.

I had a couple questions about the HSC. And you mentioned that we could get into more details later, but I just have some broad-based questions and won't get into the real specifics. But kind of maybe break these up with some other questions from around the room. I have only four.

But looking at some of the talks yesterday and the importance of the hierarchical habitat model, that -- you know, the macro, meso, micro habitat. That model was used to map habitats. And it seemed to structure some of the surveys in the studies of 9.5.

And in 9.6, I didn't see how it was used to structure surveys for HSC. It wasn't very clear to me. So for one example, like the influence of meso habitats, for example, on habitat utilization -- and this is an -- some of these are assumptions you'll correct me on if I'm wrong -- but didn't account for the meso habitats when you were designing surveys. And this didn't carry through either through the data analysis.

And so the concern, general concern, is that when the distribution of habitat isn't used to structure the surveys ahead of time and the data analysis, it questions the validity of the comparisons between -- within and among habitats, and in particular, the isolation, any efforts to isolate which micro habitats were structuring habitat selection.

So that was -- that was the first. And I'll pause there for -- I'm just going to cross that one off of there.

MR. HILGERT: You kind of have two different questions. One is, is did we use the meso habitat in order to identify the HSC sampling? And from an instream flow from the weighted usable area standpoint, our output's going to be really on the macro habitat scale. And we did use macro habitats.

And I was going to turn it over to Mike Gagner. We have him called in on, and I want to make sure he gets at least a couple questions. I was hoping for a harder one. But I'll turn it over to him.

MR. REISER: Let me just make sure that -- because I -- I got that -- I interpreted your question a little bit differently in terms of the study area selection process.

Is that where you were thinking that the --

MR. MOUW: Well, that's part of it. You know, you select -- you know, you selected congregations of spawning, for example. If we can isolate the question to spawning, make it simpler that way. The -- in order -- and you did a great job by assessing availability of habitat. We don't always see that. You know, there's so many great things that you did do, lots of things that are praiseworthy.

We don't have a lot of time here, so I just have to focus on what the questions are.

But when you're looking at comparing used and available habitats and trying to sort out, okay, what was important at a micro habitat perspective, and that has to be extremely structured. And so there was the development of this hierarchical model. And -- but -- and I saw that as important in structuring some of the other studies, but I didn't see that structure carried through in the surveys.

And then the analysis of the data is another question. But --

MR. REISER: Okay.

MR. MOUW: -- we can start with the surveys.

MR. REISER: I think Phil is correct; this is a -- you know, Mike Gagner, Mike Gagner is probably -- because I -- let me just back up. Because I was thinking your -- what your question was, Jason, was that you were asking about the study area selection broadly. Getting back to the actual study and site selection, not just specific to HSC. So your question is more on the HSC front.

Okay. That's fine.

So Mike? Mike?

MR. GAGNER: Yeah. This is Mike Gagner. And I'm not sure I'm exactly tracking your question, but that's all right. We will look forward to seeing it in writing, and hopefully we can give you a little -- a better answer then.

But your assumption is correct. We use the macro habitats to help us for site selection. So we used the stratified random sampling approach based on those macro habitats.

When we started the process for selecting sites, the meso habitat mapping was not yet completed and there was still some sort of debate on what the actual calls were going to be for these meso habitat types and how they were going to be mapped within the field. So we obviously had to get started.

So we went ahead and used the macro habitat types with the thinking that the individual macro habitat types would be comprised of the different meso habitat types and they would be a unique selection of meso habitat types generally within each of the macros. So we thought by using the macros we'd still get a pretty good representation of the available habitat within each of the focus areas.

For spawning, in particular, you can imagine that, you know, the fish are not -- with any of these focus areas and with any species and life stage, the fish are not uniformly distributed within a focus area. And this is maybe even more especially true for spawning since they're keying on a particular set of variables, that they appear to be selecting a particular set of variables to -- for site selection.

So we attempted to use, as much as we could, again, that random stratified sampling approach for spawning locations. But we also had to rely somewhat on data from the 1980s and some of the more contemporary data to help us identify those spots so that we could actually go out and actually get some measurements. Otherwise, we would have ended up with just a whole lot of zeroes. And that wouldn't have done us much good in trying to identify, again, what types of habitat these fish were selecting or what their preference was.

MR. MOUW: Yeah. Thank you. That was very helpful. Yes. It leads me right into the next question. And so I understand entirely why you focused on congregations of spawning or clusters, as you called them, of spawning. Seems, you know, really straightforward and most effective.

The concern that I have, though, in trying to analyze what's driving that selection of those -- of those locations is, is how do we go about structuring a survey of available habitat that would allow us to isolate what's going on within those clusters?

And so did you give that any consideration? Because the use and availability measurements were all located within those clusters. So my assumption is that's broadly within the distribution of fish. Did you -- were you able to look outside those clusters in comparable habitat types? Again, highly structured so that you can isolate the influence or compare the distributions, the statistical distributions of the micro habitat variables that we are looking and questioning, amongst the meso and macro habitat levels.

So when we are looking at a shallow shoreline of a -- of a main channel -- let's stick with spawning -- within one of these clusters, could we move up or downstream? Or did you move up or downstream outside the cluster and look at a shallow shoreline to look at the statistical distribution, to be able to compare, were there differences and what might the micro habitat variables be that --

And one of the biggest questions is groundwater. So if you're within the cluster and you have VHG, which is one of the big praises for the study, you have VHG characterized along that cluster. But you're within the distribution of fish so that you have basically a cluster that's defined most often by one VHG. It's probably positive, and I'm sure you had some examples where it was negative. But if you didn't go outside that cluster, it sort of forfeits the ability to evaluate what an alternative set of conditions would look like.

MS. SHELLY: Hi, this is Alice on the phone, Alice Shelly.

I can take that, if that's okay, Phil.

MR. HILGERT: Go right ahead.

MS. SHELLY: Okay. So I guess the answer to that question is sort of a yes and a no. We didn't, you know, go downstream or upstream of a selected site and take extra availability measurements.

However, we do have a fair number of sites where there were no spawning or, you know, rearing observations. So we have some sites where we have only availability data and there was no fish captured. We have a fair number of those sites. So we haven't used that data in the way that you're suggesting directly. I mean, we haven't presented any sort of, I guess, analyses of the habitat available in sites that weren't used at all. Although, I have looked at some of that and haven't seen anything very earth-shattering.

But I'd be interested in your comments on how we could use that in a different way, I guess. We didn't -- I was -- was already stretching -- stretching the bar here to get as many availability measurements as we could get from the field people, so we didn't pursue that sort of idea. But it is interesting.

MR. GAGNER: This is Mike again.

Yes, we certainly did think about doing that, extending, you know, just -- again, going outside of our individual sampling sites, you know, of some increment, 50 meters, you know, a hundred meters upstream, downstream and sort of, you know, poking around and seeing what we could find.

But, again, as Alice pointed out, you know, we had a study design and we didn't really feel that we had the opportunity to sort of start deviating, you know, from that during the middle of a field sampling effort, so we stayed with our initial sampling study design.

There was, though -- in addition to that, there was actually quite a bit of variability in the one variable you're pointing to, this presence of groundwater upwelling or downwelling. And there was considerable variation at times, even within a site.

Generally, a site was predominantly either upwelling or downwelling, but you certainly had areas within a 50-meter or a hundred-meter sampling site for spawning, where you had, you know, neutral or you could not detect an upwelling or downwelling current.

So there -- we do have, you know, some variability, again, with each of those sites. But we didn’t -- we did not extend it to areas outside of the individual sampling sites.

We would -- we will, though, hopefully, in the next phase of the project, have a little more additional data for groundwater. I think you folks had talked about that earlier today. And once that modeling is progressed a little bit, there may be an opportunity to try to actually, you know, expand our view of the worlds outside of our 50- or hundred-meter site and to look at the presence of potential for groundwater upwelling and downwelling in close proximity to our sample locations.

MR. MOUW: Well, I don't want to hog all the time here, so -- I have a couple questions, but they're -- I'll ask those later.

MR. PADULA: Thanks.

MR. GEIGER: Hi, this is Hal Geiger.

So I have got some questions about the development of the models, and I don't want -- there's a whole bunch of people in this room. We could burn up a whole lot of time unproductively looking at little squiggles, so I don't want to do that.

And I'm going to suggest that we -- I'm going to suggest that we have a separate technical meeting at a later time to really address these in more detail, because it's -- really waste a lot of time.

But I do want to make a couple of points to give you some hints of why I'm confused. So the day before yesterday, I made -- I tried to make the point a couple of times that as I went through to do my review, there were two things that were really important to us, that were our guiding principles.

When we looked at estimates, we were looking to ensure that the estimates were supported by the data. And I talked a little bit about sampling error and standard deviations and so forth as one guide for that.

And then the other thing we were looking for, is -- in trying to answer the question, are the estimates appropriate for their intended use? So as I got to the -- these habitat suitability curves for salmon, I couldn't answer either one of those questions. And that's because that there was -- what we got, essentially, were just the results.

And so there was all of this stuff, all of the diagnostics, all of the things about how well the data fit the model were all kept behind the curtain. And when I finally did get to some equations, like, for example, the equation at the bottom of Page 33 in Appendix D, I found this very surprising and what I would consider an unconventional equation. And it didn't really make a lot of sense to me.

But later I found this wording over and over again, that this -- let's see if I can find it -- some wording to the effect -- I can't find the exact wording -- but wording to the effect that this error term was in here to express the intent of the model. And so that's maybe why I'm confused, that maybe the intent was not to have a technically correct equation here, but just to get across some information to the reader, that somehow didn't come across to me very well.

And I don't want to burn up a whole lot of time, but I do want to make clear what I would have expected in terms of the narration of how the models were developed.

So I would have expected, first, a conceptual model written down and on the left-hand side of that equation be something that you could observe.

So, for example, if we were interested in whether a coin -- what proportion of time a coin came up with heads, I would expect on the left-hand side something to do with the number of heads. And you see in the equation at the bottom of Page 33, you have a logit.

So the first equation we should see is something that where on the left-hand side, it would be something about the number of heads you would get.

Then the next thing I would expect is some sort of statement of how you're going to take data and turn that into estimates.

And then finally I'd -- or, not finally. But the third thing I would expect would be some --

some report on what the estimates are together with some things like standard errors or confidence intervals or some conventional measure of how well the estimation process took place.

And then I would look for some proof that the modeling actually did work.

When new drugs are proposed, people have to produce some kind of proof that the drug works, and that's generally true of models, too.

I think all that was kept behind the curtain, I think. And perhaps it's somewhere in the documents, but I was not able to find it. And I spent quite a bit of time bouncing around.

And I found some inconsistencies. So on Page 9, we see that these -- these curves would fit the logistic regression, which is important -- which is a very conventional and reasonable thing to do.

But then as I look at these equations at the bottom of 33, that -- those equations seem inconsistent with logistic regression, because they're showing normally distributed error mixed in with some model estimates on the right-hand side. But on the left-hand side, what we are seeing is what's presumably the true unknowable parameter.

I don't know if I'm making my point. But that's where I find this unconventional.

So anyway, I don't want to -- us to spend the rest of the day just looking at little squiggles. And if some people are looking at this equation and thinking, well, it's Greek to me, well, that's because this literally is Greek on the far right-hand side.

Anyway, that -- I suggest we defer these issues and questions to another -- to another time.

MR. HILGERT: I know that Alice is just anxious to answer your response, because she's been spending a lot of time and we have had a lot of discussion about these.

But I agree with you. I think we should just put this off to a later time where we can have more time to go through this in detail.

You want to comment at all?

MR. REISER: Alice, do you have any general comments to make on that? I agree with Phil, we do want to keep it -- keep it short at this point in time. But you may have just some general comments to make.

MS. SHELLY: Well, I guess I'd just have to disagree that this was unconventional. When you -- it's a generalized linear model. And when you use a logistic function, the error is normal. I feel like I have described the models ad nauseam, but we sure look forward to your comments and suggestions on how we could describe them more fully.

MR. REISER: Yeah, I think that's definitely going to need a little additional discussion on that.

I think those are good comments, though, Hal, and good to get those on the record.

And AEA, we can follow up, I assume, on that.

MS. MCGREGOR: Yeah.

MR. REISER: Thanks.

MS. WALKER: Hi, this is Sue Walker, for NMFS. A process point is that we are making recommendations and comments based on the information that we have, which at this point is incomplete. We have requested this meeting since -- it was scheduled for two hours before the project was put on abeyance at the end of December of 2000 -- was it '15? -- '14. How time passes.

So I think it would be beneficial for all parties if this meeting did occur, because it would eliminate the possibility of doing a lot of work, asking a lot of questions, that could be clarified with just a short in-person meeting. So again, we make that request.

Thank you.

MS. McGREGOR: This is Betsy with AEA.

As we've been sitting here and listening to the feedback from folks, we have identified areas that we would like to follow up and, you know, either resolve some of the comments or questions or get on the same page or be able to allow the agencies or the other stakeholders to have more targeted comments for things that are still remaining. So that's our intent and to have it coincide with the FERC filings in the schedule coming up.

MS. STEELE: So this is Marie Steele with DNR. So just to follow up. And this may be a premature question. With the meeting summary coming out in -- when is that? -- the last of --

UNIDENTIFIED SPEAKER: In a month.

MS. STEELE: -- April, the 28th of April, is this something that could be done before then so that you could incorporate any results into the meeting summary?

MS. McGREGOR: That's our intent, to the extent that we can. And if we can't get it resolved in time for our filing of the meeting summary, at least if we have a plan forward and a schedule and -- then we can file that information subsequently.

MR. PADULA: Thank you.

And go to the other Betsy.

MS. McCRACKEN: A quick follow-up. This is Betsy McCracken with the Fish and Wildlife Service. And I appreciate that we are talking about getting together to meet again, and in particular, about this topic, because as Sue mentioned, we have requested a meeting and didn't get to have it. And I know in prior communications we discussed the desire to have the HSC data from both used and unused sites. And I think it's still something that we are hoping to resolve.

Thank you.

MR. GAGNER: This is Mike Gagner again.

We have provided AEA with all of our data, both utilization and availability data. It's all in a very extensive database that has been provided to AEA and should be available to you folks.

MR. EAGAN: Sean, National Marine Fisheries.

I understand how you go out there and you can see upwelling pretty clearly and you can say that's a variable that's associated with fry or something like that.

I'm unclear -- everyone keeps talking about downwelling spots. Is it easy to just walk by a stream and see where downwelling is happening?

MR. GAGNER: No.

This is Mike Gagner.

No, you can't see downwelling. And in most cases, you actually can't see upwelling unless there's a very strong indicator with like fine particulate matter available, that you can actually see some sort of a plume. Or in other cases, you can detect a little bit of a temperature difference if you're very near it, because the groundwater is colder in some cases than the surface water.

So the downwelling is actually detected using a micro-piezometer that's inserted into the substrate at about the depth of a typical egg pocket for a salmonid. And then we use, basically, a methodology to actually then detect whether there is upwelling or downwelling or neutral at those site locations.

Those are -- within those 50- or hundred-meter sample sites that we described earlier, there's generally a minimum of three to five measurements made to just detect the availability, whether there is groundwater upwelling or downwelling within a site. And then at most of the spawning locations, in very close proximity to the individual nets or the redds, we also made those measurements to see if there was upwelling or downwelling present.

MR. EAGAN: Okay. Thanks. You had this tool, and you took it with you to the sites.

Thank you.

UNIDENTIFIED SPEAKER: Have a question in the room.

MR. MOUW: So I do have a question specifically about groundwater.

Yes. Thank you.

This is Jason Mouw again.

So I'll use Sean's question to move on to that. Of course, you know in Alaska it seems perhaps more than elsewhere groundwater is really important, you know, through the winter, but also for incubation, but also for spawning site selection.

You know, just it's important, I think, to recognize that we have -- from a fish perspective, you know, moving down from our discussion yesterday, we have exchanges occurring between river and groundwater at the floodplain scale, happening at the channel scale. So we have water that's moving between channels through bars, you know, regardless of what the floodplain or regional gradient would be.

Then you've got advection of flow through the bed, you know, typically in your topographical highs. And I'm sure you're well aware with all that.

So the water quality associated with each of these pathways is -- can be very thermally and chemically distinctive. So it's extremely important, because spawning and incubation are behavioral responses to this hierarchical exchange.

So I was elated to see that you have some data collected within in the clusters. I'm still very interested to know what's occurring outside the spawning clusters. And on the phone, you know, we saw that -- or we heard there was a little bit of analysis within and outside clusters. But the results weren't very earth-shattering. And that's to be expected.

You know, I -- in looking at these kinds of data sets, when considering the influence of VHG throughout the state, I have not seen much of a difference between spawning and non-spawning sites when it -- it relates to depth of velocity.

And so some of the variables that we’re using -- you know, we typically use to model flow habitat relationships don't fall out as being the most relevant. So just the fact that we have these clusters, we have spawning occurring, very isolated areas on this middle Susitna River, tends to suggest that, you know, there's a water quality -- associated water quality gradient. Usually, it's temperature associated with this upwelling. That could really only be teased out with these -- within and outside cluster comparisons.

MR. PADULA: A question from Chris?

MR. GAGNER: This is Mike again.

Yes, I think that's an excellent point. And as we said, you know, as that groundwater modeling data becomes more available, readily available to us, it's something that we think would be beneficial to the project to take a look at down the road.

MADAM REPORTER: Who is that?

MR. PADULA: Mike Gagner.

MADAM REPORTER: Okay. Thank you.

MR. JOHNSON: Chris with USGS.

I think to, I guess, build on what Jason was saying there. You know, understanding that the curve development is not finalized, I think there's some issues with looking at the habitat models that are based on some of those physical conditions.

And the question, when we are looking at project effects of whether or not those physical conditions can actually be predicted under the various operation scenarios, you know, such as temperature, water quality in those off-channel locations, water depths in locations under mixed surface water and groundwater influences, velocity under ice.

You know, and we go back to kind of the integration flow chart, all of that kind of comes down from all these different models down to these habitat-specific variables that are physical components that we are currently measuring, but we are trying to look at project effects in the future that are going to be conditions that we currently aren't able to model, potentially model, or even have data that we have measured that meets those conditions.

And so I think that's something that in some of the HSC stuff we looked at, you know, D.O. -- you know, temperature, D.O., and a few of those things that were initially looked at, and said they weren't significant, you know, within the specific HSC, but they were, you know, looked at from a larger standpoint that it is important under project operations, but how that is going to be implemented in the HSC analysis and how well we will be able to predict those values.

We talked with the water quality model yesterday on, you know, Slough 8A. You know, are they going to be able to predict that information that can be utilized by the 2D hydraulic model in the analysis that's done within that?

I heard you guys have some additional data that you've collected as part of the HSC, that can maybe help that model. But I think it still gets down to -- again, the idea of the POC meeting that we did kind of laid out the overall approach for all of this, and I think that that was helpful. You mentioned that, you know, the results of that was reason for you guys to go out and do additional data sampling, after talking within the different models and groups that are doing their studies.

And I think while we can't do it right now, but now we have a lot of that data. And actually applying that in that kind of pilot study application, I think, really emphasize or address a lot of the questions that we are bringing up now in terms of, will we be able to utilize this data to answer that final question of what is that project effect on that habitat variable?

And I think there's still some unknown on what that habitat variable is that we are really using to address project effects. There's, you know, a list of possible metrics that might be looked at. But I think doing that pilot study would get down to that final answer of, what is that metric that actually can or maybe can't show what project effects are?

MR. REISER: Yeah, I'd just -- those are good comments, because I think those are very right-on points to make. And I go back to the proof of concept. Again, that was -- that was the effort where we pulled together conceptually how these models were going to be, we were thinking, are going to be working.

We have collected data subsequent to that process, and we now have additional information that can be brought to bear to see, okay, can we actually do that? So those are -- those are good things. Definitely good comments to make. We understand that. And clearly that's going to need to be done before you go down any further into the evaluation of impacts. You want to make sure that what you're getting from the models is going to be usable in answering the questions that we have, so --

MR. GAGNER: I don't really have any further comment.

MR. GAGNER: The initial study report -- I mean, just look at it.

MR. HILGERT: Yeah, this is the initial study report, so we don't have all the answers. What we want to do is be able to look at, or is the data that we are collecting going to give us the ability and the modeling to look at project effects? And, frankly, right now we have a very complex weighted usable area procedure that requires the integration of groundwater and water quality and ice processes.

And we have got this structure that is, frankly, very complex and very aggressive and very ambitious. And some areas are working out better than others, perhaps. And we are trying to resolve those.

And what we are really looking at is, as we go through this process, if we find that we are not able to perhaps predict as -- quite as accurately with some of the riverine process models that feed into the weighted usable area, we may have to drop back a little bit.

But at this point in the stage of the FERC process, we have gathered the data. We have gone through the proof of concept. We are looking at how those are integrated. We are looking at kind of -- we are waiting for some of the model results and then kind of seeing how that all fits together. So it's not -- we are not done.

MR. JOHNSON: Yeah, I definitely appreciate that, you know, it is a process and the complexity there. Especially in this type of a system, it is very complicated and isn't maybe able to be looked at, at this point.

But I also think, while some of the studies, you know, have additional data that needs to be collected, I think that it would be a benefit to AEA to be able to pull all those models together and actually apply them to make sure that there isn't additional data that needs to be collected prior to going out and doing any of that data collection.

You know, rather than, you know, getting down to the process and saying, okay, we are now at the USR or the next step, and now we find that we are actually not able to utilize these models and therefore now we can't make that assessment for project effects. Then you're kind of stuck in the water. You've spent that entire time doing all that data collection and finding that you're missing some things that maybe we could have ID'd earlier on in the process.

MR. CUTLIP: Matt Cutlip with FERC.

I have a question about schedule. Because I hear a lot of concerns about when we are going to get model results, whether or not those model results can be trusted, if we have an opportunity to really review those results before they start to be utilized in this analysis of project effects.

So will we have completed models by -- and by that, I mean an initial model being, you know, completed, calibrated, with the result presented by the USR? Because I haven't heard that yet. Maybe I'm just not looking or hearing in the right places.

UNIDENTIFIED SPEAKER: In unison?

MR. REISER: Yes. Yeah. I mean, that would definitely be -- before we get to that point, we would -- we would have addressed a lot of what Chris is bringing out right now and have those model outputs, initial outputs, put forward in the USR.

MR. HILGERT: Yeah. Betsy mentioned, I think, on Monday that the draft license application is where they'll be looking at various alternative scenarios. But we envision for the -- the USR will have existing conditions and one scenario as an example. You're right. We have to be able to demonstrate that it works.

MR. MOUW: This is Jason Mouw again. I just have one last sort of a bigger scale question. And seeing that this HSC component of the study is really where the rubber hits the road, it's where everything gets integrated to make an assessment of project impacts.

The question I have is, when I looked at the analysis of the -- both the utilization and abundance data, they were all pooled together, it seemed, in the analysis.

And so, to me, when we are looking at pooling data by species from all the various macro habitats, so we are pooling main channel data, with upland slough data, with all the other macros and various meso habitats in between and we are analyzing that as one unit, if you will, it appears to me that that -- well, that doesn't -- first of all, it doesn't make a lot of sense to me ecologically.

But then looking forward -- and I know that you have the data, so you could parse them out later and look at things separately. But is that something that could be -- that's the first part of the question -- is that something that could be done?

Right now we are looking at this broad range of macro habitats all at once for, say, chum spawning. And we are not developing models that are specific for main channel, you know, all the way to the extreme in an upland slough-type condition. Very different ecological settings. Very different spawning strategies. Very different incubation strategies. So I'm just curious about that.

MR. REISER: Well, I guess ecologically, I think of -- I have always taken a very simplified approach, but I'm going to let Alice answer some of the more detailed statistical analysis.

But when I consider fish utilization and where fish are actually finding themselves, I rely on the attributes of that given environment that they're in. And so across a wide range of macro habitat types, you let the fish select those areas based upon what's there.

So pooling, to me, makes sense. Because you're -- you know, you're bringing all those different attributes together or different habitat types together. And you're allowing the attributes there that you modeled or you measured within those to understand where those fish are -- where those -- fish are.

I've not been involved in any instream flow studies that I can think of, that bring it down to HSC curve development on a -- you know, on a meso habitat scale, where you're developing for riffle or run or pool or -- it just that's -- the complexity of that would be, you know, unbelievable at this point.

MR. MOUW: Well, just let's keep it at the macro scale, then. So if we are looking at, you know -- I mean, we can all visualize the gross differences in habitat between a glacially occluded fine-grain shallow shoreline in the main channel, which is, you know, flowing quite rapidly, and a very course-grained, very slow-moving, very different in terms of its thermal and chemical properties, upland slough.

Having a model that's going to predict project effects saying the same things about those two seem -- widely different environments, doesn't seem to -- because we know, for example, that there are different spawning tactics. We will just keep it to spawning. There are different rearing strategies as well. This gets really complicated really quickly.

But just within spawning, there are a -- there are different spawning tactics that are related to an incubation strategy that are going to play out -- they're going to relate very differently to both up- and downwelling, for example. And they're going to relate very differently to depth and velocity.

MR. GAGNER: This is Mike Gagner again.

You know, part of the reason, obviously, that we have pooled the data is that trying to get a large enough sample size within all of the different macro habitat types would be a tremendous effort, as you can imagine and as you know. Since you know Alaska streams, these fish are selecting specific macro habitat types. Chum and sockeye are in the off-channel areas, for the most part.

So being able to create a specific and statistically robust curve for each individual macro habitat type is somewhat impractical, simply because you would not be able to make enough observations to be able to cover them all.

MR. GEIGER: I'd like to change the subject.

Yes. This is Hal Geiger again.

So I understand when you're modeling things, you can't take everything into account. That leads to (Indiscernible - noise). But --

Now, is this --

Oh, okay.

I understand you can't take everything into consideration. But I'm looking here at the bottom of Page 36. And I'm seeing for the chum salmon spawning model, it -- like all the others, it's a function of depth and velocity. But knowing something about the biology of chum salmon, the most important thing to them, as far as spawning, is upwelling.

And so at some point, we are going to have to convince ourselves that we have captured some sort of proxy for the most important thing that those chum salmon are considering. And all we really have in front of us is just this equation that's saying: Here it is; that's the truth.

We need -- we need some sort of -- some sort of evidence that we have captured by proxy what's really important.

MR. HILGERT: Yeah, I guess I take exception that we know what's going on. The idea of instream flow modeling is to try to use a metric to describe what the effects of the project are. On a real gross basis, it used to be depth and velocity. We added substrate. We added cover.

Now we are looking at additional ones. As we add components, it improves our ability to look at what are actually project effects. But we have to add components that actually drive where the fish are spawning.

When we went out and took HSC measurements, both where they were and also available -- habitat availability, we took the VHG measurements at 85 to 90 percent of the sites. We took dissolved oxygen measurements. We took a lot of these different factors and then looking at -- at, frankly, on a site-specific basis, which factors most correlated with where the fish are. And that's what we are showing.

I went into this thinking that chum are really tied in to upwelling. And some of the observations suggest that we are finding fish sometimes where there isn't upwelling. Now, my own personal bias is that I think, over time, those fish that are in the upwelling have a better survival rate; and that's why they keep coming back there.

But you also have fish spawning in areas that are not upwelling, and those also go into the equation. So when you start looking at HSC, you've got to take what the fish are telling you. Not all fish spawn only in upwelling areas; there's always some that spawn in other areas. And those, I think, are important to the -- to keep that flexibility and variability over time.

MR. GAGNER: Phil, this is Mike Gagner. Can I follow up with that?

MR. HILGERT: Go ahead.

MR. GAGNER: We also went into it with a very similar sort of, you know, biased thinking that -- because some of the -- there's a strong indication in the literature, again, that chum, in particular, and sockeye as well are keying on these areas with groundwater upwelling.

So that was one of the reasons why the agencies, and justifiably so, and FERC requested that we try to use something like these micro-piezometers to see if we could detect upwelling and downwelling. And what we found is that about 68 percent of our spawning utilization sites, you had upwelling. But about 32 percent of those sites, you actually had neutral or downwelling.

So it's -- there -- although there is a slight indication that they are keying on the upwelling, it's not as strong as what we may believe.

So we have really wrestled with this variable, whether we include it or we don't include it. But, you know, we found through Alice's very detailed statistical analysis that we get a stronger fit with the model when we don't include upwelling.

Now, we may decide down the road that we are just going to follow our intuition and we are going to say, look, we are going to force it. We think that downwelling or upwelling are variables that just simply have to be included into this model because they fit our thinking. And there is a way to do that.

But we wanted to stay consistent with the approach that we've been following to date with all the other species and life stages and follow what the statistical model is saying. And right now it's telling us that there's a better model fit if we do not include upwelling.

That's not to say we might not consider it or push it into the model later on, but right now it's telling us that there's not that clear strong indication that they only spawn on upwelling sites.

Many of you may remember some of the 1980s work that was done. And they simplified the approach even further and made it basically binary and said, look, if there's no upwelling at a location, then spawning suitability is zero. So we now know from this current work, by using these micro-piezometers that that assumption is simply not true.

So how we deal with it, you know, luckily we still have another half of this study to be able to rassle with and figure out how we'll move forward with it.

MR. HILGERT: Just one quick one. Right now we are using the VHG measurements as an indication of groundwater upwelling. And one of the things that we're looking forward to is as these folks and others get that groundwater model done, we will have additional information on groundwater movement within those focus areas that will help us and give us a better indication that will support or supplement that -- the VHG measurements. We just don't have the groundwater results yet.

MR. PADULA: Thanks, Phil.

Jeff, I would like to ask you to hold just a bit more. I think Jim's got a related comment.

MR. MUNTER: This is Jim Munter with the NMFS team.

Three points on groundwater here: One is, I think there's a scale issue; and I guess I'd encourage you to talk to the groundwater modelers and consider a refined node size in areas where you have upwelling and field data, because models -- you know, like, it's analogous to having a model simulate a single water well. It doesn't work very well if the node is hundreds of feet on the side. So there's that.

The second thing is that on the VHS measurements -- or, VHG measurements, that's not a reliable measure, necessarily, of the upwelling quantity or the flux that I had talked about yesterday. And I think that's a really important thing to use as a calibration parameter for the modeling, where you have full measurements in these sloughs and you can correlate that to all these other habitat things.

And finally, on the VHGs, it might also be -- the data there might be dependent on river stage; when there's a summer high flow or fall high flow, you're going to more likely get downwelling. And so you could have a site that's kind of flat when you're out there; but then in the wintertime, when the river level drops, it could be upwelling. And that maybe the fish can predict the future better than humans can sometimes. So that might be an important parameter.

MR. REISER: Yeah. Let me just -- I'll just follow up on that comment. Those are the very types of things that we've been talking with, with Steve on, Steve Swope. And so we are getting into that. We have provided all VHG measurements to them and all of the data, temperature data, et cetera, as much as we can. But the idea is to get more into that very way of thinking with the groundwater coming in and the temporal patterns that you're talking about, too.

One time it might be upwelling; one time it might be downwelling, depending upon the stage. So it depends on when you're out there measuring -- taking your measurement as to whether you may be maybe getting a signature of upwelling or downwelling.

Yeah.

MR. PADULA: Jason, do you have a follow-up on this topic?

MR. MOUW: Yeah, real quick.

Yeah, this is Jason. Just real briefly on the -- on the groundwater. If you look at the whole lateral gradient from the main channel all the way to an upland slough, so we are looking at a fluvial to a parafluvial environment, you know, time since it was a flash-flooded or scoured. We see such a broad gradient of thermal and -- well, let's just leave it at that. Thermal different -- seasonal thermal characteristics.

And that -- that's responded to in the periodicity of these species. So if you even look at, you know, in other systems -- and I don't know about the Susitna. I'm not talking about site-specific knowledge here. But from what we see throughout the state of Alaska, I would expect that the periodicity, even within a given species, would be different among the various macro habitat types, so when you -- as it relates to their use in the different macro habitat types.

So that tends to be related to the kinds of environments that they're selecting. So within the main channel, almost universally, summer species are spawning in downwelling. Within the off-channel, almost universally, summer species are spawning in upwelling, but only in reaches or regions of the floodplain that are regionally downwelling. So it gets very complicated and it's hierarchical.

And then when you get into the fall,

species are typically -- again, this is using Alaska-based literature, functional analogous systems in Kamchatka -- we see an almost universal selection for regional upwelling. So when we say that we look at upwelling -- and sometimes it's important and sometimes it's not, but we are looking at it, you know, across this broad gradient for all the various, you know, potential spawning tactics and periodicities that occur.

And, again, you could probably address whether you saw variation within species.

You're not going to see the differences and the importance that drive the differences in periodicity, unless you're segregating things out and looking at -- for these relationships individually based on your hierarchical habitat model.

MR. PADULA: Thanks, Jason.

He's been very -- is there a response?

Very patient. We're now going to hear from?

UNIDENTIFIED SPEAKER: Jeff Davis here.

MR. WOOD: This is Mike Wood.

MR. PADULA: Yeah, Mike.

MR. WOOD: Hello?

MR. PADULA: Yes, Mike.

MR. WOOD: Hi, I have got just two observations to add to the conversation. Two is -- or one is, in the -- spawning fish in the Susitna are very shy and discreet, and they often are spawning in murky water that you can't even see them in the side channel and sloughs and whatnot. And I've seen -- I found out, especially in 8A, when we were camping there during some of those studies. That was in two places there that were like that. You wouldn't expect it, because it was just so murky.

The other thing I'd mention is, like way beyond the main channel of the river, out in the woods, there's quite a bit of upwellings of groundwater, where you find a lot of juvenile fish being reared.

MR. PADULA: Thank you.

And Jeff has ceded his time many times now, so it's your turn.

MR. DAVIS: I've had my share of turns to talk, so it's all right.

You know, just to kind of feed off this, you know, differences among macro -- I want to shift gear. You know, I'm always thinking about juvenile fish. I'm thinking about juvenile Chinook, coho, and sockeye salmon, so instead of spawning.

And also think -- and what I've seen is, there are differences among these macro habitats. And it may be explained by differences in these micro habitat variables that we ask you to evaluate. And I'm looking forward to seeing -- and I wish we had a little bit better results from the first year of the fish distribution and abundance study that were reported, that would give you a value for a macro habitat, you know, that we could use to evaluate your equations to see how well you did to predict, you know, the distribution of those species.

One thing I'd like to comment on, on the micro habitat variable tech memo. That was one of the recommendations FERC -- in the FERC determination. And I don't think that you covered that topic very well. As you state it in that tech memo, really we are limited in the amount of places where there was overlapping variables and fish data.

And, for example, for the juvenile salmon and evaluation of -- and I'll just use for example -- dissolved oxygen, you had to combine Chinook and coho salmon. And then based on the literature, those two species may respond differently to dissolved oxygen. So when you combine those and say, do they respond to dissolved oxygen, and you say that they don't, it's really because you had to combine them.

So my recommendation on the micro habitat variable studies is to probably develop a slight study modification. I think the assumption was that the data would overlap, and it didn't really turn out that way. So I think for a lot of those that has to occur.

For nitrogen and phosphorus, I think you mentioned yesterday that a lot of that was going to be picked up in the river productivity study. But unless the river productivity study can replicate more macro habitats, I don't think you'll be able to do that. And as we know, that the water quality study also isn't getting those variables in those off-channel habitats.

So I guess that's -- and I'm just going to keep talking. That's one recommendations, is micro habitat variables. And I'm going to stay on that same topic when -- and I'm going to stick with dissolved oxygen just for an example.

And when you went to develop your equations and you saw a reduced -- reduction in -- well, I guess increase in juvenile coho salmon habitat use -- I know that's not the right terminology -- with a decrease in dissolved oxygen, you said that this wasn't ecologically -- didn't ecologically make sense. And I've seen that same thing, over sampling over a number of years throughout multiple -- in tributaries, groundwater streams within the Mat-Su borough.

And thus, it does make ecological sense because they're usually the only species there and that they're able to withstand low dissolved oxygen level.

You don't often see a lot of rainbow trout or Dolly Varden or other predators there. And you also don't see a lot of competitive species there, like Chinook salmon, as at as high a density.

So they're able to take advantage of these low D.O. sites. And usually they're very productive with large organic matter, material. And they're probably why they are low D.O.

And so I think it does make ecological sense. I'd like you to reconsider that.

I have a couple more points. But if you feel like you want to make a comment or something, Dudley, at this point --

MR. REISER: No, I think those are fine comments. I think we will get those on the record, and we will -- you know, we can then evaluate those a little bit more clearly. I'm not quite sure -- I'm not tracking you exactly on where you're referring to these -- where we said it wasn't ecologically significant or whatever. But we can get that information.

MR. DAVIS: And I think every single one of those little sections where you had your equation, you said here's the -- here's the relationship to D.O. --

MR. REISER: Oh, about the relationship with micro habitat variables?

MR. DAVIS: Yes.

MR. REISER: Okay.

MR. HILGERT: I was just going to say, we didn't cover the September 2014 TM during this meeting, because we presented it in October 2014. That's why you didn't see anything today.

MR. DAVIS: I really like those pressure loggers that you had out during the winter, and you talked about that physical habitat data there. It would sure be nice to see more of those throughout those off-channel habitats, particularly when we are having, you know, some questions about what is going on during winter under the ice.

I don't know how often your pressure

loggers read. I know there -- like the one at the side slough in 8A, it's pretty close to that side channel.

Am I still making sense?

It showed, you know, water surface elevations increase. But it wasn't clear whether that was like backwater; or it was over top to the upstream berm, and then that's why water levels increased.

And it also would be nice if you had them reading often enough so you know how fast that water level dropped. I don't know if they're reading once a day or every hour. Because it would be nice to get some feel for velocities. You know, how fast is that flushing out? As the ice opens up downstream and that water surface elevation drops during winter.

UNIDENTIFIED SPEAKER: I'm pretty sure that the frequency interval should be listed in that --

MR. HILGERT: I think they're 15 minute.

Mike, are you still on?

MR. GAGNER: Yeah. I think those are set at 15 minutes. At the upper extent, it would be 30, but I think they're at 15 minutes.

MR. DAVIS: So it would be nice to provide those data, then, so you can get some kind of velocity -- some idea of what velocity is. Particularly if you've got a cross-sectional area there, which I'm sure you do, then you could calculate some kind of velocity. Although there's ice on the borders and other things, but at least you get an idea of how fast they're flushing out.

You know, during your winter study for instream flow, you know, I think it's real important that you sample in January and February.

I know yesterday -- name's slipping my mind -- from the fish distribution study, talked about, you know, short day length.

UNIDENTIFIED SPEAKER: (Indiscernible - lowered voice).

MR. DAVIS: Yeah.

I don't think that's really significant. I mean, you can get out there in January and February. Certainly you can sample. We've been doing it for quite a few years now.

One of the main things I think -- reasons why I think that's important is, if you look at your water depth, your pressure discharge data, you could see that there's changes that start to occur about mid-March, as the main stem starts opening up and those off-channel habitats starts -- start draining out, basically, into the main stem. You're getting some differences in physical habitat conditions during mid-March. So I think it's really important to sample in mid-winter, January and February.

We have also seen Chinook salmon move into sites in March, that weren't there all winter long. So I think that Chinook are starting -- pretty small, they're starting to move around. So you might get some weird signals if you have some Chinooks moving into sites, that weren't there earlier. So mid-winter sampling is important.

I'd like to suggest also that you -- I think it's important that you need to sample under the ice during the winter, whether you use cameras or, you know -- you know, the fish distribution and study use cameras, and they saw a lot of fish. It's hard to get species ID.

But I think maybe if you use cameras and then you use trapping and some other method to assign IDs to those fish that you're observing under the ice, that might be one way to get at it. But I don't think you're getting a good clear picture of, again, juvenile salmon habitat during winter, unless you're sampling under the ice. Because it just -- it's so prevalent. And really, those under-ice habitats is where we are finding really most of the fish.

I mean, we really could talk about this topic for two or three days. But I'll just throw those things out as kind of the main points that I think other people haven't covered already. --

MR. PADULA: Sue next.

MS. WALKER: Sue Walker, National Marine Fisheries Service. I'd like to point out that NMFS has funded ARRI to do four years of winter fish studies. And we have offered this information to AEA. And this year -- we have provided last year's report. We have winter data for winter HSC's coho. After this year's data are analyzed, we should have HSC data for Chinooks, juveniles, as well.

In terms of being cost-effective, this is research that NMFS has funded solely and we have offered to make available to AEA, and that offer stands. But we have not seen any of this work cited or used. It's great additional winter-use data. It's on sampling mostly under the ice, little bit in open water.

And I'd also like to comment that sampling, you know, fish in open water areas with electrofishing isn't the most effective or complete way of determining where juvenile fish are in the river in winter. So I do recommend that under-ice sampling be conducted and that standardized sampling methodology be used, be it minnow traps or video counts.

MR. REISER: Now, I think if you look at the results of the winter studies 2012/2013, 2013/2014, you'll see that there was an array of different methodologies that we used, including -- including under-ice observations with cameras. So that technique has been looked at, and it's useful. But, you know, Mike can jump in here, too.

MS. WALKER: But we have -- here, I'll let you finish.

MR. REISER: You've got those reports. Yeah. You've got those reports.

MS. WALKER: Yeah, we have looked at that.

But your -- your video times are really short and --

MR. REISER: Right.

I mean, we were just exploratory at that --

MS. WALKER: -- we've done the same thing. Jeff has done the same thing, but longer time frames. But it is -- we will have detailed comments on that. So we have -- but we have looked at your reports.

MR. REISER: And we have got -- just so we talk about the reports that ARRI has generated on the winter studies, we got -- I've seen two -- two separate reports. I think they're very -- they're like continuation but an expansion in areas, study areas, that you've had?

UNIDENTIFIED SPEAKER: Correct.

MR. REISER: I've not seen three years -- or four years or the data. We have not seen those data. So we'd be happy to integrate those in, and I'll look forward to that.

MR. PADULA: Thanks.

Anyone on the phone? Again, not to ignore you folks. Have any additional comments that haven't been covered by anyone else here to date?

MR. KONIGSBERG: Yeah. Steve, hi. This is -- this is Jan. I just wanted to follow up on the question I had earlier.

MR. PADULA: Go ahead, Jan.

MR. KONIGSBERG: Thanks.

If it turns out -- if it is the case that the Chulitna, Talkeetna ice process is affected by the Susitna ice process, let's say hypothetically that ice forms later in the year in the Talkeetna and Chulitna and break-up occurs sooner than it usually does, in terms of the baseline, if we're looking at project impacts, I would think it's important to understand how those systems currently operate and what the impacts to those rivers would be due to project operations.

And, again, maybe I'm -- I may be missing something here, but I haven't heard any discussion about that connection between the Susitna watershed and the other watersheds. Because I think the -- from the licensing perspective, its effect -- if it's affecting the basin, we are going to need to know what those potential impacts are.

Now, if there isn't any significant impact due to, let's say, specifically ice processes, you know, my concern isn't there. But at this point, it would certainly -- I guess it would require new studies on those two rivers. So I just wanted to reiterate that point from the standpoint of fish production, since those two systems, other systems, do contribute to the Susitna basin fish production and to productivity.

MR. PADULA: Thanks for that comment and reiteration, Jan. Appreciate it.

Anything else?

Chris?

MR. JOHNSON: Chris, USGS.

I just had a question in terms of the comments that we are making and knowing that this is an iterative process, specifically with the open water flow-routing model and various other models that are there.

With the open water flow, we are now at Version 2.8, and that has existing conditions that have been applied. In the original ISR, the OS1B project operations was put through that model. And then in the latest updates, there's reference made to the ILF-1 scenario.

And I guess, just wondering, but I didn't see that that had actually been run through the model at this point. It was just referenced as a kind of new scenario that was being looked at to kind of not do OS1B, but do the intermediate load following scenario.

So I'm just curious, from a comment standpoint, if we should be commenting on, you know, results and things that the open water flow model was done with effects from OS1B, knowing that that may not be an operational scenario that's being considered anymore.

We have had that with some other comments, where -- specifically with some of the models going through, that what we are commenting on is, for lack of a better term, old models or old data. So just trying to get, I guess, AEA's take on the best way to proceed with that; that we don't comment on things that maybe, then, the response is that there's a newer model now, so we know that that's not good.

MR. HILGERT: This is Phil Hilgert.

Version 2.8, you can comment on the predictive capability or comments on the technical accuracy and calibration details, whether you ran ILF-1 or OS1B. The model doesn't really care. So use Version 2.8 that's in the SIR appendix, and that's the most current version we have.

MR. PADULA: Great.

We are running a little over, but not doing bad at all, given the content of the discussion.

I've got about ten after 12:00. Again, I'd appreciate best efforts to get back here at 1:00, realizing some folks may be a little late. But we will get started as soon as we have everybody back in the room.

With that, Kevin Fetherston.

(Off record)

12:12:25

(On record)

1:13:28

MR. PADULA: Okay. We're going to get started with the afternoon session, on our one o'clock agenda item.

Has anyone on the phone joined us since lunch, who did not identify themselves this morning?

(Additional participants attending telephonically introduce themselves).

MR. PADULA: And how about in the room? Anyone join us since morning?

(Additional participants in meeting room introduce themselves)

MR. PADULA: Okay. Well, let's get started.

So, Kevin, I don't know who's driving slides for Kevin.

Dudley is going to drive. And Kevin going to take it away.

MS. HANSEN: Okay. This is Leanne Hansen. I called in this morning, but I don't know if you caught my name.

MR. PADULA: All right, Leanne. Thank you.

MS. HANSEN: A little bit after you guys

(Indiscernible - telephonic speech).

MR. PADULA: Okay. Thanks, appreciate that.

MR. FETHERSTON: Okay. So we're ready to go?

MR. PADULA: Yeah.

RIPARIAN INSTREAM FLOW STUDY

(Study 8.6)-K. Fetherston

MR. FETHERSTON: Good afternoon. My name is Kevin Fetherston. I'm lead of the Riparian Instream Flow Study from R2 Resource Consultants. And what we're going to be doing this afternoon is, it's a two-part series of presentations.

First, we're going to be -- I will be presenting the riparian IFS study, followed up by Dr. Aaron Wells, who's in the room. He will be presenting the riparian vegetation study. And these -- both of these studies, as most of you know, are integrated together. So in terms of question and answers, I will be answering questions, as well as Aaron, in the room. And we'll go back and forth for both presentations.

What I have done is, we have prepared a

27-slide presentation for the record. And what I'm going to be doing is, is giving a brief high-level review of, number one, the study status and its progress; two, results, briefly highlighting. I will discuss variances and modifications. And then I will touch upon the next steps. And we won't be going through each of these slides individually. The entire presentation is posted on the website. But we'll be using all the slides as reference material for our discussion.

Dudley, if you could slide -- that's great, yeah -- into the next slide.

And actually, what we'll do is, we'll go directly to -- the first slide, underneath Status here, I will be referring back to these different elements.

To the next slide, please.

And then to the -- two more slides down. I believe it's Slide 5.

Yeah. This is the -- this objective -- yeah, prior to that were the objectives of the entire study laid out in detail. What we'll do is, we'll use this slide, which is the compilation of the individual study components of the riparian IFS. And what I will do is simply walk through each one of these and discuss the study status of each element.

The literature review of dam effects on downstream vegetation is complete. The technical memo has been posted, and it's available publicly. So that element is finished.

The second element is the riparian process domain delineation, which is still in process. With the completion of the tree ice scar mapping throughout the Middle River, we're now in a position where we can finish up the riparian process domain delineation as a next step. What that is, is that is breaking up the Susitna River into different domains. And by domains, these are different regions of the river that have similar geomorphic and physical disturbance processes that generate and maintain characteristic vegetation.

The third component, which is the seed dispersal and seedling establishment study, to date we have done one year of seed dispersal studies and developed a preliminary model relating seed dispersal to climate. The next step in that study is to do one more year of seed dispersal measurements. And by seed dispersal, we're talking about tracking the timing of seed release of black cottonwood and a suite of willow species relative to temperature, climate, and the flow regime of the river.

The next is the seedling establishment study, which we -- as of the summer of 2015, we have completed the three-year long longitudinal study of willow and cottonwood seedling establishment and survival. And we have finished that. And that data is collected, has been QC-3'd. And the next step in that is to proceed with the data analysis.

Number four, the river ice effects on floodplain vegetation. Again, in 2015, we completed mapping evidence of tree ice scars. That is, ice jam and ice block scarring of trees throughout the Middle and the Lower River, and with the idea of identifying different regions of the river relative to the effects of ice on riparian vegetation. That is, how is it affecting the pattern of riparian vegetation that we see in -- longitudinally within different regions of the river? It varies from the Lower River all the way up to the dam site.

And we have completed the tree ice scar mapping. And the next step in doing that is to begin to use that data in terms of providing an analysis of the relationship of the pattern of vegetation we see with the distribution of ice and ice effects.

Component number five, which is the

floodplain stratigraphy and floodplain development study element, we completed the data collection in terms of we're doing a sediment isotope study to identify and characterize the rate of sediment deposition on floodplain surfaces within the Middle River with the objective of being able to -- not only to identify how rapidly -- just what is the rate in which the floodplains are building during overbank flooding, but to characterize -- to identify and characterize the role that ice dams play throughout the Middle River and the Lower River.

It became apparent within the first two years of the study that ice, ice dam formation, and backwater floods, which are associated with ice dams, are a major component in terms of both the geomorphology of floodplains and also the vegetation patterns that we're seeing in areas where ice dams cause -- essentially, what happens is, the ice blocks up the river, backs up the water, and then you have overbank flooding during the spring break-up, as well as during any time ice dams are formed, say, during the -- it happens in December, but the primary time period is during ice break-up.

And what we began to understand is that these ice dam sedimentation processes are very likely to play a critical role in the development of floodplains and, therefore, also the floodplain vegetation patterns that we're seeing out there.

So we've finished with the sediment sampling. And the results will be forthcoming this spring from University of Exeter, who's doing the sediment isotope. We're using lead-210 and cesium-137 to -- for the geochronological aspects of that piece of work. And that's being done in conjunction, in collaboration, with the fluvial geomorphology group.

Component number six, the riparian groundwater and surface water study. We have -- it's been ongoing. And through 2000, we have -- as of April 2014, we had a technical work group meeting. And it was brought to discussion and -- that the -- the type of measurements that we're using, in terms of evapotranspiration measurements, measuring sap flow within trees and stomatal conductance of herbaceous and shrub vegetation to identify water loss due to evaporation; that that element of the study is likely not necessary to complete the modeling of groundwater, given the fact that it's -- the Susitna is in a -- it is not in a precipitation-limited environment.

And therefore, the -- it's highly likely that the vegetation is not limited by the -- by the amount of groundwater availability. Although, the larger study looks at rooting depth and will be able to identify the relationship between groundwater and vegetation usage through our much larger groundwater surface water study.

But it was brought to discussion and -- that if we were going to reduce any part of the study, that this -- that this element itself -- so we're proposing that this would be a modification, that we'd no longer do any more of the evapotranspiration measurements and simply use the data that we have collected to date, to drive the groundwater surface water model.

And that's pretty much it in terms of results.

The number seven, which is riparian vegetation modeling synthesis and project area scaling, that's all future work in terms of the next steps of this process. That's essentially doing the project effects. That is taking all the -- the different elements of the study and pulling it together when looking at the changes in the hydroregime and the ice processes regime and its overall effects or impacts upon vegetation and potential vegetation change through the study area.

So that's a summary -- pretty much a summary of the results. And we have -- again, what I'd like to highlight here is that in the -- we don't have any variances since the ISR. And we have the singular-proposed modification to the evapotranspiration element of the groundwater/surface water study.

And with that, I'm going to pretty much open it up to questions.

MR. AUBLE: This is Greg with USGS. I always have questions.

This one, the seedling study, you talk -- in the slide you've got right there about that you're going to focus on the first year. And yet I was looking at the data tables that you're -- you presented, but they -- you -- you seem to be sampling alder seedlings also. And the reason I bring that up is, like, if you're sampling the alder seedlings and you're doing this in consecutive years as you did -- which is wonderful to keep doing that in this, like, abeyance period -- but can you estimate overwinter mortality? Because I'm just expecting that's astronomical.

MR. FETHERSTON: Oh, yes. Yeah, yeah, we can. We can certainly measure overwinter mortality, which is probably the biggest driver out there, that we're seeing. And --

MR. AUBLE: Great. I just know -- when you were talking about dropping back to first year, whether you -- that you lost the ability to do that. But okay. That's great.

MR. FETHERSTON: It's interesting, Greg, looking at the slide here, we were -- we are actually measuring more than simply the first-year establishment. Because we are actually in -- in years two and three, there were -- we were able to identify second-year-old seedlings in the transects, and we noted that.

MR. AUBLE: Great. And I guess I certainly -- well, Bob and I both suggested this originally, but I certainly concur in the idea of deemphasizing the detailed transpiration measurements. Not because they aren't interesting, but I just don't see -- I don't see the groundwater modelers actually using that, that much. Well, for all the reasons we've suggested.

MR. FETHERSTON: Right.

MR. AUBLE: Let me ask you just -- again, this was in response to comments that Bob and I had had earlier. But you put together a real nice table of the -- sort of the status of the sampling. And between 11.6 and 8.6 -- 6, you're going out and measuring vegetation at a bunch of locations where you also know the groundwater and surface water regime --

MR. FETHERSTON: Yeah.

MR. AUBLE: -- to build a probability-of-occurrence model.

But there's a whole lot of -- I mean, you're not very far along on those samples. It didn't look like.

MR. FETHERSTON: Right.

MR. AUBLE: Well, okay. That's -- that's a lot of work and, to me, the remaining to be done. And it seems to me that that's sort of the guts of your ability to predict project impacts, is the use of that relationship. So I appreciate you tallying up where you were on there, but there's a lot more work to be done there.

And there's also, at least in my mind, some confusion about what combination of measurements and models of what kind are going to be driving the groundwater part of that data stat.

But, again, you developed that technical memorandum, but -- which is good, you know, but it's still not crystal clear to me.

MR. FETHERSTON: Okay. We'll make note of that.

MR. AUBLE: That's it.

MR. FETHERSTON: So you're talking -- you're talking specifically about the relationship between the vegetation sampling and how we're relating that to the groundwater; is that correct?

MR. AUBLE: Yeah. Where is the groundwater regime coming from? Some cases --

MR. FETHERSTON: Right.

MR. AUBLE: -- it's coming a couple years of measurement from a well. You know, some cases, it's coming from a -- observations of a groundwater gradient transect. In some cases, it's coming from Modflow, it looks like.

MR. FETHERSTON: Yup.

MR. AUBLE: There's a whole bunch of pieces there that have to fit together before you can -- you have got an observation in that regression equation. And -- and then I'm particularly concerned -- okay, even if you can -- you put that together from a combination of models and measurement, in order to use it to do project impacts, you have got to be able to predict what that groundwater is going to be post-project. And --

MR. FETHERSTON: Right.

MR. AUBLE: -- I can see exactly how to do that with surface water, but the groundwater part is a little dicey.

MR. FETHERSTON: Yeah. The groundwater -- the groundwater relationship, I mean, the -- currently Modflow's model has -- is being developed. And the -- with -- with -- as designed and in the studies design, with the whole idea of being able to relate -- to -- to predict what would happen, you know, with changes, project operational changes, in the hydroregime.

And, you know, how -- what happens when you change the surface water elevations to the groundwater elevations within, you know, the central part of the floodplains at FA-128? You know, just how -- is it directly influencing groundwater, which is feeding vegetation, seems to me the big question.

MR. AUBLE: Right.

MR. FETHERSTON: And --

MR. AUBLE: I mean, I listen to them -- I mean, well, this is a conversation for you all to have, not me. But, yeah, you're going to have it for 128. How many other places are you going to have it for? That's --

MR. FETHERSTON: Well, we're going to have -- we're going to have it for -- at FA-115 and FA-104, along the transects.

MR. AUBLE: Right. Well, yeah, predictional on the transects is not necessarily the same thing as a calibrated Modflow. Unless -- okay, maybe you're using a -- anyway, that's -- I -- I -- it's not worth talking about that in detail. That was just a concern I had.

How's that?

MR. FETHERSTON: Sure. Noted.

MR. PADULA: I think we have a question in the room.

MR. RYCHENER: This is Tyler Rychener with FERC, contractor to FERC.

I guess kind of following up on Greg's question, I'm wondering if you can -- and maybe this is a better question for the next presenter. But the timing on that next set of vegetation data collection, is that all part of the -- sort of the unknown future schedule?

Or I'm wondering if you can give an update about how many of those -- I guess I'm referring to the -- the collection along the transects parallel -- perpendicular to the well transects. Has the groundwater data from those wells been collected already? Or would that be collected at the time that you're doing the vegetation transects?

I'm just thinking, it seems like there's a lot of vegetation data on those transects to collect, that we have also talked about pulling infrastructure this summer. And I was just wondering how that all would -- goes together.

MR. FETHERSTON: Good question. The -- indeed, there's more vegetation data to be collected along the transects. And the current status of -- of well removal is yet to be determined. And we have a couple years' worth of well data from all of the wells.

And the relationship between that and existing vegetation say -- what I believe you're getting at is, in terms of doing the vegetation sampling after, say, wells are no longer functioning.

Is that -- and then using that to look at the relationship between groundwater, surface water, and vegetation pattern along those transects.

MR. RYCHENER: Right. That's sort of what I'm getting at. I am just trying to get a feel for what kind of (Indiscernible - simultaneous speech) --

MR. FETHERSTON: Is that what your question is directed to?

MR. RYCHENER: Yes. Yes.

MS. McGREGOR: Hi, this is Betsy with -- Kevin?

MR. FETHERSTON: I don't have an answer for it.

MS. McGREGOR: Kevin, I can answer that.

MR. FETHERSTON: Pardon me?

MS. McGREGOR: This is Betsy with AEA. I can answer that.

MR. FETHERSTON: Oh. Great.

MS. McGREGOR: I'm sorry. I probably confused people. The equipment that we're going to remove are the equipment from the focus areas related to the instream flow instrumentation that's out there. The groundwater equipment, we're waiting pretty much to get through the session and figure out what our next steps are.

MR. RYCHENER: Okay. Thank you.

MR. FETHERSTON: Great. Thank you, Betsy.

MR. PADULA: Question coming from the room.

MR. MUNTER: Hi, Kevin. This is Jim Munter.

I've been reviewing the groundwater studies for NMFS. And yesterday we were talking about the importance of trying to simulate a direct recharge to groundwater for these transient pulse situations. And somewhere I remember seeing a comment from somebody -- I can't remember now -- but whether or not the project is collecting any soil moisture data above the water table.

And I'm just wondering if that's part of your ET package that got dropped or if it was never part of that or if there's still some soil moisture. Because in the summertime, as you're probably aware, the rainfalls tend not to produce big groundwater spikes, because it goes into the soil moisture deficit.

So that's an important process for groundwater. I wonder if you have any light to shed on that.

MR. FETHERSTON: Jim, you're talking directly about the capillary fringe above the groundwater table?

MR. MUNTER: Yeah. But even above the capillary fringe. Really, the -- the organic horizon where plants are growing and, you know, when it rains and they are grabbing at -- while they are growing and sending that back into the atmosphere, it generally doesn't go to the water table. So soil moisture throughout from the land surface down to the capillary fringe.

MR. FETHERSTON: We have made direct measurements of soil moisture at a number of the weather stations. And we have soil moisture gradient from the surface down to, I believe, a meter and a half.

MR. PADULA: Kevin, let us know if there's any particular slide you would like us to put up, please.

MR. FETHERSTON: Okay.

Does that get to your question, Jim?

MR. MUNTER: I'm not sure where all those stations are. Are they -- like, do you have one near FA-128?

MR. FETHERSTON: The soil moisture stations are at -- at FA-104 and FA-128.

MR. MUNTER: Excellent. Thank you for that.

MR. LaCROIX: Kevin, this is Matt LaCroix with EPA.

I just have a question specific to the ice effects component.

MR. FETHERSTON: Sure.

MR. LaCROIX: I'm wondering if it is fair to characterize that as kind of a subcomponent to the process domain delineation.

MR. FETHERSTON: Uh-huh.

MR. LaCROIX: I mean, the reason -- or part of the reason you have been looking at the ice effects is because of how they control riparian vegetation, as well as some of the formation and maintenance of those overbanks. And --

MR. FETHERSTON: Sure.

MR. LaCROIX: So I'm wondering if you could just briefly touch a little bit on the specific processes that you're looking at in the ice piece. Is it just mechanical effect? Is it flooding? Is it -- I mean, I know it's part of the maintenance of the stratigraphy. But just, if you could take a minute or two to go into the various process components that you're examining as part of that project.

MR. FETHERSTON: Sure. Sure, sure.

It became apparent, again, after two years' worth of work -- actually, after the first year of work -- that ice, through a number of different processes, as you indicated, is affecting and is very likely affecting the distribution of vegetation throughout the active floodplain area.

And to get at that, we were interested. Because we know from the life histories of -- for example, the dominant tree in the lower parts of the active floodplain is black cottonwood. And we know that black cottonwood recruits or becomes -- you know, seedlings germinate and become established only on fresh gravel deposits.

And the first evidence that really started directing us towards ice effects on these higher floodplain surfaces where cottonwood was growing was that we noticed that there were cottonwood groves that were growing -- we were out after -- I believe it was in 2012. There was a 78,000 cfs flow in September that flooded Talkeetna. And we were out on the river immediately following that. And there were floodplain surfaces that were clearly a meter to a meter and a half higher than this 78,000 cfs flood upon which cottonwood were growing. And there were stands of cottonwood.

So that was direct evidence that there -- to us, that there's something going on on the Susitna

River relative to depositing gravel, sands and gravels, upon which these black cottonwood had become established at these higher elevation surfaces. And that led us into -- deeper into the study of ice effects and ice dam effects.

And upon being able to witness a couple of -- in 2013, especially, the dramatic ice break-up and ice dam formations, we were able to observe that from helicopters and actually see ice dams forming and the backwater effects, live in process. We were able to watch ice being -- tumbling across floodplains. And then going out and examining these floodplains immediately following this and finding fresh deposits of sediment at elevations way above the hundred-year floodplain -- I mean, surfaces.

So that was direct evidence that -- and then we -- that's where the whole sediment chronology part of the study is, to investigate that process.

So that -- that's one element. That's one process. That is, active ice dam backwatering deposition of sediments in higher elevations, as well as at lower elevations, but -- and in addition to the sediment isotope study, we -- looking at sedimentation rates and their location.

The tree ice scar, the study, is direct

evidence of where these ice dam backwater effects are occurring on the river. And so we went out and directly mapped those. And we now have a map of regions of where ice is affecting these higher elevation surfaces, from direct evidence from tree ice scars.

Number two is that in the -- the lower elevation surfaces, such as the mid-channel islands, ice has a tremendous shearing effect, which we're able to observe in real time, as well as -- as we got deeper into our forest composition and structural sampling, we were able to identify that, for example, on a lot of these mid-channel islands, it became readily apparent that the ice-shearing effects are generating and maintaining mid-channel islands in early successional states.

For example, Alaska felt-leaf willow stands, those are basically sheared annually. And if the ice effects were not occurring, you would have a forest growing in these places. But the annual river break-up has dramatic effects on -- through mechanical-shearing processes, as well as sediment deposition, on mid-channel islands and lateral floodplain lower elevation along the channel margins, the lower -- the proximal areas of floodplain, that are affected by ice during this backwater-flooding events.

And those are the primary processes that we have identified and that we're quantitatively describing. And it's -- the thought right now is that those dramatically control the distribution -- you could almost call it -- of the cottonwood zone. Or we had talked earlier about the Salicaceae domain. Salicaceae is the plant family that willows and cottonwoods grow in. That there is a domain, a geographic domain, out there on the Susitna River that is actively maintained through these ice processes.

Does that get to your question?

MR. LaCROIX: Yes, Kevin, it does. Thank you. It kind of sounds, the way you characterize it there, that the ice processes are the fundamental process domains, but -- rather than the ice --

MR. FETHERSTON: Yeah. Yeah, yeah.

MR. LaCROIX: -- as being kind of a subset.

Perhaps the open water --

MR. FETHERSTON: Uh-huh.

MR. LaCROIX: -- flooding is the subset.

MR. FETHERSTON: Right. Yeah, open water flooding has its own effects. But the -- the ice, which, you know, we can geographically define with the aerial distribution of it, with the tree ice scar mapping. You know, just where is it affecting? We can draw lines now on a map and identify those zones, and they directly correlate with the distribution of cottonwood, for example, that you see out there.

MR. PADULA: Thanks, Kevin.

Any other questions in the room or on the phone? Anyone on the phone have a question for Kevin?

MR. AUBLE: This is Greg from the USGS. I've got one more.

From the aging of the scar, ice scars of the trees that you have sampled in the course of doing the mapping?

MR. FETHERSTON: Yes.

MR. AUBLE: Do you have a sense of how much sampling -- how many scars would you have to look at in order to put together some sort of frequency distribution?

I mean, I'm thinking about doing ice-stage-by-year distribution so you can construct something similar to a flood frequency distribution --

MR. FETHERSTON: Yeah.

MR. AUBLE: -- (Indiscernible - simultaneous speech) ice event.

MR. FETHERSTON: Yup.

MR. AUBLE: You got an idea whether that's --

MR. FETHERSTON: (Indiscernible - simultaneous speech).

MR. AUBLE: -- 3,000 trees or 300 trees?

MR. FETHERSTON: I think it's more like 300 trees.

Actually, there was a great piece of work done, I believe, on the Peace River in Canada. And they were looking at this exact question, is how many trees do you need to measure tree ice scars on to come up with a flood frequency?

And what -- for example, we have 48 trees that we took samples of for aging for the ice scars. And that indicates -- I mean, those -- that data shows that -- you know, a range of dates. But I think to get at your question on frequency of distribution, you would probably need five times as much as that, or more.

MR. AUBLE: Have you ran any --

MR. FETHERSTON: You really --

MR. AUBLE: Have you got any slabs where

you're seeing buried scars? Or over -- completely overgrown scars?

MR. FETHERSTON: Yeah, yeah, absolutely.

And, in fact, this Canadian study, they actually cut trees down. So they did some major destructive -- major destructive sampling. Because you find a lot of these trees have multiple scars on them, and you just can't get at it using the wedge approach. You know, you would basically take the tree down if you did that.

But it's a great question. And it -- you know, with enough sampling, you can certainly -- you could certainly do that. But it would be a bigger effort.

MR. AUBLE: Yeah, I would just weakly submit that that might be -- although it's a big effort, the fact that that disturbance is such a primary cause of vegetation pattern, it's like, it might be efficient, in terms of value per dollar.

MR. FETHERSTON: I agree.

MR. WOOD: This is Mike Wood.

MR. FETHERSTON: Mike.

MR. PADULA: Go ahead, Mike.

MR. WOOD: Very good observations, Kevin, and very well explained.

Thank you.
MR. PADULA: Okay. We have another question in the room.
MR. MUNTER: Yeah. Hi, this is Jim Munter again.
MR. FETHERSTON: Great. Thanks, Mike.
MR. MUNTER: This is Jim Munter again.
Kevin, some of what you're doing here is highly relevant to the groundwater study. But to make my question make sense, I have to ask you if you were there yesterday for the session.
Did you listen in on that?
MR. FETHERSTON: No, I didn't --
MR. MUNTER: Okay. Well --
MR. FETHERSTON: -- actually.
MR. MUNTER: What you're -- this is under the topic of floodplain stratigraphy. And it sounds like you're mainly interested in age dating. But what is really important to the groundwater study is the types of deposits in the stratigraphy.
MR. FETHERSTON: Right.
MR. MUNTER: And the preliminary model -- and I understand it's preliminary and this is still subject to calibration changes. But the storage coefficient they came up with initially is indicative

of a semi-confined aquifer. It's very small number. It's about an order of magnitude below the lower bound of a water table aquifer.

For there to be a semi-confined aquifer, there needs to be a semi-confining layer, which would be a clayer silt. And there's not a lot of backhoe pits out there from this -- from this --

MR. FETHERSTON: Right.

MR. MUNTER: -- (Indiscernible - simultaneous speech).

And -- but one of the ways to get a handle on this, I think, is observations of the types of deposits that you're observing in going up and down the river corridor from these -- particularly the ice jam flooding. And I get the sense that they are mostly sands. And it's a very high energy environment. And we're not seeing a lot of quiet water overbank deposition, which -- you know, whatever inferences we have got can then feed into a conceptual model for the -- to support whatever the groundwater model comes out saying.

MR. FETHERSTON: Sure.

MR. MUNTER: And so I'd encourage whatever information you have got feeding into that groundwater conceptual model with regard to the nature of the aquifer, and not just at 128, but really up and down the -- mainly the Middle River corridor.

So do you have anything that you can share on sediment types you have seen or any other data along those lines?

MR. FETHERSTON: Yeah, I do, actually.

We have, I think -- we have sediment cores that range from about 60 centimeters to 1.25 -- 125 centimeters for the sediment geochronology. And in addition to looking at the isotopic stratigraphy, we have detailed soil descriptions for all of those.

And in addition to that, we have -- and I'm going to pass this over to Aaron Wells in just a minute -- the -- we have detailed soil samples for -- and Aaron can address this -- a couple -- a couple of hundred different soil pits throughout the study area associated with the vegetation plots. And we describe, you know, sediment texture for all of these.

And this could all be valuable information to go directly to what you're talking about in terms of hydrologic characteristics of the soil profiles that we're seeing out there.

MR. MUNTER: That's excellent. Thank you

very much.

MR. FETHERSTON: And, Aaron, if you want to add something to that, in terms of the -- the breadth, the extent and the detail of the soil survey associated with the plant community sampling.

MR. WELLS: Yeah. Sure, Kevin.

Yeah, so as Kevin mentioned, we have got detailed stratigraphy down to, you know, a meter and a half or so at the cores where we were getting the sediments domain done. And then at several hundred plots we have down to 50 centimeters, we have predominant texture in that -- that upper part of the soil profile. So we have -- that's distributed across the Lower River all the way up the -- to the Middle River. So it's --

MR. FETHERSTON: And all of that data is available. We have it in a database, in terms of summarizing general characteristics relative to, for example, floodplain surfaces, elevation, et cetera.

MR. PADULA: Any other questions at this time for Kevin?

Okay. I think we'll make a transition, then.

Dr. Wells?

MR. FETHERSTON: Well, great. Well, thanks everyone. I appreciate your comments.

RIPARIAN VEGETATION STUDY DOWNSTREAM
OF THE PROPOSED SUSITNA-WATANA DAM
(Study 11.6)-A. Wells

MR. WELLS: Okay. Well, thanks, Kevin.

And good afternoon, everyone. My name is Aaron Wells. I'm with ABR, Inc. And I'm the PI on the riparian vegetation study downstream of the proposed Susitna-Watana Dam.

So I've got 27 slides and ten minutes. And that's like 22 seconds per slide, so I'm going to skip a bunch of slides. I'm going to kind of go quickly through and focus on about ten slides.

Okay. So the status of our study is from 2013 -- well, through 2012 through 2015, field surveys were completed. And in doing so, we implemented three variances, which we'll talk about in a little bit.

The aging of the sediment cores is currently in process -- in progress and is near in completion. In 2015, September 2015, we returned to the field to describe the soil stratigraphy at -- at any soil cores that we didn't get to in 2014. This gets us to that question that we just discussed about the soil descriptions.

And then lastly, the integrated terrain unit mapping, the ITU mapping, is currently undergoing senior level QA/QC. And we're in the process of developing riparian ecotypes, wildlife habitats, and wetland classes to assign to the -- to the mapping.

Okay. The objectives of the study are, number one, to classify, delineate, and map riparian ecotypes, also, wetlands and wildlife habitats downstream of the Watana dam site; to characterize the role of erosion and sedimentation in the formation of floodplain surfaces, soils, and vegetation; to quantify and describe Susitna River riparian vegetation communities; and to coordinate closely with studies 8.6, 7.5, 7.6, and 6.6.

As Kevin mentioned, our studies are collaborative, our two studies in particular. I'm on his team and he is on my team, essentially. So we're working together closely. You'll see a lot of overlap in our presentations, as well.

Okay. So to skip on to the variances, there's three of them, as I mentioned. The first is, the original plot-allocation procedure for the focus areas was modified. It was originally based on focus area size alone. And in response to agency comments, we revised that to account for both focus area size and the number of ecotypes.

And this led to, overall, a higher number of sample sites per focus area. And this is described in the technical memorandum filed with FERC on July 1st, 2013.

The second variance is related to the point-intercept sampling spacing interval. We originally were going to sample at point -- at half a meter interval. We -- given the type -- the vegetation out there, it's very robust. A half a meter was really too close. We were -- we were sampling the same plant twice. So we spaced it out to a meter, which led to a more appropriate sampling design for the vegetation out there.

And then lastly, as far as the vegetation and groundwater study that's going on out there, we originally had intended to have the groundwater plots -- or, groundwater infrastructure right in the middle of the vegetation plot. And we decided that there was too much risk of vegetation disturbance in doing that.

So we placed the groundwater infrastructure just outside the plots so it wouldn't cause damage or disturbance to the vegetation. And that's important because these intensive plots were designed -- are designed as long-term monitoring plots, to be able to go back in the future and sample them again.

Okay. I'm going to skip through field surveys.

So we can come back to this if there's questions on the mapping.

The proposed modifications. So the first one is also a variance. So this is the spacing of the point-intercept sampling. And it's a variance because -- or, it's a modification because it's going to continue on into the study, with the rapid vegetation transects that I will talk about in a moment, at the groundwater plots.

The second modification is the rapid vegetation transects. And so we -- in response to agency comments during the October 2014 ISR meeting, we revised the study design for the co-located sampling of groundwater/surface water riparian vegetation plots.

And the revised design calls for the additional sampling of what we're calling rapid vegetation transects to be established in four focus areas in the Middle River and along four riparian transects in the Lower River, at which there are groundwater/surface water transects and groundwater wells. And so the details are described in Appendix A of the SIR.

Okay. Steps to complete the study. I will wrap up with this. There's a -- there -- as we discussed earlier during Kevin's talk, there's additional vegetation sampling to be done out there, so we'll be determining where those are, those areas are, and sampling those. Additional vegetation sampling will include rapid vegetation transects at the -- at the groundwater plots.

The ITU mapping, the integrated terrain unit mapping, is currently being reviewed for consistency and being finalized. Field data for all years will be combined and analyzed to update the current ecotype classification that's currently in progress.

And wildlife habitats and wetland types will be derived from the integrated terrain unit data and applied to the mapping. And we'll also be joining in the geographic information system to the adjoining wetland mapping that's occurring in the Upper River, or where our two study areas overlap.

That's currently in progress, as well.

Three more. The laboratory geochronology study, as I mentioned earlier, is in progress and should be completed soon. And as part of the effects analysis, we'll be developing successional models, as well as collaborating with the rest of the team in modeling the post-development changes in riparian vegetation.

That's all I have. Does anyone have any questions or discussions?

MR. PADULA: Yes. A question from the room coming.

MR. LaCROIX: Yeah, Aaron. This is Matt LaCroix with EPA.

I know the mapping, the vegetation mapping, is not complete yet. But based on what you've seen so far, are -- are the riparian wetlands that you're -- you've been sampling or identifying out there, are they predominantly or is there a dominant feature? Are they mineral soil or organic soil?

MR. WELLS: Predominantly organic soil. And the vast majority of them are in the Lower River. There are some in the Upper River, and a lot of those are the -- what we have observed is the groundwater is actually creeping in from the -- from uphill. So that's -- in the -- in the Middle River, anyway.

MR. LaCROIX: Okay. Yeah, I was curious because of the implications for the process domains. You know, if they were mineral soil, they could be in areas of deposition overbank or backwater flooding. If they are organic, clearly that would not be the case. Although, the hydrology for -- in either case could potentially be partially maintained by either overbank or, you know, flooding.

I'm also curious about whether or not, in terms of your vegetation communities mapping, you're looking at the question of beaver dams, the maintenance of beaver dams and how that also fits in the process domains.

MR. WELLS: Well, we're -- in our mapping we're mapping beaver complexes. So we have, in a sense. We actually -- we did, in coordination with -- with one of the wildlife studies, we have mapped where we observed in the imagery, the aerial imagery that we're mapping on, beaver dams that we -- are either intact or we can't -- sort of flagging them as to whether we think they are intact or not. Sometimes you can't tell. But in that sense, we're flagging where they are. And so we are incorporating that into the -- into the mapping project.

MR. LaCROIX: But as far as you -- I probably should have asked this when Kevin was -- but I know he's still on the line.

So in terms of process domains, are beaver dam complexes associated with any specific process domain or a variety of process domains? Or how -- does it fit in that piece at all, in that puzzle?

MR. WELLS: Well, I will speak to this, and then Kevin can jump in. What we have observed is that in the Middle River, there's, you know -- in the lateral wetlands, there's a lot -- there's -- there are beaver dams.

And like I -- as I mentioned, the Lower River has many more lateral wetlands that are outside of the predominant flood zone. And so if you have too much flooding, too much regular flooding, the beaver dams could fall down.

In the Lower River, the floodplain's quite a bit wider. And those very far lateral wetlands have a lot more beaver dams and a lot of beaver activity going on. So there's that in the sense of the -- process domains being one of them, is at the Middle River; one of them is the Lower River. And so there's a -- there's a -- there's an effect there.

MR. LaCROIX: Thank you.

MR. WELLS: Kevin, do you want to talk -- speak to that, at all?

MR. FETHERSTON: Sure.

Matt, that's a great question. And as you were -- and Aaron was talking about it, it -- it is not something that we put into the riparian process domain multivariate analysis that we're doing for classifying. Although, it could be put in as an additional variable.

It seems to me that, as Aaron described, that, you know, the beaver -- there's definitely -- that there are geographic areas of the valley bottom in which beavers play a large role and geographic areas where they don't. And how that would fall out in terms of the broader riparian process domain delineation, I would have to think about that a bit.

But I think that, because, for example -- again, as Aaron was saying, there appear to be more beaver dams in the less actively disturbed areas, in terms of flooding and ice. As you get off the active channel, up on to the floodplain, especially associated with those areas in which you have hillslope hydrology contributing along the lateral margins of the floodplains, there is a lot of water coming off of the uplands, down into the floodplain. And those geographic areas there are beavers all over.

So I think that -- two things: One, well, one is that you're absolutely right. There are geographic areas that -- in which there are beavers; there are areas that there aren't. How that -- how we could fit that into the broader riparian domain delineation, you know, we haven't run that final run, in terms of that analysis. But that could easily be put into that as an additional variable, in terms of looking at it.

I think the larger process domains are going to be driven by ice, is my hunch right now. But within that, that would be a subprocess that then is geographically distributed in specific areas. But it's a great question.

MR. LaCROIX: Well, thanks for that additional --

MR. AUBLE: Yeah. This is Greg from USGS. I have -- I guess this is a question for both of you. But it has to do with this whole process domain and the role of ice in that (Indiscernible - telephonic speech).

I mean, early on, you were defining those domains on things like, you know, gradient and valley geomorphology. Ice is -- well, okay, here's the question: What are you going to do about the 30-mile reach downstream of the dam that used to be in the ice domain but isn't any longer, because of water temperature? I mean, are you going allow the --

UNIDENTIFIED SPEAKER: What are we going to do -- Greg, what are we -- (Indiscernible - simultaneous speech) --

MR. AUBLE: Are you going to allow the project to change the domain?

MR. FETHERSTON: Our job pretty much here is to describe where and what would happen, you know, in terms of the effects analysis. And we can certainly predict certain levels of change, in terms of the vegetation and the geomorphology.

Beyond that, what we would do with that, I'm not quite sure how to answer that.

MR. AUBLE: Well, when you use whether or not it's being subject to severe ice damage as one of the variables to define domain --

MR. FETHERSTON: Right.

MR. AUBLE: -- then you potentially -- the project itself is going to change which domain a bunch of land is in?

MR. FETHERSTON: Yup.

MR. AUBLE: Okay.

MR. FETHERSTON: Exactly. Exactly. And that's one of the -- that's one of the -- the reasons for doing this riparian process domain exercise in the first place, is to -- was to identify. Because we know that physical disturbance processes, we know that those affect vegetation pattern and floodplain development.

Whether it's overbank flooding due to ice or if it's overbank flooding from open water, we know that's how floodplains develop, you know, in terms of just the flat-out geomorphology. In that layer on top of that, you have vegetational patterns that are associated with those different processes.

And using -- being able to delineate the existing conditions under the natural open water flow regime and the natural ice process regimes, we're able to describe just what -- we're able to get at, what are those physical processes that are dominant in determining the different types of vegetation, riparian vegetation, that we see throughout the entire study area.

And then the secondary utility of the riparian process domain approach is, is then we can say with project effects, you're going to be changing the aerial distribution of these processes, of open water flooding. You're going to be changing the aerial distribution of where ice affects and where it doesn't. And you're going to be effectively shrinking that zone.

Such as, you have -- pre-project, you have a certain area that's flooded in open water and ice effects. And then post-project, you have an area that's different. And that gives us the ability, then, to predict areas of change, which is the goal of the entire project. Yeah.

MR. AUBLE: Okay. Yeah. I was thinking more of them as longitudinal breaks rather than -- yeah, okay, I understand what you're saying. Here's another --

MR. FETHERSTON: Yeah. Yeah.

MR. AUBLE: Here's another question for both of you. In your planning of, like, adding these rapid vegetation transects and, you know, thinking about out years, have you been -- the additional vegetation sampling that needs to be done to inform the probability-of-occurrence model, have you been thinking of that -- of accomplishing that in one field season or multiple field seasons?

MR. FETHERSTON: One field season.

MR. WELLS: One big field season.

MR. FETHERSTON: Go ahead, Aaron.

MR. WELLS: Yeah. Well, it's one big field season. And we call them rapid vegetation transects because they are designed to be rapid. So we move through them quickly so we can get them done.

MR. AUBLE: Yeah, but there's a bunch of the other kind. You know, what? The ELP? The more permanent ones that (Indiscernible - simultaneous speech) --

MR. WELLS: The ELS plots, yeah.

MR. AUBLE: Yeah, okay. It just seemed to me like a lot of sampling.

MR. FETHERSTON: Yes.

MR. LaCROIX: Yeah. This is Matt LaCroix again. I just wanted to -- I appreciate, Aaron and Kevin, your responses. I just look back, to close -- to wrap up that thought and tag on to what Greg is raising, in terms of issues and ability to predict, you know, potential project effects.

And so I would encourage thinking -- or at least considering linking the vegetation community mapping, particularly the beaver dam complex habitat, with the process domains. Because you could potentially have a circumstance where a project-related effect would, for example, reduce the periodicity of disturbance in the lateral floodplain habitat that would make those areas more suitable for beaver habitat.

And likewise, you have a number of your other vegetation communities are linked potentially to predictable project effects. Like the early succession willow habitat on the mid-channel bars, you know, clearly valuable moose habitat, and process-related changes associated with the project could have effects. And you could predict and you could map those.

So I think linking those to analyses. So not necessarily putting the beaver dam complexes in as a process function, but more of a correlated, you know, variable that could enable a second tier kind of analysis.

MR. PADULA: Thank you, Matthew.

MR. FETHERSTON: I agree. It's not something that -- I mean, it's -- would simply be a subset of the whole process analysis that we would, you know, end up doing; in terms of riparian process domains; in terms of the distribution; and in terms of groundwater/surface water changes, both comparing existing conditions with project conditions and where it's going change geographically relative to where the beavers are. It's something that is -- a lot of it is cartographic analysis.

MR. WELLS: It also seems like an opportunity to work with the wildlife teams for the fur bearer study that are -- that are beaver --

MR. FETHERSTON: Yup.

MR. WELLS: -- studies going on for that.

MR. FETHERSTON: Exactly. Yeah.

MR. PADULA: Any other questions for either Kevin or Aaron?

MR. MUNTER: This is Jim Munter again.

And my question has to do -- go back to the -- what you said earlier, Kevin, about -- a couple of the primary processes are the ice, ice jam, and ice effects; and the other one is overbank.

Some of the literature reviews I read as part of this project indicated that dams can have an effect on lowering water tables in floodplains. And I think -- I'd like to suggest that be retained as one of the -- and I think you are going to be including that.

There's a couple challenges here: One is -- I actually had two questions. The first one, I've been scratching my head to try and figure out how the analysis is going to proceed below the confluence of the three rivers. Because only groundwater sites are in the Middle River area, except for the private wells. And the private wells are not out in the braidplains. So you have, at best, a proxy indicator, I think, for what's going on out there.

So, you know, if I read -- if I had time to read more of the reports that you guys have been generating, I might know the answer. But maybe you could just summarize the approach for analyzing groundwater impacts downstream of the three rivers confluence.

MR. WELLS: So that was covered.

Do you want to go ahead, Kevin? I was going to say, that was covered in the October 2014 meeting, that question, but we could address it.

Kevin, do you want to --

MR. FETHERSTON: Go for it, Aaron. I will add to it.

MR. WELLS: Yeah. Well, I'd say that you would know best. In fact, I would like to ask Michael Lilly. But I would -- I will defer to you, Kevin.

MR. FETHERSTON: Yeah.

We have data from -- I forget the actual number of -- we had a number of wells in the Lower River, basically, as a preliminary look, in terms of groundwater/surface water vegetation relationships. And to compare them -- to compare the Lower River relationships relative to what we're finding at the really detailed case studies of the focus areas.

And we haven't worked this data up yet, but we have the original groundwater well data from those sites. And, you know, the idea was to -- and we haven't gotten to this stage of the analysis, but it was to -- in terms of, you know, what is the relationship between the surface water regime and the groundwater regime? And how can we, number one, characterize that?

And that's the whole exercise of developing Modflow at both transects as well as at the larger spacial example at FA-128. And from that, you know, to begin to characterize, you know, how -- what is the lateral extent in which you're having, for example, recharge of the floodplain aquifer from surface water? Is that occurring? And where? What is the relationship between adjacent hillslope hydrology?

Hydro -- I mean, these are -- what you're asking is a really complex question. And it goes to the heart of, what is the lateral range of influence of changes in the surface water regime, both in the Middle River and the Lower River? And how are we going to characterize that?

And the -- and I'd have to say that our approach to date has been to do this -- you know, and at these, what I'd call, individual case studies at FA-104, FA-115, and FA-128, to develop those Modflow models, which are basically just being done currently; and to look at the results and see the relationship between surface water and groundwater.

And then go to the open water modeling, the 1D model of the entire river, and look at the actual -- because still, to this day, we don't -- we don't have the results of, you know, what would be -- what would change, say, in the Lower River all the way down to Willow or down to the Yentna, in terms of the surface water, the natural surface water hydroregime, the flooding frequency?

You know, what stage changes would occur longitudinally throughout the Lower River with project operations? That's currently an unknown. We haven't finished the modeling on that.

But the -- so the steps forward in look -- addressing the question you're asking is to, you know, develop this case study approach with the Modflow; look at the relationships; see if it's significant; and then further examine the relationship of stage change throughout the Lower River with the surface water model.

MR. REISER: So, Kevin, this is Dudley Reiser.

Just a -- one quick point. I think there's five wells, Jim, that are down in the Lower River, that are still -- I think they are still operational at this point in time.

MR. FETHERSTON: Right.

MR. MUNTER: This is Jim. Maybe I can --

MR. FETHERSTON: Does that -- does that begin to get at your question, Jim?

MR. MUNTER: Yeah, it gets part of the way there.

One of the things we talked about yesterday is the transfer value, geographically, of the model --

MR. FETHERSTON: Yup.

MR. MUNTER: -- from a focus area to an adjacent section of river. And the literature review, basically, indicated from the '80s that a different slough would be so different that you would have to build a different groundwater model to really do things quantitatively with changes in the temperature and discharge of water.

And that's a challenge that we talked about. And I think there are ways to make approximations and do an analysis. Yesterday maybe I was a little overly negative on that. But it's still a problem, but it might be solvable.

But the reason I asked this question is because I think that the problem is magnified by about an order of magnitude when you go below the confluence, because it's a completely different river.

MR. FETHERSTON: Yeah.

MR. MUNTER: And when you have got a main -- you know, in the Middle River, you have got the main channel, side channels, and sloughs. And then you go down to a distributory channel situation where the whole hydrogeologic regime is just like a different planet.

And I think the idea that those groundwater models are going to be useful, now is probably a good time to rethink that. And if they are not, what can be done to analyze the problem? Because the problem doesn't go away.

If you have either reduced flood flows or if you have channel down-cutting, you're likely to have a reduction in water table, which can result in vegetation changes. You know, spruce or birch could even come into certain areas with fuller --

MR. FETHERSTON: Sure.

MR. MUNTER: -- persistent water tables.

And I'm just not seeing how that analysis is going to go from the data we have to the answers that people want. And I'm not sure you can answer that here over the phone either. But I think it's a really important topic.

MR. FETHERSTON: We will make note of that. I appreciate that.

MR. PADULA: Any other comments or questions, either from anyone on the phone or in the room?

Okay. Yes, that's a wrap on our presentations. We would like to take -- if folks can be patient, take maybe a --

You need 15 minutes, Betsy?

Ten?

Let's say a ten-minute break, and then

we'll come back with some closing remarks from AEA. And maybe give an opportunity for anyone else who may want to have any closing remarks, too. So let's take ten minutes.

(Off record) 6

2:22:18

(On record)

2:38:12

MR. PADULA: I appreciate everybody's patience to let us take a short break there. We're going to try and summarize some of the discussions around next steps, process, follow-up, at least to articulate what we think was discussed and some of the commitments that were made.

I will just start with this slide from the opening slides. Just a general reminder of where we are in the process and what is ahead for everybody, leading up to the October study plan determination.

So, again, AEA will file the meeting summaries. And Betsy will talk a little bit about what those will include and what will accompany the meeting summaries.

And then, again, just major deadlines. I'm sure these are all burned into everybody's cortex at this point. So June and then August for major filing deadlines. And then the study plan determination.

I don't think there's probably any questions around that at that point. We're following the FERC-approved schedule at this point.

Betsy.

Do you have a mic? Somebody stole the mic.

MS. McGREGOR: First off, I'd like to thank CIRI and their IT staff and logistics staff, as well as our facilitators Dan, Steve, and Julie. I think they did a great job over the last few days. As well as all the stakeholders, for being prepared. And I think we had some great discussion, really good technical discourse.

There were several action items that we have identified throughout this meeting. People asking for specific information that some of our contractors said they would follow up on.

We will -- before April 24th, we'll work on those action items and we'll post them on our website underneath the respective meeting date. We will also include those with our meeting summary, which we'll file April 24th.

There were some areas that we plan on following up with individuals for clarifications in some of the questions that they've raised.

The meeting summary will be filed on April 24th. It's going to include a summary of the discussions we've had and any points of agreement. If we have had follow-up discussions prior to April 24th, we'll capture those in the meeting summary, as well.

We're also going to file our presentations. I would like people to pay attention to AEA's proposed modifications that are in the presentations, because we clarified -- I know this is kind of difficult with all the documents that are out there, but we did try to clarify our proposed modifications in summary, moving forward in the presentations. So please refer to the presentations in evaluating AEA's proposed modifications.

And we will file the transcripts. They are going to be filed as is. We don't plan on correcting them. But they can be there for people to use as a backup to the meeting summary that we provide to FERC.

I just wanted to thank everybody again for participating.

MR. PADULA: Great. Thank you, Betsy.

Without further adieu, it's nice to be done a little early. Really appreciate everybody's participation and cooperation. I really thought it was three great days of meetings. And you guys actually made it real easy on the facilitator, so I appreciate that.

Yeah. Anybody else have anything in way of a final comment to make?

Great. Thank you all very much. Thanks to folks on the phone. Meeting's adjourned.

2:41:48

(Off record)

SESSION RECESSED

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)ss.
STATE OF ALASKA)

I, GAIL RUTH PECKHAM, RPR, do hereby certify:

That the foregoing pages numbered 5 through 204 contain a true, accurate and complete transcript of the Initial Study Report (ISR) Meeting of March 24, 2016, taken before Sunny Morrison and Sydney Hamilton, court reporters, and transcribed by me, from a copy of the electronic sound recording, to the best of my knowledge and ability.

____
Gail Ruth Peckham, Transcriptionist