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FEDERAL ENERGY REGULATORY COMMISSION

Loup River Public Power District
Project No. 1256-029-Nebraska

Loup River
Hydroelectric Project
(FERC No. 1256-029)
Study Results Meeting - Day 1

New World Inn
Columbus, Nebraska
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P A R T I C I P A N T S

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(Whereupon, the following proceedings were had, to-wit:)

STEPHANIE WHITE: Everybody should have an agenda and you should have a packet of slides, note slides. Real quick I'll just hit a couple of highlights in the agenda.

This morning we're going to walk through Study 4 and Study 8, water temperature in the bypass reach and recreation and creel surveys. We'll break for lunch at noon, and depending on if we have people fill in these spaces this morning, I might ask some of you to move forward, or you might just do that on your own whether or not you can hear.

This afternoon we'll do Studies 1 and 12. We'll adjourn for the day at 5:00. Tomorrow we'll do Studies 2, 5, and we'll do a little bit of next steps, what happens next, where are we in the process tomorrow afternoon.

Ground rules. Essentially, No. 1, is really about utilizing the microphone so the people on the phone can hear you today. I think we have a pretty good system, but I might interrupt you if you start off softly or somebody can't hear you.

The second one is really for the phone attendees. If you would, please don't put us on hold. What happens when you do that is we get a nice elevator music that can sometimes go on for 45 minutes to an hour. So if you would put us on mute, that's fine, but not on hold.

Number 3, for those of you on the phone, we also need an alternative way to get ahold of you. So if somebody in the room has your cell phone numbers. Lee, do you have the first phone numbers?

LEE EMERY: I don't have their cell phone numbers.

STEPHANIE WHITE: And I know we have John and we've got your cell number.

Cell phones --

JOHN BENDER: I'll give you my desk phone number.

STEPHANIE WHITE: Great. We'll take breaks periodically throughout the day. Also, if you have a hard time hearing anybody, raise your hand, let me know, speak up, and we'll work to adjust.

Anything else? Okay. Today -- here we are, the second ISR meeting. The goals are to present the remaining study results and talk about any proposals to modify. I'm going to let Lisa take it from here.

LISA RICHARDSON: Thanks, Stephanie. And I apologize, I've got kind of a funky voice thing going on, a cold that's lingering for about three weeks, so -- okay. I just wanted to start off with a little bit of background for everybody.

We've been meeting with pretty much all of you for several years now. We started off -- we've had probably close to a dozen meetings, several of them large meetings like this. We talked about the issues that are associated with the project or the concerns that agencies have. We also had several meetings to develop this study plan, which we've now conducted the studies according to the study plan that was developed, so this has been a long process, so there may be some new faces, and if any of the new faces have questions, please ask, but I think some of you this will be -- you know, this is just a continuation of where we've been before.

I wanted to just kind of highlight where we are in the process for relicensing.

STEPHANIE WHITE: We're on slide six now.

LISA RICHARDSON: Thank you. This is a graphic that we've shown at many of our meetings. The relicensing process that the district is using is the integrated licensing process, the ILP. It has a very prescribed process, lots of dates that are set in the regulation. We did some early information gathering and developing the studies and defining the issues. Now we're in the issue -- in the issue study phase. Hopefully we'll be completing that here in the next few months, and then the next step is really applying for the license.

The district will be submitting a draft license application to FERC in November, and then the official license application goes in in March of next year. So we're not quite to the end. A new license is not anticipated until 2014. That's when FERC is expected to make their decision on the license, but we are getting closer and closer, and all the hard work that everybody's putting in it I think is paying off.

The study plan determination, I just want to briefly go back over that. We submitted the study report -- excuse me, the initial -- the revised study plan. We've had so many reports, I can't keep them straight. The revised study plan. FERC put out their determination on that study plan and made some adjustments and changes to it.

There were three studies that were

removed, water temperature in the Platte River, fish sampling, and creel survey, which was actually just combined with recreation use. Three studies were approved without modification. That is -- those were fish passage, the land use inventory and Section 106 compliance.

And then there were six studies that had some modifications requested by FERC, sedimentation, hydrocycling, water temperature in the Loup River bypass, flow depletion and flow diversion, recreation use, and ice jam flooding on the Loup River. That was FERC's study plan determination from August of 2009. Most of the studies that had modifications are the ones that we're presenting today.

As you've all noticed, this is the second initial study results meeting. I've gotten a little bit of flak for that, the second initial, that's kind of odd.

We all met back in September, and the studies that were presented then was sedimentation study, the fish passage study, there was an update on recreation use that really focused on the telephone survey portion of the recreation study, the land use inventory, Section 106 compliance, and then wasn't really a full-blown study, but the PCB fish tissue sampling that MDQ did last summer. So those studies are complete with the exception of sedimentation.

There were some ungaged site analyses that needed to be completed. The data wasn't available at the meeting in September, so Pat and the guys have been working on finishing that analysis and is going to be presented today.

So after the first study -- first initial study results meeting, there was an opportunity for agencies to comment. The district responded and then FERC made a determination on modification requests for the studies. There were three studies that FERC did not require any modifications. Those studies are considered to be complete and final: Study 7, fish passage, Study 10, land use inventory, and Study 11, Section 106 compliance.

There were two studies that FERC requested some additional analyses or work to be done. For those on the phone, I'm now on slide ten. There were two studies that were requested revisions to. The first one was sedimentation. These were in response to some of the comments that were received. Confidence limits for sediment rating curves.

Include the aggradation/degradation analysis at Duncan, North Bend and Ashland and Louisville. This was information that was included in the PAD, but will be included in the final sedimentation report.

Then perform some aggradation/degradation analysis at Genoa, perform the Kendall Tau, that should be a U, not an N, Kendall Tau test to assess aggradation/degradation trends, and then do some statistical analysis on the tern and plover nesting in relation to the various sediment transport parameters. And then one was to provide some additional reference materials.

Under hydrocycling, there was one request made at the last meeting, and that was the sediment transport analysis for hydrocycling be conducted using the HEC-RAS model. Those revisions are currently underway. We will be presenting the results related to those revisions at the updated study results meeting or in the updated study report. That report will be due in August of this year.

So what do we have on tap today, as Stephanie mentioned, sedimentation. The focus on the sedimentation study is the results from the ungaged analysis. We're not planning to go back through the original analysis that was presented in September. However, if you have any questions related to that, feel free to ask them.

Water temperature in the Loup River bypass reach, flow depletion and flow diversion, recreation use, and then ice jam flooding on the Loup River.

That is where we're headed today, and so after today's meeting there are several things that will happen. We've kind of had a dry run on this you might say or a wet run I guess because we already did this once with the initial study results meeting.

There is an opportunity -- first the district will submit a summary of the meeting. That's due to FERC March 11th. Then agencies and other stakeholders have an opportunity to comment on the meeting and the report just as you did on the report and meeting from back in September.

May 12th -- and that's due by April 11th, excuse me, your comments are due by April 11th, including any request for modification to studies.

May 12th, the district will provide responses to any comments that are received relating to how we would try to address those. And then in June we would expect FERC to make a final determination on modifications for the requests that are made in this round of studies.

So that's kind of the timeline for the studies we're presenting today. And then as I mentioned a little bit ago, in August we'll be submitting the updated study report. Because of the timing of things, we may -- if there are revisions to these studies, we'll have to see what they might be to see if they can be completed by August. If they can't, we'll end up having to do a second meeting for that as well. Maybe we'll just push everything into one meeting. We'll have to see how that goes.

There would be a meeting in September -- the report would be due in August, meeting in September, and then, as I mentioned, November the district will be filing their draft license application. And I think that takes care of everything I had. Did anybody have any questions on the upfront stuff. Jeff?

JEFF RUNGE: Yeah. This is Jeff Runge from the Fish and Wildlife Service. My question is to FERC about the process. You know, looking at the timelines, the next step is NEPA, and based on what I was told at the last meeting that these studies are to incorporate all of the variability that would be associated with a NEPA analysis. And that there is no means -- after this second round of studies, there is no means of coming back and reanalyzing so that you can learn differences associated with alternatives; is that correct, or is this sort of the last step when it comes to study requests and analysis of the effects?

LEE EMERY: It is for study requests. Analysis -- we'll do analysis once the application is filed, you'll have more opportunity to comment then on the analysis.

JEFF RUNGE: But as far as analysis of effects, if there is NEPA -- for example, a potential EIS to where there is multiple alternatives that would be evaluated that looked at effects to different resources, I'm wondering here if that -- is that to be addressed in the study results, or is this -- is there a follow-up to that that will fine tune evaluations for NEPA alternatives?

LEE EMERY: Once the application is filed, we will prepare a NEPA document. That's where we've analyzed all of the different alternatives.

JEFF RUNGE: I guess I'll be a little bit more exact here. Do we need to identify what the effects are to our resources and what the alternatives would be so that this next round of studies will incorporate these protective mitigation enhancement measures into their studies so that they can look at a range of alternatives and what those effects may be to the resources?

LEE EMERY: I'm not sure what you mean by the next range of studies.

JEFF RUNGE: Well, there is one last step for modification of these studies, and, you know, for us I would think that our last step would be to use this information to feed into an alternatives analysis for NEPA?

LEE EMERY: It would. You would make your comments and we would incorporate that analysis in our NEPA document.

JEFF RUNGE: So within this next letter, would we have to identify what the effects are to our resources of concern, and would we have to propose protection mitigation enhancement measures at this time so that -- so that you can incorporate that into NEPA.

LEE EMERY: You would not have to do that at this stage of the analysis. You would have a chance to write any descriptions and the recommendations later on in the process.

JEFF RUNGE: Okay. That's helpful. That's helpful when it comes to --

LEE EMERY: Is that right, Nick?

NICK JAYJACK: Yes, Lee, that's correct. We're a little bit early for that right at the moment, so the district will prepare a draft license application, and at that point you can review it and make comments as to what environmental measures you would like to see or what environmental alternatives you would have them look at.

Of course, once the license application comes here and we review it, and we find that it meets our regs as far as an adequacy review, then we would issue a notice of ready for EA along with an acceptance notice. And then we would at that time ask for your final recommendations, terms and conditions, et cetera.

Multiple points at which you can make recommendations for measures and communicate to us and to the district what you would like to see for your resource.

JEFF RUNGE: That's good. That's really helpful, because I would hate to get to the point to where we identify these measures only to find out that it's too late to go back and evaluate the effects of those measures, and that there is still an ability to do that in the future.

STEPHANIE WHITE: Nick, this is Stephanie. Lee gave us a cue before you spoke and he called you by name, but for those of you on the phone, if you wouldn't mind saying your name at the beginning of your comment, I think it would really help with the court reporter and the record of the meeting.

RANDY THORESON: Randy Thoreson, National Park Service. Just go back to the schedule for a minute, if you would, Lisa.

LISA RICHARDSON: This part?

RANDY THORESON: Yes, please.

STEPHANIE WHITE: We're looking at slide 12 now.

RANDY THORESON: March 11th the district submits meeting summary. After the first initial study report, I submitted a letter summarizing my comments from that meeting. Would I also have an opportunity to do that prior to March 11th in relation to the second --

LISA RICHARDSON: Actually your opportunity -- you can submit your comments whenever you'd like. Your deadline is April 11th. We're going to be summarizing -- we're creating a transcript of the meeting, but that's not the meeting summary that we'll be submitting to FERC. Last time we put together, I don't know, six or seven pages worth of notes kind of summarizing the discussion. And then that's available for agencies to review, and if they have comments on that summary, or other comments that they wish to submit, your deadline is April 11th. So, yeah, you can feel free to submit them sooner than that. We would like to have them as soon as we can get them. Yeah, you have plenty of time I think to submit some comments.

RANDY THORESON: Thank you.

STEPHANIE WHITE: Before we move into the next set, I'm going to turn the lights off up here. I would like to get a sense from the back of the room if that makes it easier to see. I'm going to disappear, I'll be right back.

LISA RICHARDSON: Now, I'm going to turn it over to George Hunt to present the results of the water temperature in the bypass reach study.

GEORGE HUNT: Thank you. I'm George Hunt with HDR.

This is study number -- this is four,

study water temperature in the bypass reach.

Our goal was to determine if project operations, flow diversion to the Loup Power Canal, materially affect water temperature in the Loup River bypass reach. Particular emphasis on the reach between the diversion weir and the confluence of Beaver Creek with the Loup River or in the Platte River bypass reach.

And we set out to do -- to achieve that goal through four objectives. I'm on slide 16. Objective one, to estimate the relationship between flow in the project bypass reach, and ambient temperature, water temperature, relative humidity and solar radiation.

The second objective was to describe and quantify the relationship, if any, between diversion of water into the Loup Power Canal and water temperature in the project bypass reach.

No. 3 was to determine if a critical reach relative to water temperature excursions exists within the project bypass reach.

And No. 4 was to determine if an accurate and reasonable method exists for predicting water temperature excursion events.

And we defined excursion events as any

time the water temperature got above 90 degrees Fahrenheit, which was the NDEQ standard for the protection of aquatic life.

So our study area -- I think you guys have all seen this before, but we have the Loup bypass reach here, we have the Platte bypass reach, the diversion, and the tailrace canal return. And this is the stretch we want to study in here. We had -- well, let me move on.

Our methodology was to coordinate with the USGS.

STEPHANIE WHITE: Stop just one second. We're on slide 18.

GEORGE HUNT: Slide 18. Was to coordinate with the USGS so they can put temperature probes in, and I'll show you where in a second. So the USGS was able to collect water temperature and water flow. We were able to collect water temperature as well, and we obtained meteorological data from a site at Monroe from the High Plains Regional Climate Center. Our data analysis for the methodology, we use linear regression, ANOVA tests, logistic regression and exceedance probability.

I'm on slide 10 on the map. So what we did was the USGS was able to put a temperature probe upstream on the Loup River at a site called Merchiston, which is a brand new site from USGS. And they started collecting temperature in early May, and went all the way through the end of August and just left it in as long as they could.

They put a temperature probe at their existing site at Genoa. So we have flow and temperature there at Genoa. And we were lucky enough the USGS put in a probe at Columbus as well, which we didn't know about originally.

We had temperature data loggers. These little tidbits on slide 18, this is what they look like, and it's about their size, and they can collect temperature data for weeks and months.

We put -- as a test, we put them in alongside Genoa just to make sure that our installation methodology was as good as the USGS or we got equivalent data out, we got equivalent data. We tested in a week in June, and then we pulled it out, and then in -- at the end of August we put them back in. We put probes, two apiece, two at Columbus, coincident with the USGS location. We also had -- sorry, we also had flow there collected by the Nebraska DNR. We had probes at upstream of the -- on the Platte upstream of the Loup River confluence. And we put probes in the Platte upstream of the tailrace.

A lot of dates and stuff. Any questions about that?

Okay. Slide 20, objective one, again, is there a relationship between air temperature or flow or water temperature. Is there a relationship for water temperature between air temperature, relative humidity, solar radiation or flow.

We found that there is not a statistically significant relationship between water temperature and either flow, radiative flux or relative humidity.

We found that there was a statistically significant relationship between water temperature and air temperature and soil temperature.

Here I'm on slide 21. We've plotted flow and temperature on the same graph here. You can see the early May the temperature started -- and this graph just happens to plot until near the end of August.

We have drawn here the NDEQ standard at 90 degrees, and you can see here early June the Genoa USGS probe got washed away, so we had to wait a while until they were able to put the probe back in.

You can see here we had some excursions above the standard in August, and you can also see the diurnal variations of the temperature going up and down every day.

I'm on slide 22. In the back and forth, you know, and developing the study plans, it was requested of us that we -- in addition to what we propose in terms of regressions, we used the methodology presented by Sinokrot & Gulliver, and it's a water temperature exceedance probability. There is not a lot of data on this graph. There weren't a lot of excursions. We didn't want to draw too many conclusions from this graph, because like I mentioned in the results slide, we did not find a statistically significant relationship between flow and water temperature. And this methodology kind of ignores that and just plots the flow and temperature. But basically what it's saying is for about 200 CSF, there is a 50/50 chance of exceeding the standard.

Here we have flow plotted against water temperature. Sorry, I'm on slide 23.

And you can see, it really wasn't appropriate to put the linear regression on this plot. They are kind of scattered. Basically because on a day you can have the flow be very even, but the temperature is just going to go up during the day and then down during the night, so you can get the up and down pretty much in the same flow.

I'm on slide 24. We also plotted air temperature versus water temperature. We have a very good correlation, slight spread of the data, but the water temperature is statistically related to air temperature.

Slide 25, we have soil temperature versus water temperature. We have a much tighter pattern, again, a statistically significant relationship. It's a much tighter pattern. We think it's just based on response time being soil.

LEE EMERY: Question, Lee Emery, FERC. On your soil temperature, I guess it was collected at Monroe. I didn't go back to see the original outline of the study. How was that measured?

GEORGE HUNT: I don't know. I would have to go through the methodology. I would have to go back through the --

LEE EMERY: I didn't see anything in the report saying how it was done. I figured it was probably done -- the original study plan. I was just curious.

GEORGE HUNT: I don't know. I would have to go back through the original data you download.

LISA RICHARDSON: We didn't do those measurements, it was from the Great Plains --

LEE EMERY: Climate control. Just keep a probe in year round and take measurements off of it or something?

LISA RICHARDSON: I'm not sure.

LEE EMERY: It's in the study plan, the original design of how data would be collected?

GEORGE HUNT: I'm sorry, what was your question?

LEE EMERY: The methodology for the soil temperature collection was in the original study plan I guess about how --

GEORGE HUNT: No. I think we just said we would get it from the agency.

LEE EMERY: I'm curious. I've never done that before. I'm curious how they get that. A probe stuck in the ground year round or something? In this case it has quite a influence it seems like on temperature and water in your study.

GEORGE HUNT: We came to the conclusion that air temperature is influencing soil temperature, but the water and the soil just have the same -- a similar response time, and so you're going to have a much tighter pattern.

Slide 26, we have relative humidity versus water temperature. And, again, we didn't do a regression on this slide. We found no statistic relationship.

One thing, if you're using this dataset, you're able to say, well, there weren't any excursions with relative humidity below 50 percent, the excursions all happened above 50 percent.

Slide 27, radiation flux. Excursions could happen at the -- during the whole range of measurements, from zero all the way up to 800, and just say, well, it could be hot on a cloudy day as well.

On slide 28, we have maximum daily water temperature versus maximum daily air temperature. Again, there is a statistically significant relationship between this. These two datasets slightly higher correlation, but we think that's due to just a lot less data points.

Slide 29, we also -- we did two other analyses on two other datasets. We had a dataset where we took just the daily maximum water temperatures and daily maximum air temperatures, and we also had a second dataset where we took all water temperatures above 63 degrees Fahrenheit.

We performed two different analyses on these two different datasets, multiple logistic regression modeling, multiple linear regression modeling, and both models on both datasets show the air temperature is the best predictor for water temperature.

The logistic modeling was able to show that if you included relative humidity in the predictor model, it improved the results and improved the prediction. And neither one of the models for neither datasets was improved by including flow in the analysis.

So to sum up for objective one, there is not a statistically significant relationship between water temperature, flow, relative humidity or radiative flux. And there is a statistically significant relationship between water temperature and air temperature.

Slide 31, objective two, to describe and quantify the relationship, if any, between diversion water and Loup Power Canal and water temperature in the bypass reach.

So the first step is we analyze Merchiston, the data from the Merchiston site similarly to the data from the Genoa site, and the same relationships were found, you know, related to air temperature and no statistically significant relationship between radiative flux, relative humidity or flow.

There is synchronous daily oscillations in water temperature between the two stations, and there is a statistically significant relationship at -- one-to-one relationship between the recorded water temperature at the two stations.

This is a similar slide. I'm on slide 32 that I showed before for Genoa. Again, same pattern.

And, again, I'm on slide 33 with the Sinokrot and Gulliver methodology. This time we have four data points, and here it's showing for about 2500 CFS you have a 50/50 probability of exceedance.

Slide 34, Merchiston, showing air temperature versus water temperature. A strong correlation again, statistically significant.

And here we've plotted -- just plot the data for Merchiston in blue on slide 35 and Genoa in red. And this is from early May through mid June about, and you can see they are practically right on top of each other.

And then moving on to slide 36, we have the other half of the Genoa data from mid July through near the end of August.

And here -- we think right here the data is a little -- you know, doesn't follow the same pattern as usual. We believe that the Genoa probe got exposed to the atmosphere a little bit there.

And then we plotted one against the other, Merchiston water temperature versus Genoa water temperature, and the standards on each side. You can see there is a very high correlation.

I've also plotted the one-to-one line, so if the data were exactly the same, they would all fall along this line, and they follow it almost right on.

This -- I'm back on slide 36. We did announce these both with these data points and then without, and the same relationship, it doesn't matter. It's just that this plot looks a lot better with them out.

Slide 38, in summary, water temperature at Merchiston, similarly at Genoa, had no statistically significant relationship between flow and relative humidity or radiative flux.

Water temperature at Merchiston had a statistically significant relationship to air temperature.

We seen synchronous daily oscillations in water temperature between the stations, and a statistically significant relationship exists between the two stations.

The third objective was to determine if a critical reach relative to water temperature excursions exists in the bypass reach. And a little history, this came about because we had -- you know, we had planned on just collecting temperature data at Genoa, because Genoa is upstream of where Beaver Creek comes in, and if flow was important, this would be having the least amount of flow.

So we also -- that's why we had temperature at Columbus and then upstream and downstream on the Platte of the Loup confluence.

We found synchronous daily oscillations in water temperature between Genoa and Columbus. Almost identical to the Merchiston and Genoa.

Synchronous daily oscillations in water temperature in the Platte bypass reach. And the

Platte River bypass reach temperature was correlated with the temperature in the Platte upstream. Therefore, no critical reach was identified.

Here is Genoa versus Loup River. These are all USGS data. On slide 40, this time Genoa is blue and Columbus is red. And both Genoa and Columbus probes are washed out mid June, and then Columbus had a little issue in July with being exposed to atmosphere.

Here is -- I'm on slide 41. Here is a week between August 13th and August 23rd about where we are comparing Genoa -- USGS measured Genoa temperature and one of our tidbit probes at Columbus. You can see synchronous daily oscillations right on top of each other.

And then again Genoa this time on the X and -- on slide 42 -- Columbus on the Y, and, again, we're showing the one-to-one statistically significant relationship between the two.

Slide 43. So during the week that we had our tidbit probes in, what this analysis -- what we did for this analysis, we averaged for every day of the week all the midnight flows, we averaged all the 1 a.m. flows and so on. So this is an average of that week.

You can see that Genoa and Columbus tracked right on top of each other generally. You have Genoa on top in the morning, but they track together, and then Columbus is on top in the evening, but they all track similarly.

Now, if you look at the purple triangles, the tailrace, that's in the Platte bypass reach, it's higher than the flows -- I mean, than the temperatures in Genoa and Columbus. But if you compare it to the temperature in the Platte upstream of the Loup confluence, those two probes match very well also. Purple and the green track during the day, green goes up a little higher than purple, but then purple goes up a little higher. They correlate together the same way that Columbus and Genoa correlate together.

Slide 44. So, again, to summarize, synchronous daily oscillations in water temperature seen between Genoa and Columbus. There is a statistically significant relationship between water temperature at Genoa and Columbus, and the temperature in the Platte River, the two temperature probes are correlated together. And, therefore, no critical reach was determined -- was found.

Slide 45, objective four, is there an

accurate and reasonable method to predict excursions. Well, so if the temperature in the water is a function of air temperature, then we need to look at how do we predict a high air temperature during the day. And if we wanted some warning, we would want to look at it, what is the air temperature -- can we look at the air temperature in the morning and find out if the air temperature in the afternoon, which brings up the water temperature above 90, if that was a good predictor.

What we found was that if the -- I'm going to switch to slide 46. If the air temperature hit 74 degrees at 8 a.m., you're highly likely to have an excursion that day. If it's a hot morning, it's going to be a hot day, and you're going to have hot water.

And that's --

STEPHANIE WHITE: Any questions for George?

JEFF RUNGE: Yeah. Jeff Runge. Just going through FERC's final study determination, on Page 19 of that they requested that if the Platte River -- the Platte River bypass area, if the water temperature is substantially higher than the Loup River bypass area, then the district shall conduct additional water temperature monitoring and analyze water temperature, ambient weather conditions, and pretty much it's -- if the water temperature in the Platte River is higher than that of the Loup bypass temperature, then you would have to conduct the same analyses as you did for the Loup system. I was wondering is it because of that correlation with the Duncan is why that wasn't done or --

GEORGE HUNT: Right. That was before we had decided -- we decided later to put that extra probe in. I think that was written -- if I remember correctly, that was written before we had decided to put a third probe upstream. And by putting that third probe upstream at the same time, we were able to show that the temperature in that section of the Platte is related to temperature upstream of the Platte.

JEFF RUNGE: Okay.

LISA RICHARDSON: I guess, George -- this is Lisa Richardson. I believe you did the same analyses, you just had a different dataset, a smaller dataset; is that correct?

GEORGE HUNT: Did we do the same linear regression showing -- you're asking did we do the same linear regressions?

JEFF RUNGE: Same linear regressions, probability of exceedance analyses, all the logistic regressions and those types of similar tests for the Platte system.

GEORGE HUNT: We did not perform that analysis. We saw that the temperature in that section of the Platte was driven by the temperature -- you know, I'm going to go back to slide 43. Genoa and Columbus tracked together and the two Platte track together.

JEFF RUNGE: And that's under the conditions of last year?

GEORGE HUNT: That's correct, yep. That's using this dataset using data collected during this time period.

JEFF RUNGE: Thank you.

LEE EMERY: Lee Emery from FERC. On a couple of your tables in the report, you have AT which is air temperature, what is RH?

GEORGE HUNT: Relative humidity.

LEE EMERY: Sorry. I didn't see it any place in the document. You do have a footnote in several of the charts what AT was. Thank you.

GEORGE HUNT: Okay.

FRANK ALBRECHT: Frank Albrecht, Game and

Parks Commission. Will you help me out on explaining something? I don't understand -- if you go to slide 23. I guess I anticipated that there would -- you know, one of your conclusions is there is no statistical difference in the flow versus the water temperature, and I guess that part surprised me. I thought -- I guess what I was anticipating was that's the higher flow of -- you know, the water temp is going to go down somewhat, didn't know how much, but this scale is a little bit -- on the flow on the CFS on the bottom, maybe that's what confuses me I guess, the way it's clustered there. But you still have a temperature difference on the water temp of 48 up to 96 or something like that. I know that probably -- some of that is air temp like you've been describing, but isn't that a pretty significant difference in the water temperature?

And I guess where I'm going with that, there is some flow issues on that bypass reach, and we've had some fish killed and so on. It's not the temperature from the -- I'm trying to figure out what's going on there then. So can you help me out on this one on this graph, and then that overall question that I have?

JEFF RUNGE: One thing, too, to maybe help with your question there, there is the previous slide. That sort of filters out a lot of the noise in the second graph. Oh, not that one, the next one. That one there. That if you go to the next graph, you see that there is a lot of scatter, a lot of noise as far as when there is a -- an evaluation is done.

A lot of the regressions doesn't look at -- correct me if I'm wrong, doesn't look at just flows above 90 and the probability of that, it includes all the temperatures across all the different flow ranges.

STEPHANIE WHITE: We're on slide 23.

GEORGE HUNT: This graph?

JEFF RUNGE: Yeah, or a lot of the regression analyses looks at all of the evaluation -- all of the relationships between water and temperature across all the different water ranges and all the different temperature ranges. It doesn't focus on things like -- you know, like on the very low end and the very high temperature end of things.

GEORGE HUNT: Yeah, we did -- I'm looking through the report now. If you look, for example, on pages -- I'm on study four, Page 21. We have --

JEFF RUNGE: Before we get to that. Just that previous slide, though, for me it sort of filters out that noise. Knowing that there is a lot of scatter, that there is somewhat of a relationship there. A curve to linear relationship between your main daily discharge and the probability of exceeding that temperature limit. But sorry about that. Sorry for interrupting you, but I thought I would just show that real quick and allow for you to go into the other analyses.

GEORGE HUNT: Well, if I understand your question, you're saying it doesn't seem intuitive that flow would not have an effect?

JEFF RUNGE: Well, to me it's -- I'm not a statistician, but there is a lot of scatter. I think they term it like heteroscedastic, and it's sometimes like multiple regressions. I'm not familiar with logistic regressions, but maybe like a regression quantile would be able to filter out a relationship within a subset of the data as opposed to a linear relationship, linear regression that sort of looks at all the data. You know, tries to get that medium fit between the relationships.

GEORGE HUNT: We did analysis, so I'm going to -- we have two analyses that I think address your question. We have the analyses where we reduced the dataset to flows just below 50 CFS, 100 CFS, 200 CFS, and then just -- so we feel like we've addressed that sort of -- you know, let's just look at low flows and what happens, let's just look at high temperatures, what happens.

Now, the logistic analysis, what that -- in report we describe how we took -- any time the temperature is above 87 or 88 degrees Fahrenheit, we set that as a one, and any time it's below, it's a zero, and that reduced all that scatter. And so you have above and below. And it was able to, you know, use that methodology reducing the scatter, addressing the heteroscedastic; is that right?

JEFF RUNGE: Yeah, you know what I'm talking about now.

GEORGE HUNT: Yeah. We feel that that analysis addressed that concern and it found the same results.

JEFF RUNGE: Yeah, I think you might be right. Like I said, I'm not familiar with logistic regressions, and I think that that does have that capability of sort of model building and looking at that subset, so that's something I'll just have to follow-up on, but I do recall that, and it does --

yeah, the information looks good from that perspective.

GEORGE HUNT: Did I --

FRANK ALBRECHT: It doesn't entirely answer my -- if that scale was different on the X axis, maybe if it was just zero to 2000 CFS, maybe that would help. I guess what I'm still getting at is, A --

GEORGE HUNT: Do you have our copy of the report, can you take a look at these --

FRANK ALBRECHT: I do, but maybe -- okay. Isn't that a significant amount of change I guess from 48 to 96 under those lower flow conditions on that one, or am I probably missing something?

GEORGE HUNT: Forty-eight to --

FRANK ALBRECHT: Temperature on the Y axis is 48 up to 94, 95.

GEORGE HUNT: Uh-huh.

FRANK ALBRECHT: That's a pretty significant jump, especially when the threshold is 90. Like I said, I'm probably missing it. But your conclusion is there is no statistical --

GEORGE HUNT: So what this is saying for about the same flow rate at Merchiston it says --

FRANK ALBRECHT: That's where maybe I'm

missing it, because the scale on the other axis it's all clustered there on the lower flow conditions, so maybe if that was spread out I would see it a little easier.

GEORGE HUNT: What I'm trying to say is if you look at our report plots, like on Page 21, 22, 23, 24, we've plotted this data, the same data, just reducing the dataset down to exactly what I think you're asking for.

FRANK ALBRECHT: Okay. So I need to look at that a little bit more then.

GEORGE WALDOW: George Waldow, HDR. Correct me, George, because I think I asked the same kind of question earlier on this slide that what we're seeing at the left margin is all of the -- all of the temperature points that were collected during this period of the summer warm season. And your explanation to me was that the temperature varied all over the map under low flow conditions during those -- during that period of record. You're not seeing anything other than the raw plot of temperature occurrences during all of these days, and there are a lot of temperatures at low flows because there were low flow -- many more low flow days than high flow days. It's that simple.

STEPHANIE WHITE: Does that help, Frank?

FRANK ALBRECHT: Yes. I'm looking at this. This scale, zero to 500 CFS, it does.

LISA RICHARDSON: George, maybe go to 35, where you're seeing it's exactly the same.

GEORGE HUNT: So on slide 35, this is another way to look at the data. Frank, this is another way to look at the data. Just plot them right on top of each other. And we know that the flow at Merchiston is higher than the flow at Genoa, but the temperature is plotted right on top of each other.

FRANK ALBRECHT: Okay. That's one of the later slides, isn't it?

GEORGE HUNT: This is slide 35 I'm looking at right now.

FRANK ALBRECHT: Okay. Thank you.

STEPHANIE WHITE: Any other questions for George? We're doing pretty well on time. If you're open to it, I would like to keep going.

Okay. I turned the air off to help with acoustics. I think it's fine, but if we need to take a break and turn it back on, we can. I think I will not have it on during the presentations.

I think we might be ready for Study 8.

Quinn, come up.

QUINN DAMGAARD: My name is Quinn Damgaard. I'm with HDR. I've been working on the recreation study for a while along with Mike Gutzmer is here, he's with New Century Environmental. Mike did a lot of the underground survey work, so he was a very big help.

I did work with George a little bit, just a very little bit on the temperature study. I'm certainly glad George was here to go through that with you. I think this will maybe be a step down in technicality. Hopefully we can move right through it.

The goals and objectives have really not changed since FERC's study plan determination. They are to determine the public awareness, usage perception and demand of the project's existing facilities, including fisheries and the Loup River bypass reach.

The bypass reach was something that was added per the study plan determination as well as the Loup Lands WMA, Wildlife Management Area. That's an area that's owned by the district and managed by the Game and Parks Commission. That was also added for the study plan determination. And to determine if potential improvements are needed, and to ultimately develop a recreation management plan to address existing and future recreation needs.

The objectives, I believe there are five or six. To measure recreation use of the project facilities, including the fisheries, the Loup River bypass reach and the wildlife management area, and to document the types of recreation use occurring at the facilities and along the bypass reach, to determine whether recreation facilities meet current demand, and to determine the public perception, the awareness of the facilities, including the fisheries, and identify the impact, if any, of the operation -- project operations on recreation use.

And then moving more to the creel aspect of the survey, we look to determine what species anglers are targeting, what they are catching, including their catch rates, and to collect data for use -- ultimately to collect the data used to prepare the recreation management plan.

The study area is the Loup Power Canal in its entirety, the 35-mile length, including the developed recreation facilities along its stretch there. They are listed there. Also, as we said, the bypass reach was also looked at.

The bullets here, the two public parks, the wildlife management areas and the road bridges were areas that were used. They were publicly accessible areas used to access the bypass reach during our survey.

Methodology, very quickly, outreach was performed ahead of the surveys. It consisted of paid newspaper advertisements, press releases, web page announcements, as well as the district actually installed some signs at the entrances and multiple recreation sites just kind of announcing that they would be doing a recreation survey during the 2010 recreation season. Just letting people know when Mike and his crew approached them to be cordial hopefully and provide us some information that we needed.

A facility inventory was done. That was done along all the developed facilities along the canal. Basically just seeing -- getting a real good handle on what's out there now, getting the kind of baseline condition. It was also performed per the study plan determination along the access locations at the bypass reach. So those wildlife management areas and the public parks were also inventoried for their existing facilities and amenities.

And then the real big piece, of course, was the in-person surveys and the user counts. Those started the first of May, they ran through October, they were done on ten days every month at the randomly selected days, four weekend days and six weekdays, again, every month, as well as on the three holiday weekends, so Memorial Day, the 4th and Labor Day we had crews out there. The survey schedule was developed by the Game and Parks. It was done with their -- actually with their creel survey schedule software, and, again, randomly selected.

The district also installed three trail counters to get a handle on what's the usage of their trail network. There is three main trails that kind of surround Lake Babcock, Two Lakes Trail, Bob Lake Trail and Robert White Trail. The trail counters were installed right at the very end of April, and they collected data May through October as well.

And we did do a telephone survey. A professional market research firm did that, I believe, April and May of last year. The results of that I think were presented last September during the initial study results made.

So getting into the results. First we're going to hit the results of the survey that was performed along the canal, specifically along the canal. We'll then look at what we learned along the bypass reach, and then the third phase will be the creel survey results.

STEPHANIE WHITE: Is there a question on the phone?

ISIS JOHNSON: No, sorry.

STEPHANIE WHITE: We're now on slide 55.

QUINN DAMGAARD: I've been failing miserably at identifying what slide I'm on.

So slide 55, the user demographics collected from the respondents, again, along the canal. The ratio composition was approximately 90 percent white, nonHispanic. Pretty much the remainder was Hispanic. There was really no other racial or ethnic groups represented.

The most frequently -- the most frequent annual household income was between 26 and 50,000. That was 34 percent of our respondents. And I guess just in generalities, as the income range went up, the frequency decreased. There was kind of an inverse relationship there.

The most popular age of user was actually the children, 22 percent were 12 and under, and there was a similar relationship there, as the age went up, the frequency decreased, so -- and the residents of users, 96 percent of our survey respondents reside in Nebraska, more specifically 46 percent were from here in Columbus. We actually asked them their zip code, so we were able to extrapolate that, and that's kind of graphically shown here.

These numbers are probably hard to see, but basically the darker color the more concentrated the recreation use that we interviewed. But, you know, a fairly good dispersion throughout at least the eastern half of the state.

Some general findings from our -- slide 57. General findings of our survey along the canal, the size of the party was generally one or two. A lot of folks were either by themselves or just with a single guest. That was over half of the people we surveyed.

Miles traveled to access the district facilities, 60 percent traveled less than 25 miles, and 92 percent traveled less than 100 miles.

If you look at where Columbus falls in the state, it's almost 100 miles exactly to the nearest state border to the northeast and the west, so most of the people there were in state as you saw by the last figure.

If you -- what's interesting about the folks that traveled over 25 miles, we did some cross tabs on what those folks were doing at the district's facilities. Most of the folks that came here from more than 25 miles away were here for the OHV park. Again, the district has an OHV, off highway vehicle, maybe ATV. They have a park associated with Headworks Park that does draw people from quite an area. So most of the people that traveled more than 25 miles were here for that reason.

Overnight stays, 35 percent of our survey respondents were staying overnight, and of those, two-thirds were staying in RVs. 39 percent were staying for two nights, that was our most frequent length of stay. One and three night stays were also fairly common, kind of even, but after you get over three nights, it dropped off pretty significantly.

We did ask folks if they had any special access needs of our respondents -- which I'm on slide 58 -- of our respondents of which there were I think 1,012. I should have mentioned that up front, we did have 1,012 survey responses along the canal. 2 percent cited special access needs. And in following up with those folks, one thing that they mentioned that they might like to see was maybe some -- a little more shore fishing access with some ADA compliant pass. That was something they specifically noted.

98 percent said the site adequate, the access was adequate. So the vast majority thought the recreation access was adequate throughout the facilities.

And 70 percent of our respondents said that the reason they recreate at the district facilities is because it's close to home. I suppose that makes sense.

On top of that, other things that were commonly noted was the shore fishing opportunities, the fishing opportunities as well as the OHV park. Those were the other common draws as to why people were recreating.

And the frequency of visitation, the most common frequency, we did give several choices, was two to three visits per year. That's 36 percent of the people, and that does correlate very directly with the NOHVA jamborees. NOHVA is the Nebraska Off

Highway Vehicle Association. They generally have a jamboree in -- an ATV/OHV jamboree in the spring and in the fall, so twice a year, so that's -- that does correlate with our findings.

Visitation by month, people were asked when are you here. You know, we might have hit them one time, but we did ask them when do you generally visit the facilities. Not surprisingly, they indicated May through August, the summer months were by far the most popular. It trended down a little in the fall. Very, very little use in the winter. Again, not surprisingly. Picked up again in April.

We did not survey over the winter, and based on our findings, again, the questions that were built in, there is very, very little use in the winter based on what we found, and the district I guess is of the feeling that winter surveys are probably not necessary going forward.

We also asked folks do you use other facilities, nondistrict owned facilities in the area, whether it's a city park or a wildlife management area somewhere in the area. 93 percent said they do not use. They just don't use those facilities.

We did ask people, of course, what are you doing, why are you here, what activity are you participating in. These are the top six of 18 choices that we had. So the top third, fishing, relaxing, hanging out, for lack of a better term, I guess, camping, again, the off highway vehicles, wildlife viewing and picnicking. Those were the most common activities that our respondents were participating in.

We also asked folks what are the most important things for you that you would like the district to provide. The percentages indicated are the percentage of people that said that these activities were either very important -- excuse me, important or very important. So, again, basically the same activities. With the addition of the trails, these are the people -- the things that people feel are important.

And, again, these are things to consider, that the district will consider when developing the recreation management plan going forward.

People were asked to rate the district facilities and the amenities. The percentages indicated here are the percentage of respondents that said these facilities are either very good or excellent. So people think the trails are obviously very good, again, the OHV park and things going down the list here. These are the top five of ten choices that were given.

The facility, the amenities that had the lowest rating was the restroom, restrooms.

STEPHANIE WHITE: Slide 63 now.

QUINN DAMGAARD: Respondents were also asked if there was anything, any project operation that may have interfered with their recreational enjoyment or activities. 88 percent said, no, the project did in no way interfere with my recreational enjoyment. Those that did cite some type of hindrance or interference mentioned ATV operation at night, bugs and unleashed dogs. Those were the three most commonly cited things.

We did ask respondents specifically if there were things that they might like to see at the differing developed recreation sites along the canal.

At Headworks Park, the most commonly cited request were more camper hookups and power in the restrooms. The number here in parentheses is the number of respondents that said something to that nature. Maybe not exactly, but in line with that.

Shower installs at Babcock. People

mentioned just restroom maintenance basically and maybe a shower.

At Lake North Park there was little more -- a little more focus on the fishing. People mentioned fish cleaning station would be nice, perhaps some more stocking of Lake North, fish stocking, and maybe some more fish structure, you know, sunk to the bottom of the lake for fish habitat. And also, again, restrooms and showers. That was kind of common.

Powerhouse Park, restroom lighting and fish cleaning station was again mentioned there, and, again, several fewer responses. These are the areas -- this area is not as heavily used as some of the others.

And Tailrace Park, again, the restroom and a fish cleaning station.

The trail counts, again, there were three trail counters installed along each of the main trails. They collected from May through October, the length of the study.

And here you can see that trail usage was highest in May. Pretty consistent June through August, and then it fell off in the fall. Blue is Two Lakes Trail. That's the trail that runs along the north side of Lake Babcock. It sees the most traffic by far as you can see.

And average daily trail counts, again, through the work week, fairly consistent through the work week. As you would expect, an increase during the weekend. Two Lakes Trail, right around, you know, 60, up around 80 on the weekend, 90, and the other two trails represented there with a little less use.

And then we actually plotted it by the time of day as well, when are people out. Again, picks up in the morning as you would assume, getting higher and higher in the afternoon and the evening, and dropping off at about 8:00 through the night.

We did look at some use estimates looking at how many people are actually visiting using the facilities, and what we came up with was 82,000 recreation user visits on an annual basis, with an average of 720 on the weekend day and 260 on an average weekday, so three times the use on the weekend on average.

During the week, Lake North Park saw the most traffic, the most use. Headworks Park was actually the busiest on the weekends. This is again 2010. Headworks Park was the busiest on the weekends and the holiday weekends.

We then looked at the capacity, capacity at which the current facilities operate. And our findings were generally consistent with kind of the anecdotal information provided in the PAD. And that is that the facilities seem to provide adequate capacity for the demand. There are a few minor exceptions. Of course, that's when holiday weekend when the weather was nice -- this past year that was Memorial Day weekend. 4th of July was raining and we saw use down from probably what was normal. But on Labor Day there was one -- there was one instance where the campers seemed to exceed what was considered the amount of capacity at Lake North.

The other exception occurs when the NOHVA jamborees happen at Headworks Park. The district knows that, and NOHVA knows that, that there is more demand there, capacity. NOHVA actually makes accommodations with adjacent landowners to lease additional lands there to accommodate that additional need. And, again, that's pretty isolated. That happens twice a year, once in the spring and once in the fall.

STEPHANIE WHITE: Slide 74.

QUINN DAMGAARD: So looking at demand and understanding that there is not a real good metric to base area of recreation facilities and lake trail on. The Game and Parks' new score references this NRPA standard, which I believe says that there should be -- let's see, is it -- I want to get this right here. Ten park acres per thousand people, my apologies, and one trail mile per 8,000 people. And this is a metric that's not universally recognized, but it's kind of what's out there. It's something to go by.

So when you take the 2009 census estimate for Platte and Nance counties, and you apply it to what -- using NRPA standards are, that would come up with a need of 360 recreational areas to accommodate Platte and Nancy counties in the 2009 estimate, and four and-a-half trail miles.

Now, the district alone provides these numbers, you know, far in excess of what this standard would require, and that's not including any city parks or anything else that's available here in Columbus or via the wildlife management areas or anything else. So according to this metric, the district far exceeds what would be required of adequate recreation facilities.

And looking ahead, future demand, if you compare the -- you know, the 2000 census to the 2009 estimate -- we don't have our hands on the 2010 stuff yet, but the populations here in Nance and Platte counties have been essentially static, very little increase.

And also the Game and Parks in their latest SCORP, that's a state comprehension outdoor recreations plan, they did a statewide survey with regards to recreation, and what they found was people in Nebraska generally are not recreating outdoors as much as they have in the past, and we all know with technology that that's kind of a hot issue.

So basically what that says is it doesn't look like there is a lot of future demand, a lot more future demand than what we're seeing already.

So that kind of concludes our results on the canal. Moving to the bypass --

LISA RICHARDSON: I was just going to see if there were any questions before we move on to the bypass?

JEFF SCHUCKMAN: I've got a question.

STEPHANIE WHITE: Jeff.

JEFF SCHUCKMAN: That 82,000 annual visits for the Loup Canal, does that include 11,000 some odd fishing trips? Are they included in that 82,000 total?

QUINN DAMGAARD: They are included, Jeff. That would include, yes, anglers, recreators of any type really.

JEFF SCHUCKMAN: Use that 11,000 figure or that other figure that we discussed earlier, or is that my influence, that 82,000?

QUINN DAMGAARD: No, I'm sorry. That was not determined based on the creel outputs, Jeff. That was determined based on the number of people we interviewed, and applying a few formulas with regards to the number of people interviewed versus the number of people observed. We started out -- we determined it by how many people per hour visit the sites, and then we ran it down to the day and to the week and all the way to the year.

So Jeff and I had some conversation before the meeting started, and you'll see I have a few corrected numbers on the creel side here. Jeff's asking if what we discussed before the meeting would influence these numbers, and the answer is no, Jeff, these were derived in a different way.

JEFF SCHUCKMAN: Very good.

QUINN DAMGAARD: And actually these were

derived in two different ways. We first did it the way that I mentioned there. We did an alternate method where we looked at kind of the turnover method that some of our folks on the West Coast have used in other FERC projects, and we came up with a very similar number.

STEPHANIE WHITE: Randy?

RANDY THORESON: I think I'll just keep my comments at the end when you get through all your slides.

LEE EMERY: I have one quick comment. I haven't talked to Janet Hutzel yet, but your slide 65 about structure, we've seen in various projects across the country use Christmas tree bundling, which is very low cost, and various programs, hydropower projects to create fish structure and wildlife. Just a thought.

QUINN DAMGAARD: Thank you, Lee. Ron.

RON ZIOLA: Ron Ziola, Loup Power District. We do do that in a shallower part of the lake down in the southeast corner, we do do the Christmas bundles. However, in the deeper parts of the lakes we have not done that. So we do have one area pretty much dedicated to fishery, keeping the buoys that direct boating and those kind of things, so we do have a portion of the lake that does have tree bundle structures.

STEPHANIE WHITE: It sounds like there may be a question on the phone. Janet, was that you?

JANET HUTZEL: No. I was just commenting that I see it more done in the south than the Midwest, but you could do it.

STEPHANIE WHITE: Any other questions?

QUINN DAMGAARD: All right. So moving on to the bypass reach. And the following results are specific to the folks surveyed along there. We did have -- as opposed to the 1,012 respondents we had along the canal, we had 102 respondents along the bypass reach.

And this number here is wrong, this should be 92. Racial composition along the bypass reach was essentially the same, approximately 90 percent white, nonHispanic and 5 percent Hispanic.

The household income range was the same, most commonly cited was 26 to $50,000, and the age of users was the same as well. The kids were the most common, and the frequency decreased as the age went up.

Residents of users was again along the same, 95 percent Nebraska and 52 percent Columbus.

We did ask for the zip code again, so we were able to derive the specific locale. And, again, a similar figure, the darker the shading, the more concentrated the respondents.

The size of party was the same as it was along the canal. Folks either recreating alone or with a single guest. Two-thirds of the respondents were with a party of that size. 70 percent traveled 25 miles or less, and 90 percent traveled 100 miles or less.

Overnight stays, 22 percent were staying overnight, 63 percent cited RVs. And what was interesting was the people that were staying overnight seemed to stay a little longer, again, along the bypass reach as compared to the canal, with four nights being the most common at 31 percent. The one, two and three night stays were pretty evenly distributed, and once you got over four, it dropped off pretty sharp. People on the canal generally stay two nights most commonly, people on the bypass, four nights.

People actually visit the bypass reach more frequently than the folks we interviewed along the canal. Almost half of them visit it weekly. Again, that can be skewed a little bit by the NOHVA jamborees and the folks coming a couple times of year for that specifically.

And the visitation by month was the same as expected, the summer months of May through August. 60 percent of the visitation happens there.

We'll get into a little bit of specifics on the wildlife management area, and you'll see there that folks tend to come to that area in the fall and in the spring coincident with the hunting seasons here in Nebraska as well as the mushroom hunting that happens in the spring.

Folks were -- along the bypass reach were asked similar questions with regards to their activity participation. And here are the top five of ten options that were asked. People that cited other were either walking or running, that was not one of our options, OHV riding and mushroom hunting. Those are the three real common things under other. So that did make it quite a ways up the list.

And 85 percent of the people we talked to along the bypass reach cited no hindrance to their recreational enjoyment, no interference, nothing of project operation wise was interfering with them.

So by far the vast majority -- those that did cite something requested maybe more signage for the trails. Again, keep in mind we're on the bypass reach and these are not district facilities, so they thought it would be nice to have some signage, but the district doesn't own these facilities or operate them.

The OHV riders were interfering with their enjoyment. One thing that is pertinent to the district was Headworks Park -- part of that park does abut the bypass reach, so we did survey people there along the bypass reach, and they noted showers would be nice, and that's consistent with what we saw with the folks interviewed along the canal there.

Specific to the Loup lands, the wildlife management area, the numbers here, the -- I'm on slide 81, the 77 percent that say they have never visited, this needs to be clarified. 77 percent of the people surveyed along the entire bypass reach, so this is not specific to the Loup lands area. So of the people, the 102 people we talked to, most of them have not visited the Loup lands area. Of those that do, 10 percent say they visit it annually.

And here is the interesting shift in when people visit. Again, the fall and the spring to -- coincident with the State of Nebraska hunting seasons. Deer and turkey I think are probably the most popular ones. And then the morel mushroom hunting that happens in the spring.

Activities that people are performing specific to the Loup lands area, and this area is way on the western side of the project near the Headworks for those of you not familiar.

Again, hunting is No. 1, and that's why people are there in the fall and spring, camping, fishing, wildlife viewing and hanging out.

So that kind of wraps the bypass reach results. I can take questions on that now too if anyone would like.

RANDY THORESON: Randy Thoreson, National Park Service. Lots of information, Quinn, a lot of it, and I've spent quite a bit of time looking through the reports, and I have a few just general comments that I would like to give.

As you know, the National Parks Service has been involved in recreation and relating to this relicensing project, and been involved in various stages of it. And the most recent I think written letter was in relation to the additional study report and interim recreation report, and I have comments on that.

Mainly the comments related to that was related to this study getting more information for drawing conclusions. This report here gets to that.

The three main interests of the National Park Services are the inventory, which you went over, the use and demand, which you have a couple slides on, and also the possible improvements. And I know today -- you know, we're taking this information, talking about it, but all three of those things go through recreation management plan. So I know a lot of those won't be solved or completed today in terms of conclusions and stuff like that, but the report gives a lot of good information. So, thank you, a lot of good information in the report.

As well as the Loup River bypass reach, provide a lot of comments with that requesting that bypass reach could be studied and summarize the recreation report.

When I look at the conclusions, there is really only a couple small paragraphs that I can see on Page 14 where it summarizes use and demand, and also use and demand and --

QUINN DAMGAARD: This is Page 14 of the actual study report?

RANDY THORESON: Right. Use and demand capacity, use estimates, those two things of the paragraph. I would like to probably see a little more analysis summarizing that, but we can get into that in the direct management plan summarizing those conclusions.

Also, I look -- in terms of the facilities improvements that you went over, tables 5.25 to 5.30. I think it provides good information. Rather than just the top three you picked, there is a good history that we can look at recreation management plan. I did not see -- and there is a table in the report, but you don't have in your slide, and it's 5.30 which talks about the power canal and improvements that have been reflected in that. I didn't see that in your slide and it's in the report unless I missed it.

QUINN DAMGAARD: No, we did not include that here. Just focusing on the developed areas. As Randy has mentioned, there is a lot more information in the report that maybe than we're covering here. He did reference the facility inventory. I really just mentioned that we did that. I didn't cover that here in the slides at all. There is a lot of detail in the report with regards to the baseline condition and what's out there now for amenities, but, yeah, Randy, I just -- we left that one out I guess.

RANDY THORESON: My comments are that I was looking for this information to obviously move forward with the recreation management plan, and you provided some good information. I still think we need to marry the information with the sites and look at the sites as they are developed, or as they exist, and possible improvements to the sites.

QUINN DAMGAARD: I think that's entirely our objective and our intent, and that's why we put together those tables that you referenced. Here are the requested things by site, here's what people want specific to different areas.

RANDY THORESON: And I'll be submitting written comments to what I said. What is it, April 11? And obviously I'll be submitting those comments. And I would like the opportunity to provide review and input as you develop the rec management plan, even at the early stages when you develop the outline of the management plan. I obviously would like to be involved in that. You did some good studies.

I guess in summary what I would like to

say is there is a lot of information here that I've looked at, and I still need to draw some conclusions, but what it boils down to is looking at the rec facilities and see if there is any improvements that can be made to them is where I'm coming from here.

QUINN DAMGAARD: Mike and the crew were out a lot this year, 60 some days from May to October, so there was a lot of data gathering, absolutely.

RANDY THORESON: I didn't see any real improvements requested for the trails other than trail counts. Did you have any information on requested improvements for the trails?

QUINN DAMGAARD: You know, nothing comes to mind, Randy, but really we highlighted the real top things that people requested. I would encourage you to put that in your comment form. I could look back under the very specific requests and see if there was anything referenced to trails.

RANDY THORESON: That's basically my comments. Thank you.

QUINN DAMGAARD: Move on now to the creel survey.

Last September when you all were here for the first study results meeting, I believe that was the first week in September, I was up in Canada fishing and collecting quite a stringer of walleye, so I thought I would make a lot of friends by showing you that. These pictures were actually taken the very day that you guys were here in Columbus. I thought that might be appropriate.

And, by the way, that's quite a bit more than a limit. I was with three other guys so we were perfectly legal, Jeff, and everybody else.

The study for the creel survey was specific to the canal. It did not include the bypass reach, but it did include the whole 35-mile canal, including Lake Babcock and Lake North. It also included area of the Loup River right at the Headworks. If people were there at the Headworks fishing in the river, we did survey them. Also people at Tailrace Park fishing in the Platte River right there adjacent to the park, we did survey them. So that is the area of the survey.

The methodology was produced in cooperation with the Game and Parks. We did have a meeting where we sat down and really hammered out exactly what we needed to do. It resulted in a progressive count bus-route creel survey design.

The schedule was coincident with the general use survey along the canal. It was six weekdays and four weekend days per month from May 1st through October. We only surveyed anglers during the daylight hours. We weren't out in the middle of the night collecting data.

Ultimately the analysis was input into the Game and Parks creel survey software that they provided us. And then the analysis was run and the outputs run through the software. And actually Jeff ran an error check on our data and our input, so we think we got some pretty good data.

Demographics of the creel survey, again, very consistent with the same folks we saw in the canal involved in other recreation. 88 percent white, nonHispanic, 12 percent Hispanic with really no other groups represented.

The same annual income that we've seen, and, of course, the folks fishing were 99.6 percent from Nebraska, so almost entirely -- I think there were three -- we surveyed 439 people for the creel survey, and there were three of them that were from out of state. I believe one was from Georgia and two were from Oklahoma, or maybe it was two Oklahoma and one Georgia, but those were the other states represented.

The Game and Parks survey form asks what county you reside in, it doesn't ask what zip code, so our data is a little different there. So we know that 59 percent were from Platte County. We don't necessarily get down to Columbus.

And then again the miles traveled, two-thirds were within 25 miles and 96 percent were within a hundred miles.

Here's the same similar map. Again, this goes to the county level instead of zip code, and the darker colors are more concentrated anglers that we surveyed.

So, again, 439 surveys were conducted. This slide is where Jeff has some corrections for me I think. The mean party size was 1.75, how many folks are you fishing with on average, it was just under two people.

The mean completed trip length is accurate at 2.9 hours. Generally people are fishing for almost three hours at a trip.

This number is wrong. There should be a three in front of here. It's about 32,000 total angler hours. Jeff corrected me on that this morning.

And total angler days we're probably going to maybe amend the report to make that total angler trips. So basically we take this 32,000 number and divide it by the mean trip length, and we come up with a number just shy of 11,000. So an estimate of 11,000 angler trips is what we'll end up with in the report. And, again, those two bottom numbers are going to be wrong in the report you have now. We'll get those corrected.

We asked people what are you fishing for, what are you targeting. Nearly two-thirds are after channel catfish, and that was far and away the most popular species that people were fishing for.

The second most popular thing that people said, well, we're just fishing for anything that will bite the line. They weren't targeting anything specific. They were, you know, probably out with their kids trying to get a fish on the end of the line. And then the walleye, sauger, the drum, flathead catfish and crappie kind of rounded out the top six.

Fishing pressure, that is derived by angler hours, and here's the number that should be up in the 32,000 -- no, excuse me, this is by month. So September received the most fishing pressure at

7,700 hours, fall, and by May, July, June and August and October -- I think we expect to see probably June moved up here ahead of July during a normal year. If you'll recall, and you heard this all before, but June was very wet around here so people probably weren't out as frequently as they would have been in June.

95 percent of the effort occurs via shore fishing along the canal. Boat access is pretty limited once you get outside of Lake North, so those numbers are not all that surprising.

Catch, release and harvest estimates, I'll define that real quick. A catch is you get a fish on your line and you bring it in and you've got a catch, end of story. A release is you bring the fish in, you take him off and you put him back. And a harvest is you bring the fish in, throw him in your live well and eat him for dinner later on.

So the total estimate derived from the Game and Parks output is 20,800 fish along the canal. The release estimate, 11,800, and the harvest estimate, 9,000. So what you can see there people are releasing fish more than they are harvesting fish, so that's a good sign for the viability of the fishery.

The greatest catch values were in May. People were having the most success in May, but the most fish were harvested in October. Actually May I think accounted for more than twice the catch than any other month. I think at like 29 percent of the catch happened in May. So that was by far the most productive. But people were -- apparently were the hungriest in October. They saw the days getting shorter and colder so they started keeping more fish in October.

So specific to catch estimates, again, just bring the fish in, we said 20,800, and breaking it out by species, channel catfish was almost half of the total catch, so people catch that the most. Drum and crappie were two and three. Flathead catfish and walleye were not necessarily four and five. I think they were a ways down the list, but they are a kind of notable species so I put them up there.

Fish release, again, the 11,800 number, most of the fish being released are channel catfish, they are the most being caught and released. Crappie and drum are again two and three, and then, again, the flathead and the walleye/sauger were not necessarily four and five, but, again, notable. And the same numbers for fish harvest, what are people taking home, channel catfish, drum and crappie, one, two and three again.

Because people are targeting the channel catfish the most and they are catching that the most, we ran a few analysis specific to that species. Here is the harvest estimate by months specific to channel catfish. In May and June around 400 fish were harvested as an estimate. July through September about 700 fish were harvested, channel catfish. And as you can see in October, like I said, people must have been hungry in October, because they took a lot more fish home in October.

CPU is the catch per unit effort. Basically how many fish are you catching per your hour of angling effort. The overall rate was three-tenths of a fish per hour. That's the harvest rate, not the catch rate. And the highest catch rates were in May. As we said, people had pretty good success in May at 1.3 fish per angler hour. And October was second at .86 fish per angler hour.

The highest estimated harvest rate like we said was in October, and that's when the most fish were taken at about six-tenths of a fish per angler hour.

We did ask folks about their satisfaction with the fishing opportunities and the amenities for fishing. It was not specifically asked in coordination with the creel survey, but it was asked in regards to the general use survey that we did along the canal.

From that data we were able to extrapolate -- let's only get the dataset from people that were fishing. So from that dataset, 57 percent of those folks that were fishing said that the amenities, the opportunities for fishing were above average or excellent. Only 4 percent rated it below average or poor. Those folks that did indicate lower ratings, they mentioned a lot of snags, maybe it's riprap, whatever that is.

They talk about steep banks along the canal being hard to access in locations, some overgrown vegetation. So access things along the canal. And some people again requested some more submerged structure in Lake North like we mentioned before.

So basically wrapping the results, our steps going forward as Randy kind of mentioned already is development of the recreation management plan, taking this data that we collected, finding out what's important to people, what they would like to see improved and try to get a plan on how the district can accommodate those things going forward.

So if there is any more questions, I'll field those.

JANET HUTZEL: This is Janet Hutzel from FERC. I do have a couple of questions. One was kind of a clarification.

I think like one of -- two of your tables, 5.5-7, it says white twice. Was that supposed to be white and Hispanic?

QUINN DAMGAARD: 5.5-7?

JANET HUTZEL: Table 57. It's in part of your actual recreation report.

QUINN DAMGAARD: Table 57?

JANET HUTZEL: You have listed percentage of racial composition of survey respondents, 90 percent white, second column was 9.5 percent white. I assume that's supposed to be Hispanic?

QUINN DAMGAARD: Yeah, the first one is white, nonHispanic, the second line is white, Hispanic. That's consistent with how the census bureau breaks out those ethnic demographics.

JANET HUTZEL: And the second question had to do with your capacity. I know in your report in 5.62 you gave a general overstatement as to most people were okay with the survey, most people who were surveyed were okay with the future capacity, and you had listed that they have exceeded the capacity. But specifically when FERC sees reports, we like to have a table or some sort of documentation as to each one of your facilities at what capacity they are at. Sort of like what you do for your Form 80s.

QUINN DAMGAARD: Okay. Yeah, Janet, and we do have that information. We did run that by site. We can certainly provide that in the rec management plan if you would like to see it there.

JANET HUTZEL: Yeah, that's very important, because that helps us determine if an improvement is needed or not.

QUINN DAMGAARD: Sure. Absolutely. Yeah. And we do have that data. We can certainly provide that.

JANET HUTZEL: That would be very helpful.

RANDY THORESON: Randy Thoreson, National Park Service. I agree with that. I think that would be very helpful, like I said, to run analysis on site-by-site basis. Janet brings up a good point.

LEE EMERY: I have one question not related directly to this study.

How much ice fishing occurs, if any?

QUINN DAMGAARD: Ron, can you?

RON ZIOLA: What was that question?

LEE EMERY: Ice fishing.

RON ZIOLA: Ice fishing is totally dependent again around here on the weather in as much as the last couple of winters we've had extended cold spells that allowed a reasonable amount of ice, four to 12, 14 inches. The prior probably eight winters before that we never had cold spells long enough. So the last couple of winters on Lake North, you know, we see a rather nice array of ice fishing. Maybe on a weekend, 15 to 25 or 30 people.

In some respects we actually -- when I say discourage it only from the fact that we cycle that water underneath the ice, so we don't tell people to get off. We caution them about getting on. And I'm sure there is a lot of long time ice fisherman that are aware of that, and so they kind of limit the amount of ice fishing they do. But one of our biggest concerns is that small lake where the ice fishing occurs, which is Lake North, it's around maybe close to 200 surface acres, and with that water fluctuating upwards of a foot, foot and-a-half, you know, like I say, we don't keep them off, we indicate that there is issues, so it's all a seasonal thing. When the ice is there, it appears we have a fair amount of ice fishing, like I say, 25 to 30 people a day on a weekend, but that's kind of the --

LEE EMERY: I'm from Michigan originally. Do they do any trapping for muskrats around here as well?

RON ZIOLA: Again, because of the -- you know, in all honestly, it's somewhat of a tight system, and with dogs and cats and the amount of people that kind of wander around the trails now and stuff, we do occasionally have some trapping. We limit that to maybe a particular individual that we feel very secure with that he monitors things properly. So I'm not saying it doesn't go on. Those that ask, we are very particular where they do it or how they do it, because of, again, the smallness of the actual project in total acres, and we have to be careful, you know, we don't run into some domestic animal issues.

STEPHANIE WHITE: I have a question back here. Would you state your name?

JASON BUSS: My name is Jason Buss. I'm the president of Columbus Area Recreational Trails. I just wanted to make a general comment similar to Randy's. We're looking forward to the recreation management plan. We've really enjoyed a great collaborative relationship with Loup, with the trail projects. It's very gratifying to see the appreciation shown in the survey results from the people who are using those trails. They appreciate the quality trail system there, and we look forward to that recreation plan and offer any help we can with that.

STEPHANIE WHITE: Other questions or comments?

Is there someone -- something on the phone?

JANET HUTZEL: This is Janet Hutzel again from FERC. I had one question concerning the showers. Were they requested because of the swimming, or was there a certain reason as to why showers are being requested frequently?

QUINN DAMGAARD: Well, I think, Janet, one place that was common was down at the Headworks, and

I think that was probably commonly requested by the OHV folks, and they stay for a few days, and that was common there. I don't think it's necessarily for swimming per se. And, you know, camping is pretty open at most of the areas along the canal, so I think it was more general just for people camping and staying overnight. I don't think it was specific to swimming.

And also if I could go back to your question about capacity, Janet, I did remember in Section 5.2 where we do the recreation facility inventory, we do list the capacity with regards to campsites, so on and so forth, specific to each recreation site. So there is a little bit of information in there with regards to that.

JANET HUTZEL: What section was that?

QUINN DAMGAARD: I think it's -- yeah, it's 5.2, the facility inventory. We break out, you know, the camping capacity by site.

JANET HUTZEL: Right. I guess what I'm -- I see there is like a count table; is that it?

LISA RICHARDSON: Yeah.

QUINN DAMGAARD: Yes.

JANET HUTZEL: I see there is a count. I'm more interested in whether it's a percentage, whether it's 50 percent being used. I notice in your initial study plan you had mentioned certain capacities like 70 percent usage and other percentage usage, and so that's sort of what I'm looking for. I'm looking for percent usage so we can see at capacity, under capacity, above capacity. Just like the Form 80s require 100 percent, or in the case if it's more based on observation or counting or anything of that nature. It would need that for each one of the sites here.

QUINN DAMGAARD: Okay. And the only time in 2010 when we did see more use in capacity was on Memorial Day weekend at Lake North, and during the fall, the NOHVA jamboree at the Headworks. Those were the only two occurrences during 2010. And based on the anecdotal things that the district staff provided us, that's generally when it happens.

JANET HUTZEL: I mean, yeah, if you don't have -- that's good. I mean, if you don't have the specifics for individuals, you can just put in your Form 80 that you did in 2009. For some reason I can't pull it up on the web. I guess our e-library doesn't have it online yet, but that's the sort of information we're looking for.

QUINN DAMGAARD: Okay.

STEPHANIE WHITE: Anything else for Quinn?

Okay. We're running ahead of schedule, which is a good thing. We have a half an hour at least until lunch is served. I would like to keep moving if everybody is okay with that. All right. Let's go. Let's do the next study. So we're going to jump to the 1:00 item on your agenda. This is methodology discussion. We'll probably just scratch the surface of it, but I think we'll just take advantage of these next 30 minutes.

PAT ENGELBERT: I'm guessing since everybody's been sitting in this room for an hour and-a-half or so or two hours that might be a little jittery needing to go to the bathroom, I will try and talk as fast as I can. Feel free to get up and vacate as you need to stretch your legs, use the restroom. Especially when I'm talking you'll find it's better to probably leave the room.

Anyway, a couple things that I wanted to cover prior to getting into our actual studies is we had to conduct quite a few analyses that were consistent between the studies. And instead of revisiting them during the actual study portion of the talk, we decided to pull them out front and kind of go through some of the -- what we call the preliminary analysis.

And what those -- what those analyses and efforts were was first was a data collection effort that we conducted. We also, per FERC's recommendation, we evaluated some things for wet, dry and normal flow conditions, so I'll describe that analysis.

Because we were evaluating things at sites that didn't have gages, we had to develop hydrographs at those, so I'll go through how we develop the synthetic hydrographs at those locations.

We also had to develop a hydraulic model at a few sites, and so I'll go through that development. And then we also needed to evaluate some hydrologic statistics for our studies as well as the ice study which Roger Kay from the Corps will be presenting later this afternoon. And so I'll go over very quickly how we developed some of those hydrologic statistics. That being flow duration and flood flow frequency, and the conditions under which we evaluated those.

It may be a little bit difficult to see in the back, but I wanted to go over the study sites that are consistent between the studies that we performed, that being hydrocycling, flow depletion and sedimentation.

Here's a map of the overall system. Per FERC's study plan determination letter, we needed to develop a analysis at a site upstream of the diversion structure. And so what we did is we met with the US Fish and Wildlife Service, the Nebraska Game and Parks, I believe it was January of last year in Lincoln, and we coordinated with them in identifying where the sites were to be located.

So the first site that we chose, which we will effectively call ungaged site one going from upstream to downstream is located just upstream of the diversion structure.

Throughout the course of the presentation, the rest of this presentation this morning as well as this afternoon, tomorrow morning we'll be referring to the sites as sites one, two, three, four and five, and I would like to continue showing where those are.

Ungaged site two is located just downstream of the diversion structure. Ungaged site three is located in the area between the Loup Platte confluence and the tailrace return, so it's the location upstream of the tailrace, but downstream of the Loup Platte confluence. That is ungaged site three.

Ungaged site four is located just downstream of the tailrace return, and then we had an ungaged site five which is located approximately a mile or a mile and-a-half downstream of the North Bend gage.

So, again, sites one through five go from upstream to downstream. Site one is upstream of the diversion, site two is downstream of the diversion on the Loup, site three is on the Platte downstream of the confluence and upstream of the tailrace, site four is downstream of the tailrace on the Platte, and site five is downstream of North Bend.

In order to develop some of the hydraulic models, we had to do a data collection effort. It was prescribed to us in the study plan determination when we would do that data collection effort. These were -- data was collected at all five of the ungaged sites. We got bathymetric and water surface elevations there. The dates were to be considered pre and post nesting season, which basically means around the May 1st area for the prenesting season, and mid to late August time frame for the post nesting season.

We were unable to get velocity measurements due to the high water that occurred this past year, and we covered that in some length at the September 9th study, so I won't go into that again.

Here is a table that shows the dates in which we collected the data at each of the sites, and it's -- I believe it's presented in the report. I think maybe what is a better illustration of when the data was collected are a couple of hydrographs that were developed. As you can see from this graphic, there was a large event that moved through the system from mid June of last year, lasting until approximately the 4th of July weekend. We were fortunate enough to get surveys -- now this is the Loup River. We were able to get surveys at sites one and two prior to the event, and we were able to get surveys at both sites one and two after the event on the Loup River.

STEPHANIE WHITE: So Pat is on slide 105.

PAT ENGELBERT: This next slide, slide 106, shows a hydrograph of the Platte River. Again, you can see the large event that moved through the system in the early June to early July time frame.

We were able to get a survey of site

three, that's the location just upstream of the tailrace prior to the event moving through, but we were unable to get sites four and five prior to that event moving through.

We were able to get a couple of different times at sites four and five after the event moved through, and site three we got -- we were able to get a survey about six weeks after the event moved through, and then at sites three, four and five it was roughly, you know, eight to ten weeks after the event moved through.

It's going to be important to remember those dates as I go further into this presentation and describe the relationship between the cross sections relative to the time in which the data were collected. So recall that we weren't able on sites one, two and three to get cross section surveys prior to the event moving through post spring runoff, but prior to this summer storm, and then the remainder of the cross section information was obtained after the event moved through. Some in close proximity to the event, and some, you know, four to six to eight to ten weeks after that large event moved through. I'll go into greater detail as I continue with my presentation.

And I know this is again very difficult to see in the back, but we wanted to provide an example of the cross section layout that we incorporated. Again, this was done in coordination with the Fish and Wildlife Service and the Games and Parks last spring.

This is an example of the cross section data that was collected at sites three upstream of the tailrace. Here's the tailrace, I'm on slide 107. And the data that was collected downstream of the tailrace, which is site four. Just for landmarks, here's the Tailrace Canal, here's the Burlington Northern bridge.

The spacing that was used and the locations again were selected in coordination with the service and the Game and Parks. Just to zoom in a little bit, I'm going to look specifically at ungaged site three, which is upstream of the tailrace on slide 108. We spaced our cross section surveys so that they would be within a quarter to a third of the overall channel width. At this particular location I want to say that the channel width is roughly 6 to 800 feet wide, so the spacing of the surveys would be approximately 200 feet between each of the cross sections.

We did get an additional cross section approximately one channel width downstream to provide us with some boundary conditions for our hydraulic model development.

LEE EMERY: Isn't there one upstream too? I thought the previous picture showed a site upstream.

PAT ENGELBERT: I'll go back one slide. This was site three.

LEE EMERY: What's that blue line that went across?

PAT ENGELBERT: We wanted to get an intermediate cross section between the tailrace return and the Burlington Northern bridge. And we used that -- when we develop a hydraulic model, we actually developed the model so that sites three and four were within the same models so we could evaluate and see if there were any tailwater effects associated with that.

Any questions on the locations that were surveyed or data was collected, or the cross sectional spacing, anything like that, the timing that the survey was taken?

Okay. Now I'm going to go through the cross sections or representative examples of the cross sections that were taken. I'm on slide 109. This is a photo that was taken at ungaged site one. You can see there is a sandbar feature in the middle of the channel with water flowing on either side. That's represented in the cross section here by this red line. The red line on slide 110 is the survey that was taken in October. You can see there is a large sandbar feature. The red dashed line that moves across was the water surface elevation on the date in which the surveys were obtained.

So a couple things to note -- and you'll see that it's pretty consistent within these cross sections that were surveyed. The blue diamonds or squares are the cross section that was taken in June. So at site one it was just prior to the event moving through, post spring runoff after the event moving through. The other cross section was taken in October. You can see that there was -- between those two surveys, there was a redistribution of the sand materials in the system. Low flow channels that existed in June were shifted to other parts of the channel in October. Very characteristic of a braided system. It's not to suggest that some of these sandbar features left the area, they just translate themselves downstream, thus the nature of a braided system.

Here's an example of a cross section in site two. This is located just downstream of the diversion structure. The blue line is the survey that was taken in April. Again, that occurred post spring runoff, a little bit higher flows on the hydrograph. The red line was taken in August. These were within, oh, probably two to three weeks of that large event that moved through the system. And the green line was the cross section that was taken in September.

Now, it's important to note that the red line and the blue line, those that were taken post spring runoff and post high event have some similar traits. You see a deeper channel forming for those surveys post spring runoff, but then what you see after a sustained period of more normal flows is a redistribution of the sediments in the system and kind of a leveling off of the channel.

Similarly, at site three, this is upstream of the tailrace, in May post event, post -- or post spring runoff, prehigh event, we again see kind of a deeper channel that has formed.

As we go to August, which is post runoff event, we see that deeper channel has maintained.

But as we move to September, going six to eight weeks past that high event where you have more normal flows, we again see kind of the redistribution of the sediments and some smaller low flow channels occurring. As opposed to one consolidated channel, you see several low flow channels as that channel begins to level off.

Okay. Similarly at site four. These were surveys that were taken in June is the blue, red is September. I'm on slide 113. We see essentially the same phenomenon occurring, kind of a leveling off of the channel as you get further away from the higher low flow events.

And here we are at cross section five. This is down at North Bend. The blue again is in July. This particular one was taken after -- just after the event where we had a deepening of the channel, maybe more concentrated flow in those deeper sections. And then as you move out to September, again, which is four to six, eight weeks after that large event when you've had sustained typical flows, you see kind of a redistribution of the sediments, you know, more fingers developing and a leveling off of the cross section.

Okay. Based on all of the cross sections that we took, there were between nine and ten cross sections per study site. We evaluated how the flow area changed per site. And that was done by putting a lid on top of the channel at the high banks. So, for example, here we would have -- back on slide 114, we would have put a lid on the channel at the lowest channel station and evaluated the area below that lid and compared them between survey dates.

So moving to the table on slide 115 at site one, between June and October, we saw approximately a 4 percent reduction in flow area between June and October. Remember, in June you had kind of that deeper channel, in October you kind of had that leveled off channel. So we saw a reduction between the surveys that were taken in June and October, approximately 140 square feet, which is roughly 4 percent reduction in flow area.

At site two it looked between April and September, the first and last surveys that we took, there was essentially no change, three square foot. If any of you have been on the Loup, if you step on it and sink in you probably just displaced about three square foot, but essentially no change.

However, if you look at the intermediate surveys between April and August, we saw an increase in flow area of approximately 235 square feet or 8 percent of the flow area.

Moving between August and September, we saw a reduction in flow area of approximately 7 percent. So between April and September we saw essentially no change in flow area. When you break it down between April and August and August to September, you saw a shift. You saw an increase in flow area between April and August, and then it had adjusted itself back between August and September after those long sustained flows.

At site three, between May and September, we saw reduction of approximately 6 percent in flow area. And similar to what we saw at site two, from May to August, we had a slight reduction, approximately 1 percent, and between August and September, we had a reduction of approximately just over 4 percent.

Moving on to site four, again, we see approximately a 4 percent reduction in flow area between June and September, and at site five we saw a 3 percent reduction in flow area between July and September.

Okay. So any questions on that?

What's interesting to note is it's fairly consistent regardless of location on the rivers. At site one we saw reduction in flow area upstream of the diversion, at site two just downstream of the diversion it essentially stayed neutral. Upstream of the tailrace return we saw a 6 percent reduction in flow area. Downstream of the tailrace we saw a 4 percent reduction in flow area. And down near North Bend, a 3 percent reduction in flow area.

Between those two times that were surveyed -- what I would like to note is that although this shows a reduction in flow rate between the two times that are surveyed, if you look at the specific gage reportings that are documented in a USGS report from the late 1800s to approximately 1999, it has shown that the gaged locations on both systems is essentially stable. It's neither upgrading nor degrading, it's essentially stable.

These are the results at our ungaged sites taken at two points in time, one point in the spring, I guess you could call June spring, maybe early summer, because of the high flows, and another point in September, that fall -- late summer, early fall time frame.

So any questions on the data that were collected, the locations of the cross sections, the characteristics that we saw between surveys, the timing of the surveys, and kind of the percent area reduction on average that we saw between the study sites? Any questions? Everybody is really hungry or has to go to the bathroom very badly.

LEE EMERY: Paul, are you on line?

PAUL MAKOWSKI: I am.

LEE EMERY: Okay. Thanks.

STEPHANIE WHITE: Pat, I was thinking maybe slide 18 would be a good stopping point; does that feel right to you?

LEE EMERY: One eighteen?

STEPHANIE WHITE: One eighteen.

PAT ENGELBERT: That would be fine.

STEPHANIE WHITE: Three more slides.

PAT ENGELBERT: The next analysis that we conducted, again, which is consistent between the studies, is to establish a flow classification for the water years -- or the study periods that were evaluated. And it was -- we incorporated methodology that was developed by the US Fish and Wildlife Service to where for whatever study period you're evaluating, you rank the flows -- or the mean annual flow or mean annual volume, or if you're looking at a month, you would just look at the month. But in our particular case we were identifying years, so we looked at the mean annual flow for each year in which we were evaluating, and you rank them from highest to lowest.

And so the top third, the top 33 percent of those flows are designated or classified as being a wet flow year. The bottom 25 percent of those flows are classified as a dry year. The middle, what's left, and if anyone can do the arithmetic really quick to tell me the fraction that that is, you get a candy bar after lunch. But that middle portion is considered a normal flow year. Anybody have it except those that worked on the study?

NEAL SUESS: It would be 42.

PAT ENGELBERT: The fraction, what's the fraction of that?

NEAL SUESS: Forty-two divided by a hundred.

PAT ENGELBERT: Which is roughly five-twelfths. So --

LISA RICHARDSON: No candy bars.

PAT ENGELBERT: No candy bars for Neal.

We evaluated the flow classifications for the period in which we analyzed them, and we verified that there was a wet year, a dry year and a normal year between years 2003 and 2009.

And why that was important is the gage that monitors the return flows from Comos Hydro was installed in 2003. So fortunately for the study we were able to evaluate a wet year, a dry year and a normal year between 2003 and 2009, which allowed us to use that realtime gage data that was available at the 8th Street gage which monitors or gages the return flows.

Here's a quick table that shows for both the Loup and the Platte what years were considered wet, dry, normal. I know it's very difficult to see, so we created a summary slide.

On the Platte River, 2006 was classified as a dry year, 2008 was classified as a wet year, and 2009 was classified as a normal year.

On the Loup, 2005 was classified as a normal year, and consistent with the Platte on 2006 and 2008, 2006 was a dry year and 2008 was a wet year.

Okay. So when we're talking about wet, dry and normal on those two systems, these are the water years that they are -- or not -- the calendar years that they are tied to.

Any questions on that? Any questions?

Anybody?

That's all that I'm going to present at this point on the upfront analysis. After lunch I will go through our synthetic hydrograph development, our hydraulic model development, and then some of the hydrologic statistics that we evaluated. So any questions? If not, we'll turn folks loose.

(11:56 a.m. - 1:00 p.m. lunch recess taken.)

STEPHANIE WHITE: We have a full afternoon of material. We have a request for a break this afternoon, so if you're really good, maybe 3:00. You can look for a break at about 3. Everybody's present on the phone. I think we're ready to go.

PAT ENGELBERT: Just a quick recap from the preliminary stuff that I did this morning.

Again, we collected data at the five ungaged sites, and not to get confusing, we numbered them one through five, upstream to downstream, so we'll be referring to those sites as we go through the analyses this afternoon, so hopefully you remember.

Finally, we ended up with the flow classification. And I just wanted to reiterate that on the Platte River, 2006 was classified as a dry year, 2008 a wet year, and 2009 a normal year. On the Loup, 2005 was normal, 2006 and 2008 were dry and wet respectively.

Next I would like to talk about our synthetic hydrograph development. We needed to develop hydrographs at the ungaged sites to help us, you know, perform analyses for the current operations, but we also needed to develop hydrographs for the alternative conditions that we evaluated at both the gaged and ungaged sites.

We used real time data, real time being, you know, the 15 minute to 30 minute to 60 minute data that is collected by the USGS.

Based on the gaged locations that we had, we calculated reach gains and losses, the amount of flow that is lost between the gages, and applied those to our hydrographs. And before we combined them at an ungaged site, we would adjust them for travel time.

Just to reiterate a little bit, the two conditions that we did evaluate for alternative conditions was one is a run-of-river condition. Now, that is run-of-river in the power sense, meaning they are not regulating or storing the flow in order to hydrocycle. They are running the flow through the turbines without regulating the water. That's what we call the run-of-river condition.

The other condition that we evaluated was the no diversion condition, meaning they didn't divert any water off the Loup up at the diversion structure, it all went down the bypass reach.

Here's an example, and I know the graphics are tough to see, and I know they are tough to see in the handouts, but what we plotted here was -- as far as our calibration of the synthetic hydrographs went, we generated synthetic hydrographs to test our approach at the Loup at Columbus and the Platte at North Bend. So we could compare our synthetic hydrographs using our methodology to the actual gaged hydrograph.

This particular hydrograph is the Loup River at Columbus, and this is slide 120 for those of you on the phone. The blue line, which is behind the red line and the green line, was the hydrograph that was developed based on our methodology using reach gains and losses and adjusting for travel time. The green line is the flow at Columbus, the Loup River flow at Columbus based on a regression relationship developed by the US Fish and Wildlife

Service from flows at Genoa.

So the Genoa gage has been in operation since the '40s to present. The Loup at Columbus gage was in operation from the '40s until 1978. However, the DNR just reinstalled it in 2008, but between '78 and 2008, the Fish and Wildlife Service wanted to estimate what the flows would be at Columbus based on a flow at Genoa. So we took that regression equation and ran it for the flows at Columbus.

In addition, we evaluated against the actual gaged data at Columbus. And as you can see, visually we had a pretty good fit. The timing looks really good, the peaks, we typically estimated higher peaks than what they were measuring from the DNR gage. You can see that in these locations.

We did provide or run a statistical relationship called the Nash-Sutcliffe coefficient, which evaluates measure versus predictive, and we had very favorable results at this location.

Here's a shot of the Platte River at North Bend. Again, the blue is our synthetic hydrograph that we developed compared to the red hydrograph which was actually measured at North Bend. And, again, we had a very good fit on both the timing and the magnitude, so we were very comfortable with our approach and felt, you know, through this validation process that we had done a good job of approximating what these synthetic hydrographs would look like.

Here's an example of what our synthetic hydrographs look like, and I know you're all looking at a blank screen, but we threw a little animation in on this one because it gets pretty clustered.

I'm on slide 122. The -- this dashed -- or this dotted line is the minimum flow at site four. This is downstream of the tailrace. This is our synthetic hydrograph of the minimum flow at site four.

This solid blue line is the mean discharge at site four, and this dashed blue line that just came in is the maximum.

So this is an illustration of the synthetic hydrographs that we developed using the real time data, which gave us the min, the mean and the max for any given day.

Similarly, we incorporated the run-of-river synthetic hydrograph right on top of it for comparison purposes. The yellow dotted line is the minimum run-of-river condition, the solid yellow line is the mean flow for the run-of-river condition, and the bigger dashed yellow line is the max flow run-of-river condition.

Now, this is an example of the synthetic hydrographs that we developed. This particular one is at site four. I will go into more detail as to some of the characteristics and the trends that we saw comparing current operations to run-of-river. I'll be doing that tomorrow morning during the hydrocycling study. But I just wanted to provide you an example of the types of synthetic hydrographs that we developed to evaluate the different conditions.

Any questions on synthetic hydrographs or the synthetic hydrograph development?

I'm just going to briefly go through how we developed our HEC-RAS model. HEC-RAS stands for Hydraulic Engineering Center, River Analysis System, which is a model developed by the United States Army Corps of Engineers.

We used the steady-state component of that, which provides us with steady-state water surface profiles. Some of the outputs are cross sectionally averaged hydraulic conditions, that being depth, velocity and wetted width.

We built the geometry files for this model based on the cross section surveys that we collected. We calibrated the model based on measured water surface elevations that were collected. Remember, they were collected at two different times. One time in the mid summer timeframe to the late summer, early fall timeframe. So we calibrated them for both timeframes. So we had two separate models, one for the first survey date and one for the second survey date. For those areas where we had three surveys, we calibrated it for all three dates.

The Corps of Engineers, the Omaha District Corps of Engineers, and Roger Kay will be speaking on this later. They developed a model of the -- a little grosser model of the Loup River bypass reach. Remember, our cross section spacings for our little study sites were about 200 feet apart, and the length of the model was roughly three times the channel width, so maybe 1,500 to 2,000 feet.

Roger and his guys pulled together a model of the entire Loup bypass reach, but it was a little grosser scale. They had cross sections roughly every 1,500 feet, something like that, Roger.

So what we did for our models is we worked in collaboration with Roger and his guys to make sure that we had consistent end values, consistent slopes, you know, consistent and effective flow areas, that type of thing. So we worked in collaboration with them. And actually we dumped our little smaller site reach right into their model for boundary conditions. So we had very good agreement in the parameters that we had assigned to our model to be consistent with their model.

Here is an example of site two as to how we calibrated the model. I know it's difficult to see, I'm on slide 124, but the blue lines are the water surface -- the computed water surface elevations from the model, and they represent the maximum flow for the day in which the survey was taken, the mean flow for the day in which the survey was taken, and the minimum flow for the day in which the survey was taken at each of those cross sections.

The red diamonds represent the observed water surface elevations. And the fact that we were able to bracket the observed for the max, min and mean for that particular day told us that we had a good calibrated model. We were matching what the water surface elevation that was observed on that day.

Any questions on that? Any questions on how we calibrated it to observe water surface elevations?

Okay. I'll go ahead and continue on. One of the things that we noted, and it kind of goes right along with what I described earlier this morning relative to the difference in cross sections. Here's an example of a cross section at site three. This is on slide 125. The difference between the cross section taken in June, which is this magenta color, versus the cross section that was taken in September, which are the dark boxes, just the time in which the survey was taken has a -- is directly related to the shape of the channel geometry.

Remember, just after the spring runoff or just after that high flow event, we saw little -- you know, deeper, little bit more confined channels, to whereas later in the year we saw kind of the redistribution in the leveling off. That also has an effect on the stage that is observed.

For this particular cross section, for the exact same discharge, and in this case it was around 3,400 CFS, the water surface elevation is approximately a half a foot higher for the September cross sections than for the May cross sections. So just something to note how you have continual change in those channel cross sections. So taking cross sections at two points in time and running the same discharge over shows that there is -- there was a slight increase in the stage.

Similarly, at site four we saw a very same -- very same phenomena that had occurred.

Any questions on the hydraulic model development parameters that were used, calibration effort that was done?

PAUL MAKOWSKI: I'm just looking at slide 125. Is the overall width, did that change between the two surveys? Did I interpret that correctly? The water surface, the width a little bit greater in September versus --

PAT ENGELBERT: You know, Paul, it looks like we may have shifted that one. It looks like the left bank for May is left of the left bank for September, but similarly it's a similar shift from the right bank. I can check into that. I don't believe there was a shift. I think we may have just plotted it slightly differently.

PAUL MAKOWSKI: Well, it looks to me that the later survey is greater both on the left bank and the right bank. It just doesn't look like -- it may be a scaling issue.

PAT ENGELBERT: I'm sorry, no, I see what you're saying. The magenta is inside both sides on the black. I apologize. I looked at that different. It looks like it could have shifted a little bit, yes.

PAUL MAKOWSKI: Because that's kind of important when you start comparing cross sectional areas below your top.

PAT ENGELBERT: Yes. Paul, I don't know if you were in before lunch, but we went through our calculations as to how the flow areas changed between cross sectional surveys.

PAUL MAKOWSKI: I was there, but I'm saying if you basically -- if you had it top -- I mean, you're going to gain some area, that's certainly going to have an effect if there is any type of scaling issue or what have you. If this is a true widening, that's fine, but I would be interested if this is an actual widening or not.

PAT ENGELBERT: Okay. Any other questions on the model or the model development?

Lastly, we evaluated -- we performed some hydrological statistical analysis on both the gaged sites and the ungaged sites. At the gaged sites we used the actual gage data, at the ungaged sites we used synthetic hydrographs. What we wanted to pull out of that were some different statistical parameters. In particular, development of a flow duration curve to get median discharges for different flow years. We also wanted to look at flood flow frequencies, return periods associated with flows.

A couple -- one of the packages we used was HEC-SSP, the statistical software package developed by the Corps which runs hydrological statistical analysis. That gave us the flood flow frequency, two year return flow, five year return, a hundred year return.

A lot of that data was used by Roger for his ice study, but we had incorporated some of it in our study as well.

The median discharge and the 25 percent exceedance discharge and the 75 percent exceedance discharge, we used just a standard spreadsheet for that in order to develop what those discharges are, and I will go over that in -- on this very next slide.

One of the things that we wanted to do in evaluating a wet year or dry year and a normal year is we wanted a range of flows within that wet year, within that dry year, within that normal year. So we evaluated -- and I'm on slide 128 now.

We evaluated the 50 percent flow, which means you rank all the flows. The 50 percent flow means that 50 percent of the flows are higher than it, 50 percent flows are lower than it. It's also defined as the median discharge.

The second flow that we evaluated was the 25 percent exceedance discharge. And that means that 25 percent of the flows on average are higher than that discharge, 75 percent of the flows are lower than that discharge.

Similarly, we looked at the 75 percent exceedance discharge, which means 75 percent of the flows are higher than that, 25 percent of the flows are lower than that.

And what that gave us was, for example, for a normal year, looking at the 25, 50 and 75 percent exceedance discharges, we got a wide range of discharges just within that wet year. We evaluated -- and Matt will be going through some of that during his talks.

We evaluated, you know, different

parameters looking at that wide range of flows. For example, for a normal year, we looked at it from 1,100 CFS all the way down to just over a hundred CFS for comparative purposes.

For a wet year we looked at a range of flows from roughly 1,500 CFS all the way down to just under 200 CFS. So not only did we look at a wet, dry and normal, we looked at a range of flows within each of those years.

Just as an example, this is a cross section from site four. I would like to illustrate how, you know, flow depths and stages can change based on those probability of exceedances.

On this particular graphic, this highest stage occurs, as you would expect, at the 25 percent exceedance discharge. Again, it's that discharge on average that is equal or exceeded 25 percent of the time for the study period what you're looking at.

The median line, the middle line is the 50 percent exceedance discharge, and the blue line is the 75 percent exceedance discharge at this particular cross section.

Hopefully that gives you a little bit of background on how we incorporated the 25, 50 and 75 percent exceedance discharges into some of the summary calculations that Matt will be going through a little bit later.

Any questions at all on the preliminary analyses going back all the way from data collection to wet, dry, normal to synthetic hydrograph development, model development, hydrologic statistics?

The thing to remember is we used these analyses through a lot of the studies, in particular the hydrocycling study and the flow depletion study. And then Roger incorporated some of the results into his ice study.

So hopefully that provided you a little bit of background when we use those terms later in our presentation. Any questions? Gary?

GARY LEWIS: Yeah. This is Gary Lewis with HDR. I was going to comment on the question on the cross sections, because that was I think a valuable question that appeared to show a widening of the channel.

If you look at all of the cross sections at the same location at the two different times, you see what you're seeing on this current slide. I guess you backed up there, but on the slide you had a minute ago, these banks, high banks are right on top of each other.

I don't believe that those high banks changed in that period of time, because the majority of the drawings that we looked at show them exactly on top of each other.

Remember that when they surveyed these, they went out and tried -- they weren't monumented. They went out and tried to locate where they had taken cross section six in site three or whichever -- that's cross section four I guess. Tried to locate where that was and measure the channel across that location.

If they crossed on a little bit of a skew or didn't quite start and finish at the same point, it would show -- it would have an appearance of a change in channel width. I just don't believe that's happening for the majority of the slides.

We can look at those in more detail, but I don't believe widening or narrowing are part of what we saw during that period of time.

PAT ENGELBERT: Anything else? Any other questions or comments? I think we'll move on.

And I will be staying right up here talking through sedimentation.

So this particular study is an update to our first study which evaluated the sediment transport characterization of the gaged sites. This particular study looks at the sediment transport at the ungaged sites. We evaluated it for current operations in this particular study. We'll get into the sediment transport relative to hydrocycling and flow depletion tomorrow when we cover those studies. The intent of this update is to characterize the sediment transport for current operations at the ungaged locations.

Just to reiterate, the goal of the sedimentation study was to determine the effect, if any, that project operations have on stream morphology and sediment transport in the Loup River bypass reach and in the lower Platte River. This is on slide 132.

In addition, to compare the availability of sandbar nesting habitat to tern and plover to their respective populations, and to compare the general habitat characteristics of the pallid sturgeon in multiple locations.

That second goal we did address in the initial study report. And based on comments that we received from FERC, we're going to look at some additional -- we are currently performing additional statistical analyses, and the results of that will be presented in the August 26th report, the -- is that the second initial study or --

LISA RICHARDSON: Updated.

PAT ENGELBERT: It's the report that we're going to show in August, for the challenged like myself.

The objectives associated with -- you know, in order to help us to meet that goal, were to characterize sediment transport in the Loup River bypass reach and in the lower Platte River through effective discharge and other sediment transport calculations, and to characterize stream morphology in the Loup River bypass reach and in the lower Platte River by reviewing existing data and literature on channel aggradation/degradation and cross sectional changes over time. These are the same objectives that we had back in September for the gaged locations.

These grayed out objectives, again, are to the statistical relationships between sediment transport and the nesting that we are currently performing and will be reporting on in August.

Okay. Back to objective one. To characterize sediment transport in the Loup River bypass reach and in the lower Platte River through effective discharge and other sediment transport calculations.

For this particular study, again, these are at the ungaged locations. The tasks associated with that are to look at the overall sediment budget, the sediment supply that is available, to perform our sediment transport calculations, and from that determine what the effective and dominant discharges are. And then we also evaluated the regime analysis based on those effective and dominant discharges.

The first thing we did is we looked at the sediment budget that we presented back in September, and evaluated what the yield or the potential supply is at the ungaged sites.

You recall from back in September we adjusted the Missouri River Basin Commission sediment yield table based on the reduction in dredge amounts that the district has seen in their settling basin.

Here's a table showing the ungaged sites and the potential supply that is available at those ungaged sites. For site one, the potential supply that is available, and, again, this is upstream of the diversion weir. It's approximately 4 million tons of sediment per year. Downstream of the diversion weir, and this is on slide 137, you get approximately 2 million tons of sediment is available.

Sites three, four and five you're upwards of 5 million tons per year of sediment is available.

Okay. Now that is supply. That is the potential supply that is available to the river at those points in the system.

In order to -- and this is a little bit of a summary, and I'm sure everyone pulled out their initial study report and reviewed this before today, but as a refresher, in order to perform our sediment discharge calculations, we had to develop sediment discharge rating curves.

Next we did the collective sediment discharge rating curve, and then from that we determined what the total sediment transported was, and then we evaluated what the effective dominant and -- effective and dominant discharges were.

The difference with the ungaged sites from the gaged sites is to develop our sediment discharge rating curve, we need a width, a depth and a velocity relationship in the river.

At the gaged locations we had the -- we had measured data from the USGS, over 25 plus years at each of the gaged sites, so we were able to develop those relationships for measured data.

At the ungaged sites, we used the two survey dates and our hydraulic models, and ran a series of flows through our calibrated hydraulic models to come up with those width, depth and velocity versus discharge relationships that we'll be using here.

A slight caution is that at the gaged locations it was based on 25 years of data, at the ungaged sites, you know, we're looking at a couple points in time in one particular year. So just to provide you a little bit of the scope associated with that.

Again, here the study states that we evaluated sites -- ungaged sites one, upstream of the diversion structure, two, downstream of the diversion structure, three is upstream of the return, four is downstream of the return, and five is near North Bend.

Hopefully tonight when you go home you won't have one, two, three, four, five stuck in your head with all these locations because I've repeated it so many times. My kids know where they are, but, unfortunately, they were born to an engineer.

Here's an example of the depth versus discharge relationship that we developed using the calibrated model results. And this is kind of for a lower flow range for discharges a thousand CFS and less.

You can see that there is a pretty -- you know, pretty good spread between the depth for a given discharge. And each of these points represent a cross section location in the model.

So we provided our best fit line to come up with that -- you know, the best relationship or general relationship between depth and discharge.

Here's an example, and this is at site four, depth versus discharge for higher discharges, velocity versus discharge for low discharges, and velocity versus discharges for higher discharges.

Again, just want to give you an example of the types of relationships that we developed using our calibrated hydraulic model.

Based on that information, we ran our sediment transport calculations using Yang's equation again, which is what we used at the gaged sites and which is consistently used up and down the basin. And we developed a sediment discharge rating curve. This particular example is at North Bend.

At the North Bend location, because it was also a gage location, we compared the gaged versus model results sediment transport rating curve, and they were -- they were very close to each other. I'm on slide 144.

LEE EMERY: Because these guys watching on the screen without knowing you're flipping through them.

PAT ENGELBERT: Sorry about that. I'm on slide 144.

So now that we've established -- now I'm on slide 145.

Now that we've established what our sediment discharge rating curve was at the ungaged sites, we went ahead and performed our -- continued with our calculations, and we determined the total amount of sediment that was transported assuming it was at capacity for given years.

We determined what the effective discharge was based on our sediment transport calculations, and what the dominant discharge was based on those calculations.

And as a quick refresher, I would just

like to reiterate what the definitions of each of those terms are.

I'm now on slide 146. Total sediment transport capacity is the total sediment carried for a period of interest based on the sediment discharge rating curve and the corresponding flow hydrograph.

So we take that sediment discharge rating curve that I had, which is sediment versus discharge, and we combine it with discharge, and we get the resultant sediment load that is transported.

The effective discharge, by definition, is that discharge that transports the largest fraction of the total sediment load. It results in the average morphologic characteristics of the channel, it's the channel shaping flow. It's used to assess channel characteristics within depth. However, due to subjectivity, it suggests that that's used for long-term analyses for greater than a year.

The dominant discharge is that average flow that transports the same amount of sediment as the actual hydrograph for the study period that you're evaluating.

It is also used to assess channel characteristics within depth, and it can be used for shorter periods. Typically for those periods a year or less.

So if you can picture, you know, the total sediment that is being transported by a hydrograph, let's say is a million tons, if you divide that million by 365 days, you get the average number of tons per day. You go back to your sediment discharge rating curve, and say for that many tons per day, what's the associated discharge. Let's say it's 1,500 CFS.

So if 1,500 CFS were flowing down the river every single day for the year, it would convey the same amount of sediment that the natural hydrograph did, so that is the definition of dominant discharge.

Here's a summary table showing the results of our sediment transport calculations. I'm now on slide 149.

The first site, site one, the effective discharge is approximately 3,000 CFS, the dominant discharge is a hair under 3,000 CFS. And I'll go through these pretty quickly so I'm not boring you even worse.

But we saw the same trends we saw at the gaged sites where the dominant effective discharges were increasing as we went through in the downstream direction.

What's interesting to note is we also threw up there the mean daily discharge in the third column. And there is pretty good agreement between the mean daily discharge and the dominant discharge. That is just one of the interesting pieces that we noted. That that discharge that, you know, is generally responsible for shaping the river is pretty close to the mean daily discharge.

Okay. Next we took those -- the results of those sediment transport calculations, and we compared them to the yield or the sediment supply that is available in each of those locations.

As you can see, and consistent with the trends that we saw at the gaged locations, the capacity of the system at site one is about 2.9 million tons per year, and the supply that's available at that site is a little over 4 million tons per year.

Again, we had consistent trending in the downstream direction, and in each case, just as we had found at the gaged sites, the capacity was smaller than yield, which led us to the conclusion that it is not a supply limited system. There is more supply available than what the system has the ability to carry.

Here's a quick graphic on slide 151 showing kind of our spatial analysis comparing the effective and dominant discharges to flow volumes and total sediment transport.

Again, as you work your way from upstream to downstream, it increases as you would expect in this type of system.

And then we also showed the capacity versus yield spatial analysis where at each of our gaged and ungaged sites we show the river's ability to convey it, the capacity versus the yield or the supply that's available.

Based on those dominant and effective discharges, we plotted those on the regime graphics at the ungaged locations to see if they were trending or were in the same morphology as what we had seen at the gaged locations.

On slide 153 you can see that they are all very well clustered up into the braided region of the -- of Chang's regime morphology graphic.

Similarly, for Lane's relationship, his regime analysis, we plotted both the gaged and ungaged sites, and they are all very well seated toward the braided -- toward the braided regime.

So in summary, both rivers at all locations were clearly not supply limited.

The spatial analysis of effective and dominant discharge reveal that they increase in a downstream direction, which is consistent with natural river processes.

The effective discharge and associated river morphology has not changed since '28. That's based on the Louisville gage.

Sediment transport calculations show that the channel geometries are in regime. Nothing appears to be constraining either the Loup or the Platte from maintaining the hydraulic geometries associated with those dominant and effective discharges.

The combinations of slopes, sediment sizes and effective discharges result in all locations being well within that braided regime. Okay. And none are near the threshold of transitioning to another regime.

So those are kind of the conclusions of objective one to characterize the ungaged sites and sediment transport associated with those.

Any questions on that before I go on just to talk about, you know, comparing it to the literature, which is a pretty quick little piece?

Any questions, any comment?

Anyone need coffee, Mountain Dew?

Yes, Michelle.

MICHELLE KOCH: This is Michelle Koch from the Game and Parks Commission. I think I asked this question back in September and I still don't remember the answer. But for the potential supply, what is that based on? Does that include everything, even the sediment and all the sand and stuff that's tied up in permanent, you know, stabilized sandbars, does that include all of that?

PAT ENGELBERT: The supply is calculated based on the amount of sediment that is coming off the watershed through, you know, overland flow, getting into the rills, getting into the smaller streams, the bigger streams as well as the material that's available within the channel.

MICHELLE KOCH: The movable material that's available in the channel, not the stuff that's stabilized?

PAT ENGELBERT: I'm not sure if when the Corps did this they looked at like an island in the channel that has large tree structures, if they accounted for that at all, I don't know for sure.

But I would imagine that those are relatively small in proportion to the overall watershed and what it can dump in at that point.

Gary, did you want to add anything on that?

GARY LEWIS: I wouldn't mind commenting on that. I was at the University of Nebraska when those studies were done. I actually participated in some of the studies. Not in this one. I was involved in hydrology task force on a part of the project that we looked at everything in the entire Platte basin.

But I believe the correct answer would be that the -- because of the methods used, the soil loss equations, all of the methods used in developing those yields, that would represent the production of sediment to the river by the watershed. And it doesn't have -- they didn't recount sandbars or had no way of estimating the supply available.

However, the supply available for capacity transport is in addition to the load that's carried to the river to any location, and you notice it gets bigger as you go downstream, so they must be accumulating more. And that's probably because the watershed is in between two points is contributing more sediment.

So I believe the proper way to interpret the NRDC estimates would be the load that's carried to the river at any point as it accumulates down river. So that would not include the vast amount of sand and material that's sitting in that river either stabilized or not stabilized.

But all of the investigators when they are looking at capacity to transport sediment consider the fact that even if the supply of material being brought to the river was less than the capacity, there is still a tremendous amount of sediment out there that could be mobilized, and in that case you might have some concern that maybe that's morphology unchanged. Because if the supply coming to it is less than what -- it's eaten away at the reserve, if you want to think of it that way, and because these quantities represent the amount being carried to the river, and that probably has changed over time in development and everything else. It was reflected in the district's dredging records. We saw something happening. I don't know that we know exactly what did, but there was a reduction. So hopefully we're getting the right answer to you.

The NRDC I would say in my opinion of having read that report is the supply that's carried to the stream by the watersheds, but continue to think in terms of capacity to transport. If that capacity transport starts to exceed that number and you're running out of reserve in the river, you're probably going to see some kind of a change occurring.

Just a quick comment too, the Corps of Engineers in their cumulative impacts assessment, their conclusion was, because they looked at some of the same material, the capacity that leads to yields that are coming out, and they said probably the best way to interpret this is the yield is equal to the capacity in the Platte River.

The capacity to transport is the yield, because it's going to carry that much. You probably don't have many days, although our rating curves show different, that you have it carrying less sediment than it's capable of carrying. And that -- there is such an abundance. They say the same thing on sediment there that there is not a cause for concern.

All this is saying is that if these supplies of sediment that are coming to the river are properly estimated by NRDC, and they've used the best available technology for doing that, then they are far in excess of the capacity at the river to transport it. So we're not eating into our reserve if that's coming in. In fact, we're getting an oversupply of sediment which defines a braided river.

JEFF RUNGE: But wouldn't this oversupply of sediment result in aggradation of the channel?

GARY LEWIS: The Platte River has degraded over the years long-term. It's called the backbone of Nebraska, so, yes.

JEFF RUNGE: But not within the records then of the USGS when they did the aggradation/degradation studies?

GARY LEWIS: They hadn't detected it. We're talking geologic time.

JEFF RUNGE: Yeah. But the -- if the supply greatly exceeds what is being transported, though, I mean, it seems like that would be something that would be evident on a scale that's much smaller than on a decadal scale you would see that aggradation, because it seems like there is a lot of sediment being supplied from the basin based on those studies.

GARY LEWIS: I can only report what the facts are, not explain it, because, yes, it's intuitive that you think there would be an awful lot more sediment coming than we're transporting, and, gee, why isn't it getting bigger. And it is in the long-term if you look at -- if you studied some of the reports on the paleogeology of the basin, the Platte River has gone all over the page through these erosion, deposition and stable cycles. That whole valley has been 2 or 300 feet deeper than it is now, and it spans 2 or 300 feet higher than it is now in long-term. So, yes, there is a long-term effect of this oversupply of sediment, but we don't see it, and it isn't cause for alarm in the time frame we're talking about here in the project life and some of the other measures of time.

PAT ENGELBERT: And the supply versus capacity is one piece of the puzzle. The gages as you mentioned, they are another piece of the puzzle, and they kind of show the same -- although slightly differing, show the same consistent theme that it seems to be a pretty stable system.

Anything else on -- anything else on that?

Real quickly, we also characterized the stream morphology by reviewing some of the existing data and literature, and, again, it's going back to that USGS stream gage trends as well as evaluating some other periodicals to see if they suggested anything at the ungaged sites. And, again, it's basically all the information at the gaged locations that says that both rivers are in dynamic equilibrium with no indications of aggradation or degradation or channel geometry changes over time.

Long-term literature and calculations demonstrate that the Loup River bypass reach and the lower Platte River at both the gaged and ungaged sites are in regime. They are well seated within the regime zones classified as being braided.

LEE EMERY: 158.

PAT ENGELBERT: Slide 158. Any -- 159, any questions? Any questions about the sediment transport calculations that we developed at the ungaged sites, calculations at the gaged sites, the whole sedimentation study? Jeff.

JEFF RUNGE: Yeah, I've got one question here. When it comes to those regime models that were developed, there is a Leopold and Wolman model that was in the initial study report, the first one, and then this one here it wasn't. I didn't know why that was -- why that wasn't in the second updated one.

PAT ENGELBERT: Did we plot the Leopold and Wolman; do you remember?

GARY LEWIS: Yeah, we said in the initial report that we did include that one and talked about it and pointed out two problems with it. One is that the sediment sizes that were used in that study were of a single value and they weren't representative of the range of values we used here. So you saw in the original report the data points -- or sort of curious where the plotting on it as to whether it's braided or meandering, and we just discounted it for the purposes of this second report assuming that our explanation why we discounted in the first report was adequate. So we could repeat that same logic. There was some problems with that study -- I have the original paper -- that do not make it applicable. In fact, I don't think you used any braided streams in that report. There were two problems, and I forgotten which two they were. I would have to go back and look. One was the D50 was not anything close to what we're doing here, and I believe he really didn't have braided streams, look at meandering, and he just tried to find the upper threshold of meandering, so it doesn't do a lot of good for this. We can include that graph and plot the data points on it and it will look just like it did in the other report.

TOM ECONOPOULY: This is Tom Econopouly, Fish and Wildlife. You also mentioned in that report that the Corps didn't use it.

GARY LEWIS: That's correct, too, in the -- the Corps had applied both of the evident graphs. Thank you.

You know, they didn't explain why they didn't -- which ones they didn't use or why, but they did select those two and use the same ones.

TOM ECONOPOULY: It would be nice to see them just for consistency.

PAT ENGELBERT: We can include that, yeah.

JEFF RUNGE: The other question too is when looking at things making comparisons longitudinally there is the Parker regime equation that was computed that looked at your effective flow discharge, your sediment size, slope, and then you came up with numbers like wetted width, mean depth -- or mean common velocity, mean depth. And it didn't seem like that was computed for the -- for any of the ungaged sites. That was done in the initial study for the gaged sites, but that wasn't computed for the ungaged sites?

PAT ENGELBERT: Jeff, I don't recall computing the -- using Parker's equation to compute widths and depths. We took the dominant discharge and compared it to the width and depth relationship that was developed from the gaged data, but I don't recall using the Parker's regime equations. I think we mentioned it in the report. I don't know that we actually -- I don't know that we used them. I think we used it as an example.

JEFF RUNGE: Yeah. I'll point that out as far as like a lot of that information is provided more in an appendix than it was in the document, but I can point that out.

PAT ENGELBERT: If you could, I would appreciate it. One of the things we did do is we calculated what that dominant discharge was, and then we went back into our width and depth versus discharge relationships to come up with what those channel characteristics would be associated with the dominant discharge.

GARY LEWIS: If I could comment, the -- we did have a table in there of all of the different variety of methods used to calculate effective and dominant discharge, and we showed that Parker had done some work in the simple Platte as part of the Platte River management project. I was involved at that time.

But we didn't run his method on any of these study sites or report any values of Parker's method. He calibrated it to a specific part of the sediment plant area above Grand Island, I believe, and it was one of many methods of trying to look at morphology in the Platte at that time. And recall USGS Harlinger (phonetic) and others used these same methods as well as Parker's method.

JEFF RUNGE: Yes, yes. And I guess it's real difficult to discuss this now. I'll just have to go back to the specific appendix and reference that from the original report.

GARY LEWIS: If you understood it saying we did -- we used Parkers down in the lower reach, that should have been communicated that we didn't run Parkers down in the lower. It's very difficult to calibrate.

JEFF RUNGE: Okay.

TOM ECONOPOULY: Tom Econopouly, Fish and Wildlife. I'm also interested, how did you calculate the slope for the cross sections?

PAT ENGELBERT: For use in the model?

TOM ECONOPOULY: And also within the regime diagrams.

PAT ENGELBERT: We looked at USGS topo maps, we looked at the survey information we had, and we looked at literature on the Platte River system. And I know in the initial sediment report we kind of listed the table and what the sources were for coming up with the slope. So we kind of used two or three different sources to develop --

TOM ECONOPOULY: The cross sections as well?

PAT ENGELBERT: Yeah.

GARY LEWIS: Tom, for your information, even though the graphs show bankful discharge, in one case the mean annual discharge, we explained in the original report we used dominant discharge for both sets of graphs. We think that's a better equation.

TOM ECONOPOULY: D50 was also -- that was estimated from nearby gages?

PAT ENGELBERT: Yeah, from USGS gages. And we compared that to the dredging data that the Loup Power District had, and we had a good agreement.

TOM ECONOPOULY: At the cross sections

they used the D50 from nearby gages, right?

PAT ENGELBERT: At the ungaged locations if there was -- like at Genoa, we would use the Genoa gage. For sites three and four, we interpolated between the gage locations based on river mile.

GEORGE HUNT: This table right here, Table 4-2, it lists the slopes and the D50s and their sources for every site.

PAT ENGELBERT: So in the report, Table 4-2 on Page 9 of study 1.0, sedimentation, lists the inputs used for Yang's equation.

Any other questions on sedimentation?

JEFF RUNGE: Yeah, I've got one more question here. And I'm not sure where -- well, I'll just mention, Page 11 of FERC's final study determination, they requested a longitudinal -- or they put in parentheses spatial comparisons of all sites on the Loup and lower Platte River starting at the most upstream site on each river and progressing downstream.

It seems like a lot of the variables that would be collected and analyzed in this comparison would be those similar to the Ginting and Zelt 2008 one, but as far as a longitudinal geomorphic comparison, I wasn't quite sure whether this captured that now that the ungaged site information has been collected.

PAT ENGELBERT: I guess, Jeff, what we had done is we listed what each of the sediment transport calculations were relative to their gage, and we summarized it in a table and noted what those trends or what the -- what we saw in doing that.

JEFF RUNGE: So the longitudinal comparison that was made was just more on transport, the transport at those sites?

PAT ENGELBERT: Our sediment transport calculations, yes.

JEFF RUNGE: Okay.

PAT ENGELBERT: Anything else?

I guess with that I'll turn it back over to Stephanie.

STEPHANIE WHITE: I think we're probably ready for 12. Let's start that. We'll go until 3:00, wherever that takes us.

LISA RICHARDSON: I think we'll probably be able to pretty close get through ice in an hour, don't you think, Roger?

ROGER KAY: I think so, yeah.

My name is Roger Kay. I'm with the US

Army Corps of Engineers, Omaha district. I'm the chief of hydraulics section. And part of what we do in hydraulics is look at ice affected flows in rivers. And we were asked to develop scope of study and eventually do the study on ice jam flooding on the Loup River.

The primary goals of the study were to evaluate the impact of project operations, if there are any, on ice jam flooding on the Loup and Platte Rivers between Fullerton and North Bend.

And also to develop an ice jam and/or predictive -- breakup predictive model limited only to the examination of project effects, as well as identify operational or structural measures to mitigate or minimize project effects on ice jam formation and subsequent flooding, if it is demonstrated that operation of the project materially impacts ice jam formation on the Loup and Platte Rivers.

So out of that -- those two goals, we have three objectives associated with our study that we performed. The first objective is to simply evaluate the effect of project operations on hydrology, sediment transport and channel hydraulics, and how that affects the ice processes on the Loup and Platte Rivers.

Second objective to develop an ice jam and/or predictive model to evaluate project effects.

And the third objective is to identify structural and nonstructural methods for the prevention and mitigation of ice jams, should it be demonstrated that operation of the project materially impacts ice jam formation on the Loup and Platte Rivers.

LEE EMERY: One sixty-two.

ROGER KAY: As far as our study area, this is a map on slide 163. Basically the study area extends from the Loup River upstream of the canal Headworks, up near Fullerton, Nebraska, down through the Loup River to the Platte confluence, and down the Platte River down to North Bend. It also includes the flows that are bypassed -- or diverted for the power canal. And primarily for most of our modeling purposes, we focused on the Loup River region between the Headworks and the tailrace.

Again, to get in a little bit more specifics of what our study results, our first objective, again, was to evaluate the effect of project operations on hydrology, sediment transport and channel hydraulics on the ice processes on the

Loup and Platte Rivers.

Three main tasks associated with that objective one was to assess a history of ice jams, second was to assess the impacts of -- changes in hydrology and sedimentation characteristics, and, lastly, looking at ice formation and how that may be impacted.

The second objective was to develop an ice jam and/or predictive model to evaluate project effects. The tasks associated with that objective are to look at ice transport and the ice affected hydraulics.

And the third objective, once again, identifies structural and nonstructural methods for prevention and mitigation of ice jams. The tasks associated with that is identification of methods for prevention and mitigation of ice jams.

LEE EMERY: One sixty-six.

ROGER KAY: This portion of the study was only to be carried forward if it was demonstrated that the operation of the project materially impacts the formation of ice jams.

Now going into objective one, methodologies, we looked at a -- the history of ice jams that have occurred on the Loup River, looked at all available records to determine when significant and minor flood events occur. And for purposes of this discussion, significant flood event would refer to a flood that causes either loss of life, considerable loss of infrastructure or considerable damage to property. And we used newspaper records, we used USGS reports, we used Corps reports and -- to develop this history of ice jams.

We looked over then the period of record, and analyzed to determine if there was any statistical basis to indicate if district operations have a significant effect on the occurrence and severity of these ice jam events.

I'm on slide 168. And this is just a listing of what we found for significant ice jams on the Loup River. And I apologize, the colors don't show very well, but the project went into operation in 1937, so these events March 1936 prior up to 1848 or 1849 were preproject. These are post project ice jams cause significant either damages, death.

One caveat on the 1960 flood was really more a high water event. There was some ice. There was no indication that ice jams formed on the Loup River, however, there was loss of life in Columbus and considerable damage at that time as well. But that's included in here as -- because it was -- we do know that 1960 there were ice jam floods in other portions of the study area on the Platte River.

With that we looked at how many events occurred prior to project event, project operations, post project operations, and we see that there has not been a significant change in the occurrence of ice jam floods. In fact, we show a possible decrease in the occurrence of ice jams since the commencement of operations for the project.

I'm on slide 170. We can't say definitively that the decrease can be -- decrease in probability can be credited to district operations, but the decrease in probability does discount the idea that project operations have increased the probability of ice jam occurrence on the Loup River.

One thing to note in this review of flood histories, we looked at other floods, ice jams on other large Nebraska rivers, and without exception every year that there was a significant ice jam flood event on the Loup River, there was a significant ice jam flood on one or more large Nebraska rivers as well. Primarily either the Platte or the Elkhorn Rivers.

One thing that -- you know, that points

out is that it would appear that the occurrence of ice jams on the Loup and the Platte River are driven primarily by climatological conditions rather than operational considerations.

One thing that makes the -- muddies the water maybe a little bit is that perceptions of flooding change over time. People may grow lackadaisical over flooding because it occurs frequently, they don't really pay attention to the lowland flooding, and after a period of time they just ignore it, it's just going to happen again. And over time there may become a period where we get less flow and less frequent flooding, and all of a sudden we get back into a period with more frequent flooding, people say, hey, something's happened here. So it really makes it difficult to compare the minor flooding events.

But if we look at the ice affected stages at the Genoa gage, we see that in 22 of the last 50 years, the peak stage has been ice affected, and that corresponds pretty well with frequency on other natural streams where we see ice jams occurring on average every two to three years. That doesn't mean that we have an ice jam this year and not an ice jam next year, an ice jam this year, but on average long-term we'll see ice jams form every two to three years on most natural streams. And that seems to be the occurrence on the Loup and Platte Rivers.

One thing that may contribute to severity of individual ice jams, floodplain development. And for this purposes I just want to point out that we did not evaluate any of these specific items at this site, but I just show this for example purposes.

You have elevated roadways that cross the floodplain at right angles to the flow, which can increase flows, you have areas where levies have been constructed further constraining flows, you have areas where residential developments or industrial developments have occurred further blocking the floodplain. All these things may contribute to severity of ice jam flooding. It doesn't necessarily impact the occurrence of the ice jam flooding, it just might make them more severe.

And one thing to note with the floodplain development is something that occurs gradually over time. It's not like all of a sudden with -- like the project began operation in 1937. People can point to and say in 1937 Loup Power began diverting flow and it's had this impact. Whereas with floodplain development, all this development occurs over time, people kind of forget that -- you know, well, we raised this road, we built this bridge, we built this levy, and all these things have occurred over a period of time, and when ice jams don't occur all that frequently to begin with, it can lead to a perception that the problem must be somebody else's problem. It's not my problem because I built something out here in the floodplain.

Going on to the hydrology and sedimentation portions of the study, these are studies that were done by others, by HDR, and Pat's gone through some of the sedimentation study and also the hydrology. The results of these were used as inputs to various portions of the study, such as we used the flows from the hydrology portion of the study to evaluate the flow regime, if you will, the hydraulic flow regime with -- concerning current project operations, or considering if the project did not divert any water -- or if there was no project to divert any water.

We also used sedimentation results to verify if there would be a need to change any of the geometric parameters within our hydraulic model, and I'll get into that a little bit later on as we talk about that portion of the study.

As far as results, really we do not see a discernible difference in channel geometry due to differences in sediment transport or flow regime. That's not to say there aren't differences at different discharges, but overall there are not -- there is not a measurable difference between the project and no project conditions that we modeled.

On slide 174, the last portion of objective one, last task I should say was looking at ice formation. And this looked at looking at some hydrometeorological data to determine ice production. So we looked at flow data, we looked at air data, air temperature data, precipitation data. We used that to determine if there were any trends that could be discerned due to project operation.

We estimated ice cover thickness growth and how that may be impacted by changes in the flow regime. And then if there are any differences in the ice regime that were attributable to differences in discharge in our hydraulic model studies, then we would look at two different ice regimes.

Looking at the results, I just want to -- this is on slide 175. Just talk about one term that I'll be talking about quite a bit here for the next several slides, and that's accumulated freezing degree days or AFDD.

When we look at ice production, in general it correlates very well with temperature data. In other words, how much the daily temperature deviates from freezing, the daily mean temperature deviates from freezing. That's what we designate as freezing degree days.

So, for instance, if yesterday the average air temperature was 28 degrees, we would have had four freeze degree days for yesterday.

If we look at that over the whole winter period, we accumulate those individual freezing degree days from the beginning of the onset of cold weather up through the melt out and beyond. We term that the accumulated freezing degree days or the AFDD. And that kind of gives us an indication of the severity of the coldness of the winter, and it helps us to determine what kind of ice thicknesses we might expect to be associated with that climate data.

If we look at then the flow data as well as the air temperature data, we find that based on project operations after we accumulate 11 freezing degree days on average, we begin to see the project divert flow down through the bypass reach, not take flow into the canal any more. And that condition continues until about an average of 108 freezing degree days are accumulated. And at that point there is a stable ice cover that's formed upstream, there is no longer a significant flow of frazil ice coming down the river into the study area. The project is then able to resume normal wintertime operations.

This value here, that's the average value. The median value is actually 101, which corresponds very well to just as a general rule of thumb, we on average see a natural stream form a stabilized cover when accumulated freezing degree days hits 100.

So in terms of that we don't see any difference in how ice is forming on the Loup River as opposed to rivers all across the country.

When we look at the annual maximum freezing degree day accumulations, we see that 60 percent of our ice jams occur in years where we have freezing degree day accumulation greater than 1000. And this value is about one standard deviation above the average. And if you look in the report, I don't remember the exact page, but this number is shown as 70 percent. There are a couple of typos in our report, and I believe they will be -- an errata being published showing those corrections. But those corrections don't have an impact on what our conclusions are here.

We look at 60 percent of the ice jams occurring in years where the freezing degree day accumulation is greater than a thousand, but just because we hit a thousand freezing degree days in any year doesn't guarantee that an ice jam will occur. There is only about a 20 percent chance that an ice jam actually occurs in years where we hit that. That points out there is a lot of variability in both temperature data and the snowfall data and precipitation data. All these factors go into how likely we are to have an ice jam. And I believe on the next slide -- or next couple slides we'll see that in a little more detail.

One thing that was kind of interesting to note, and this may also lead to some of the perceptions that have occurred over time as to what are the impacts of causing -- or what are the impacts causing flooding to occur on the Loup River.

We see that if we look at the annual peak freezing degree day accumulation, that these are varying on about 25- to 35-year cycle. In other words, we see about a 25- to 35-year period where the annual maximum is averaging substantially below normal. We move into a period 25, 35 years where the freezing degree day accumulations are substantially above normal.

And in this chart on slide 177 shows that a little bit more clearly as opposed to the table. You can see that -- you can see a fairly sinusoidal shape to the -- both the five year running average, ten year running average and 30 year running average looking at freezing degree days over these various periods.

And if we look at these high periods of freezing degree day accumulations as opposed to these low accumulation freezing degree day periods, we have about 30 percent probability in any year in the high freezing degree day periods of exceeding 1000 freezing degree days, but in these low freezing degree day periods we only have about 10 percent probability.

And as I said before, it appears that climatological conditions are a primary driver in the occurrence of ice jams. So you can see that based strictly on just the temperature data, there is a substantial difference in what we would expect as far as the occurrence of ice jams within these high and low freezing degree day periods.

Another thing that's kind of interesting about freezing degree days is that in these high freezing degree day periods, about 65 percent of the years are above the long-term average, but in the low freezing degree day periods, only about 35 percent of the years are greater than average.

So it indicates that not only are we seeing the long-term average, but within that period there is a certain band, if you will, that the freezing degree days do not extend beyond, so we see a lot -- see a substantial difference in the variability of these, whether it's a high freezing degree day period or a low freezing degree day period.

If we look at just strictly if ice jams are more likely to form in years where our AFDD is greater than a thousand, and we look -- we would expect to see about three times more likely to have an ice jam flood in periods of high freezing degree day periods, in other words, cold weather, colder weather periods as opposed to the warmer weather periods. That's not quite how the statistics work out. It's a little bit more about two times more likely, but there is more than just freezing degree days in effect here.

One thing to note if we go back to the slide here, project operations started in the late '30s. You can see we're kind of in the trough of that freezing degree day period.

We've gone through now one complete cycle and we're heading into what's most likely going to be colder weather than what would be experienced, so be sure to buy your stock and winter coat companies here in the next ten years.

The one thing to note is that we weren't as likely to have ice jam floods when the project began operations. After the project had been in operation for, you know, 10, 15, 20 years, we see that the climate gradually was becoming colder on average, and that we were more likely to have ice jams. And that may have led to a perception that project operations were a factor in increased ice jam formations when really all it is is just the variability in climatic conditions.

RANDY THORESON: Can you tell me what happened in 1920, go back to your chart, that little blue?

ROGER KAY: This is a five-year average, so it's just looking at the past five years. I don't have the individual years here in front of me, but there would have been a period of five years where we had -- you know, I think there was four out of five that were really high, really cold winters there. And interestingly enough there were no ice jams that occurred in that five-year period, except possibly the first year. I don't remember if this included the 1912 to 1917, or if this would have been 1913 through 1918, I don't recall.

TOM ECONOPOULY: Tom Econopouly again, US Fish and Wildlife Service. Even though there may have been an ice jam, a low probability of an ice jam in the years when there was low period AFDD, that doesn't necessarily translate into damages incurred, does it?

ROGER KAY: No.

TOM ECONOPOULY: So you can have more severe damage during a low AFDD year?

ROGER KAY: It's possible, yeah. As my next bullet points out, there was only one year where we had below normal freezing degree day accumulations that caused a significant flooding event, and that was because there was a rainfall event on top of the snowmelt event. And that's something that I'll talk a little bit more here in a another slide about, but it is possible.

One thing that I point out that I indicated earlier that freezing degree day accumulations greater than a thousand indicates about 20 percent chance of an ice jam forming. But if we couple that with the period preceding the peak accumulation and freezing degree days as being colder than normal, and we follow that with above normal temperatures as temperatures warm up, then we see about a 50 percent chance of ice jams forming. And that same thing holds true to some extent in years where we have lower freezing degree day accumulations. It's largely driven by how warm it gets, how rapidly it gets following that, and sometimes in years where we have really significant snowfall events, it just can't warm up fast enough to melt all the snow.

And, conversely, where we might have relatively low snowpack year, it could warm up very substantially, very rapidly, and even though you don't have a lot of volume, you can get a very rapid rise into the stream and cause large increases in stage and generate an ice jam. But generally there is just not enough volume in that to generate significant flooding. The event just doesn't last long enough for water to build up before the stages drop again.

Going a little bit more with snow accumulation, generally speaking, years with snow accumulations correlate very well with high discharges. Just because you have a high discharge doesn't mean you're going to have an ice jam.

One thing that kind of seems counter-intuitive at first is that 80 percent of the ice jams that occurred, occurred in years where we had above normal snowfall. And 60 percent of those ice jams occurred in years with snowfall in the 20th percentile or higher. In other words, we are one standard deviation above normal for snowfall events.

And one reason that this is, that we can get a lot of runoff, like I said, the amount of snow that's out there to melt, just because of the way that nature works, we just can't generate enough warm air fast enough to melt that snow rapidly enough to lead to real sharp increases in discharge. That's what seems to be more driving us rather than the high discharges.

Lastly, I just point out that rainfall -- this seems very intuitive. Rainfall during the snowmelt event seems to increase the probability of ice jam formation. However, there just haven't been enough precipitation driven events where ice jams formed to really conclusively state how significant precipitation is. In other words, does it take quarter inch precipitation over a large area, does it take an inch of precipitation over a large area to drive this rapid rise in stage.

There are several -- a few other things we looked at. One thing that we looked at when we looked at the maximum annual accumulation of freezing degree days is that there appears to be a downward trend. However, it's not statistically significant just because there is so much scatter in the annual freezing degree day accumulation.

As you can see, there is a cyclical pattern of 25- to 35-year periods of high and low periods. What we don't have is there a larger trend where we're seeing up and down, are we on the down side of a longer period trend, or are we in a long-term trend. We really don't have enough data to say one way or the other what's going on there.

We also looked at the monthly accumulation of freezing degree days. Some months show slight upward trend, some months show a slight downward trend. Again, there is nothing that is statistically significant with that.

If we look at when that peak freezing degree day value occurs, the date that that occurs on, we can see that the trend is the same as that of the annual freezing degree days. In other words, we're seeing a trend towards earlier accumulations of freezing degree days and thus earlier breakups of ice. However, there is just so much variability again in the natural climatic conditions from year to year that that trend is not statistically significant.

One thing to note, though, that's interesting, and I just put this up here because it is interesting. Even -- whether we have a period of high freezing degree day periods or low freezing degree day periods, the variability of that date has remained fairly constant until the last 20 years. And why that is, I don't know, but we -- one thing we do know is the project is not that powerful that they can influence the weather to cause that much variability, so I think we can ignore that for impacts to the ice jam formation.

The last task associated with the objective one is looking at ice formation. Again, we use hydroclimatic data to estimate ice cover thickness.

We also add measurements of ice thickness for -- within various years going back to the 1940s on the Loup River. And there is an equation, we call it the modified Stefan equation. It's really a differential equation that's been simplified due to various assumptions, so you get rid of all the differential equations which makes life a lot easier for us. But basically the thickness of ice is related to the square root of the accumulated freezing degree days.

If we go -- and there is a coefficient here that can vary from river to river, and there is a number of reasons why the coefficient value can vary.

On an average river -- and these values are developed more for eastern rivers as opposed to plains rivers. The standard values that are expected on average river are .4 to .5, on slightly larger rivers, like on the Loup and on the Platte and Elkhorn, we would expect to see values to be .4 to .6, and maybe .65. And those values depending on where you're at and how the river is oriented to prevailing winds, you can even see those values go a little bit higher. And that's really what we saw.

When we looked at the measured -- ice thickness measurements over the last 50, 60 some years, we see that our C value comes out to an average .56. The value in ranges generally range from .4 to .7, which falls very favorably within other streams within the State of Nebraska and also other northern plain states.

This range in -- we then took this average .56 value and looked at estimating what the average ice thickness would have been for some of the historical ice jam periods. And the values that we computed for ice thicknesses seems pretty consistent with available anecdotal evidence. We don't really have ice measurement thickness measurements prior to USGS beginning in gage operations in the late '30s on the Loup River. However, we do have photographs of some of these ice jam events that occurred in the early portion of the 20th century, and just, you know, eyeballing what the ice thickness is, appear to be based on scaling the ice to other objects in the picture, the thicknesses that we derive match very well with what we compute using this .56 coefficient.

So based on all that, really can conclude then that there is really no measurable difference in ice regimes that are attributable to project operations.

Are there any questions before I move on to the second objective?

All right. The second objective was to look at an ice jam breakup predictive model. Essentially we looked at two tasks. The first is ice transport, and that's to assess 2-D modeling of select reaches of interest may demonstrate differences in the formation of ice under with and without power canal conditions. In other words, no flow being diverted into the canal versus current -- how operations currently exist.

And the second task with that is looking at ice affected hydraulics using a one dimensional model to assess differences in flow and channel regimes between the with and without flow diversions may lead to differences in water surface profiles in the study reach. And also to assess if the flow and channel regime differences lead to differences in ice cover and ice formation, as those may lead to additional differences in water surface profiles increasing flooding risk.

For the first task, ice transport, we contracted with the Cold Regions Research and

Engineering Lab. It's a lab that's operated by the US Army Corps of Engineers in Hanover, New Hampshire. They've had considerable experience with two-dimensional model that's averaged -- the two dimensions are in the horizontal direction. They've used it to simulate ice transport through various channels as well as structures and looking also at the formation of ice jams during freeze up periods.

If you look at our study scope, the DynaRICE model was only going to be conducted if we demonstrated that there were differences between the sedimentation characteristics of the project or the reach with and without power canal operations, and if we could demonstrate that there was a difference in the ice regimes.

However, we got to a point in the study where we didn't have those answers, and in order to -- if we did determine that there were ice differences, we needed to get started on the DynaRICE modeling. So they began some modeling for us. They looked at two areas. The first area was upstream and downstream of the power canal Headworks on the Loup, and then they also looked at the section of the Loup River that passes through Columbus.

Of interest to note, and this kind of verifies with what we see in the field as well as the one dimensional modeling is that we show a freeze up jam occurring in the band just downstream of the Genoa gage with a thin ice cover, then quickly proceeding upstream to the Headworks for both high and moderate flows.

Jams are likely to occur under the no diversion condition. In other words, all the flows going down the bypass reach, and that any diversion of flow into the canal reduces the amount of ice that's available in the bypass reach for ice jam formation.

And one difficulty that the model ran into it was unstable at low flows, in other words, very little flow going down the bypass reach, and this is really due to the coarseness of the bathymetry that we had available.

If you're familiar with two dimensional models, they really require a fairly dense grid of points, and with our cross section spaced about 1,500 feet apart, there just wasn't enough detail to generate a detailed representation of the channel between those cross sections. It tends to just generate a flat channel between those, so that really becomes a problem with two dimensional flows.

One thing that was encouraging, though, was that -- as I'll point out here, the DynaRICE model showed jam formations in close proximity to where we were showing jam formation occurring with our one dimensional HEC-RAS model for these moderate and high flows.

The first location in our HEC-RAS model, this is on slide 187, and I'm not sure how well this is showing up at the back of the room, but this accumulation of ice corresponds pretty well with where they are showing some thickening of ice cover. This is the bend just downstream of the Genoa gage. You can see here, here's Genoa, this is the Highway 37 south of Genoa. This corresponds with the location of ice thickening right here.

And then there is another location our HEC-RAS model shows that's between the Genoa gage and the Headworks just downstream of this large bend, and, again, in the DynaRICE model we're seeing the same location for freeze up jams forming.

So our feeling is that for low flows this same duplication of sites would be replicated with DynaRICE if there were available bathymetry that -- if we had enough bathymetry to generate a stable model at extremely low flows.

Moving downstream to Columbus, we looked at breakup conditions, because that's typically been the concern at Columbus. The DynaRICE model demonstrates that whether flow is being diverted into the power canal or not, there is definitely a potential for significant ice to build up during breakup conditions in the Columbus area downstream of the Highway 81 bridge right out here.

One thing that the model does indicate is that diversion of flows into the canal reduces the size of a jam at Columbus, and it also thus then reduces the resulting water surface elevations and potential for flooding.

There was a third domain that was proposed for DynaRICE modeling. This was looking at the reach from upstream of the tailrace to downstream of the Burlington Northern bridge on the Platte River, however, there was not enough bathymetry available at the time to construct such a model, and per our study scope, by this time we had demonstrated there was no measurable difference in ice regime with or without project, and we didn't continue down this path because there was no need to per the study scope that was agreed upon.

One thing to note is that in terms of the DynaRICE modeling, additional bathymetry may improve model stability in both reaches that were modeled, however, it's not really -- it can't really be demonstrated that DynaRICE would indicate any difference in ice cover formation, ice jam formation given that the -- given the similarity and results between the DynaRICE modeling and the HEC-RAS modeling. And the HEC-RAS modeling was able to model these much lower flows and generated basically the same jam formation locations.

Before I go on to the ice effect and hydraulics, are there any questions regarding --

LEE EMERY: Lee Emery from FERC. Wasn't there an ice jam in recent years near the Genoa Loup canal?

ROGER KAY: There was an ice jam last year near Genoa, however, it's just -- it's just causing lowland flooding.

LEE EMERY: I just wondered how it figured into your calculations.

ROGER KAY: I think the two that -- well, we look at the years where an ice jam produced a peak stage at the Genoa gage, and based on that, you know -- the occurrence of that doesn't really differ from a natural stream in other areas where we expect to see ice jams every two to three years.

If there are no other questions, I'll move on to the second task associated with objective two, ice affected hydraulics. For this we used a one dimensional model, HEC-RAS, we used a georeferenced model. The model initially extended from just downstream of the power canal Headworks to just upstream of the Union Pacific bridge. Those were based on 2010 channel surveys. We didn't really see a difference in that way.

Profiles with previous studies, we incorporated HEC-2 model that covered from downstream of the Platte-Loup confluence to upstream of the Burlington Northern bridge, and incorporated that into the HEC-RAS model as well.

LEE EMERY: One eighty-nine.

ROGER KAY: We then took the -- overlaid these channel survey cross sections and overlaid it over a 10-meter DEM to extend our overbank geometry so that when we modeled the larger flows, we would be able to represent the conveyance that occurs outside of the natural channel.

Just going through the methodology. As Pat explained, the model is calibrated to both the

Genoa rating curve and also calibrated against major water surface elevations during the -- that were taken during the channel surveys.

The calibrated model was then used to verify the parameters from the sediment study for the open water conditions. We looked at both the effective and dominant discharge, ran those through the HEC-RAS model, and looked at both the current operating condition and the no flow -- no diversion flow condition.

And even though the values may not match exactly as far as top width or depth or velocity, the relative difference from the HEC-RAS model to what the effective and dominant discharge calculations are computing are consistent.

In other words, if our top width from the hydraulic model that we took a cross section, compared it to what Pat and his group came up with for effective and dominant discharge, top widths if no diversion scenario showed 15 percent difference in what his calculations showed versus a specific cross section in the HEC-RAS model. If we looked at the with project conditions, the difference between predicted and -- from the sediment calculations and in the hydraulic model were the same, 15 percent.

So that indicated to us that there was essentially no difference between with and without project geometry, and, therefore, there was no need to modify the model for project operations to look at two different channel geometry regimes. There is just one valid channel regime that was used.

We then took the HEC -- the HEC-RAS model. We modeled ice formation flows with 10, 25, 50, 75 percent flows by duration for the months November, December, January, since these are the months we typically see the river freeze up.

And we also then modeled a freeze-up jam with 10 percent flow by duration from December to look at both the amount of ice that's produced in the river at these various discharges under the two scenarios, current operation and no diversion, and looked at what that also has in terms of the impacts for freeze-up jams.

We'll get to the results here. For breakup period ice jams, we came up with the amount of ice that was available to be in a breakup jam by looking at our pre-breakup flows that would typically be in the month of February. We looked at the 10, 25, 50, 75 and 90 percent flows by duration to come up with a range of potential ice volumes that were available.

We also looked at ice thicknesses that were based on the average freezing degree day, and one standard deviation above freezing degree days, and that came out to about 13 inches and 19 inches.

We used those volumes of ice then within each reach to come up with how much ice would be available if an ice jam should occur.

We then modeled breakup jams with the two, five, ten, 20 and 50 year discharges, and we took the amount of ice we computed and reduced that by half.

The reason we do that is because during the course of ice breaking up, and as it's transported downstream, even though the water is still very cold, there is still enough heat in the water to begin melting the ice as it's being transported downstream. As the ice tumbles against one another, it breaks up into smaller pieces, and those smaller pieces can melt away a lot more quickly. We also see some ice getting shoved up as we get these ice runs. We see the ice getting shoved up on sandbars, up onto the high banks, and we lose quite a bit of volume of ice in those. Not every river is exactly the same, but on average

50 percent loss is kind of what we tend to see on nearly every river that we've modeled.

If we look at results from our freeze-up period, we see the HEC-RAS predicts nine locations that are most likely to freeze up, to form or freeze up jam. And I'm not sure how well these show up, but this is the first location, second location, third, fourth, fifth, sixth, seventh, eighth and ninth.

These locations varied very little based upon discharge. Depending on the specific discharge modeled, the location of the ice jam, freeze up ice jam might move upstream or downstream, one in cross section, however, there is really no trend to correlate where that ice jam may move to upstream or downstream of these locations based on discharge. Kind of just is a function of the discharge and how that -- how all the hydraulic characteristics of each cross section interplay with one another at various discharges.

The one thing that is consistent, though, is that the no diversion scenario, in other words, no water being taken into the power canal produces higher stages because we have a greater amount of flow going down the bypass reach, have a greater volume of ice.

But in all the formation of the ice cover, formation of freeze-up ice jams, and the areas where we see open water, or potential for open water are all very similar regardless of the flow in the channel.

The only thing that we can really correlate with flow is the volume of ice that can be produced out on the river, and that's just strictly a function as we have more flow in the river, the river just gradually gets wider and wider, and you can get more and more ice produced just because of that greater top width.

This is just showing where we have the reaches -- or the areas where we would most likely see the river remain open if there was not upstream ice being transported down against a stabilized cover and then progressing upstream.

These locations stayed the same regardless of discharge, and the implication there is that, you know, if there is not sufficient volume of upstream ice available to be transported down and cover this -- these areas up, that these areas would be open regardless of project operation, and that they would be producing significant volumes of frazil ice that could cause problems downstream. That's regardless of whether the project is in operation or not.

When we look at the breakup jams, we see fairly similar jam locations that we see with the freeze-up jams. Again, these locations move around just slightly with discharge, but they tend not to move more than one cross section upstream or downstream.

One thing I have up here is that HEC-RAS does not self-predict a jam below the Highway 81 bridge. It does show a thickening of the ice cover in that reach where we historically have seen ice jams on the Loup River out here. However, those thickening accumulations only occur when there is thickening of ice downstream.

And we did model this reach with the DynaRICE model and matched -- observed high water marks from 1993 to 1969 very well. We've also modeled this reach previously with HEC-2 and HEC-RAS, and we produced the ice jam floods that occurred in 1969 and 1993, so we didn't feel we could really add anything by modeling it again.

The one thing again as same as with the freeze-up period, the -- when there is no flow being diverted into the canal, you get higher stages because you've got more flow coming down the river and you have slightly greater volume of ice.

And before going to the last objective, are there any questions about the HEC-RAS modeling?

All right. The last objective was to identify methods for prevention and mitigation of ice jams. However, since we didn't identify any measurable impacts due to project operation, there was no need to identify any measures for mitigating or preventing ice jams.

On slide 196, then in summary of what our results and conclusions are, a review of the flood history of the Loup River indicates that ice jam frequency has not increased since the project began operations in 1937.

Review of the climatological data and flow data, and the use of our hydraulic models does not show a difference in occurrence of minor ice jam flooding occurring.

The third point, climatic variability and floodplain development may lead to an increase in flood risk with time.

And, lastly, we concluded the project operations have not measurably changed the Loup

River ice regime, nor increased the risk of significant ice jam flooding.

Does anybody have any questions?

STEPHANIE WHITE: Thanks. I think it's a good time for a break. Let's come back at a quarter after. It's a little bit more than a 15-minute break.

(2:55 p.m. - Recess taken.)

PAT ENGELBERT: Thank you, Stephanie. Hopefully the temperature has cooled down a little bit for folks. If you start getting warm or want us to crank it back on, just let us know, I can always talk louder.

As Stephanie said, we're ahead on schedule a little bit, so we're going to go ahead and dive into hydrocycling.

Just as a review, the goal of the hydrocycling study was to determine if project hydrocycling operations benefit or adversely affect the habitat used by interior least terns, piping plover and pallid sturgeon in the lower Platte River.

The objectives that we came up with, you know, 18 months ago or whenever we first met were -- slide 200.

So the objectives to compare the sub-daily project hydrocycling operation values, the maximum and minimum flow and stage, to daily values, mean flow and stage. In addition to same-day comparisons, we'll look at periods of weeks, months and specific seasons of interest to protected species will be evaluated to characterize the relative degrees of variance between hydrocycling, current operations and run-of-river operations in the study area.

The second objective is to determine the potential for nest inundation due to both hydrocycling, current operations, and run-of-river operations.

I would just like to note at this time the only alternative condition that has been identified is that run-of-river operation. And to review the definition from this morning, run-of-river is in the power sense in that we're not regulating the water to hydrocycling, it's going through the turbines as fast as it's diverted.

The third objective is to assess the effects, if any, of hydrocycling on sediment transport parameters, and to identify any material differences in potential effects on habitat of the tern, plover and pallid sturgeon.

Again, a quick review of the study area for the hydrocycling study. It's that area on slide 202. It's those areas that are located in the vicinity of the canal return and then going all the way down to Louisville.

So we'll be looking at the ungaged site three, which is just upstream of the return for comparison purposes, that was per the -- FERC's determination letter, ungaged site four, which is just downstream of the tailrace return, ungaged site five, and then we'll talk a little bit about the gaged sites further downstream.

Moving on to slide 203. The associated tasks that we have with meeting objective one were to develop the hydrographs of current operations and compare them to the run-of-river condition.

The methodology that we used, we incorporated the synthetic hydrographs, and that's what we discussed this morning, we plotted those for both current operations and the run-of-river operations, and then we looked at the maximum, minimum and mean flows for a wet year, a dry year and a normal year. We did that at both the gaged locations and the ungaged locations, and we looked at them annually and seasonally.

For the purposes of this presentation, I'll be showing representative slides of the normal year. The dry and wet year information is in the report, but for the sake of time, we'll be showing just the normal year information here today.

This is slide 205. This is the synthetic hydrograph that was developed at site three, which is upstream of the tailrace.

I'm going to go on to the next slide which shows it seasonally because it provides a little bit of clarity for the folks in the audience. I'm off to slide 206 now.

A couple interesting things to point out, there is some, you know, flow variability from May 1st through August 14th, 2009. You see some -- you know, some decreasing flows as you come off the typical spring high flows that occur. Here's the storm event that occurred in 2009, and then you see, you know, again some daily variation in the flows, and this is at the -- again, the gaged site that is upstream of the tailrace.

So you do see some natural flow variability that occurs, the decreasing trend in flows as you come off the spring, high flows going into the summer. This is a local storm event, and then, you know, flows transitioning toward the end of the summer to the end of the nesting season.

So that is the synthetic hydrograph that we developed for 2009 which was classified as a normal flow year for the site just upstream of the tailrace.

Going into the hydrograph -- and one thing to point out, back a slide, this is again at slide 206, the current operations and the run-of-river are the same thing. The site is unaffected by the project's operation. So the blue lines and the yellow lines are right on top of each other.

Here going down to site four, this is the ungaged site located just downstream of the tailrace. This is the annual synthetic hydrograph that was developed for 2009, and, again, we have quite a bit of information on here. The blue lines are the daily flow fluctuations as a result of project operations, and the yellow lines are the run-of-river operating condition.

I'm going to focus on the next slide, 208, which is the seasonal 2009 showing both current operations and the run-of-river. And similar to what we had done this morning, I'm going to slowly transition what each thing means so it doesn't look as cluttered as it will at the end.

The first dotted blue line that comes in, that is the daily minimum that occurs under current operations. This next line, the solid blue line is the daily mean flow rate that occurs under project operations, and the dashed blue line is the daily maximum that occurs under current operations.

Okay. So a couple things to note on this particular graphic -- again, we're on slide 208. As you can see, you have about a -- roughly a 3,000 CFS fluctuation, daily fluctuation between the maximum and minimum. That occurs under project operations.

Once you get into the storm events, you know, these are flows that are as a result of a storm event, you see a greater max and min fluctuation, the rising and falling of the particular storm event. And then near the end of this particular season as we get into more daily flows outside of the storm event or the kind of a dry weather condition, if you will, you see roughly a 2,500 CFS daily fluctuation that occurs as a result of project operations. Okay.

So is everyone kind of clear what we're demonstrating here? It's the maximum, min and mean discharges that we see on a daily basis as a result of project operations for that season between May 1st and August 15th, and this is for a normal flow year, that being 2009.

Okay. Next I'm going to cascade in the run-of-river synthetic hydrographs that were developed.

The first one is the dashed -- or the dotted yellow line, which is the minimum flow that would occur if they didn't regulate the flows, they just ran them through the turbines as fast as they could pull them off the river, or close to that.

The second line, which is pretty close to the minimum, the solid yellow line is the mean daily flow that would occur on project operations.

And this last line is the maximum flow that would occur under a run-of-river condition.

A couple things to point out here, again, you see kind of some natural flow variability that does occur under the run-of-river scenario. The peaks that would occur during the storm events are slightly lower than what is occurring under project operations. However, the minimums, the difference between max and min during the storm event are similar to the max and min we see under project operations.

Okay. Another thing that we noted or another trend that we noted is although daily we see approximately a 3,000 CFS fluctuation, under a run-of-river scenario, that 3,000 CFS fluctuation would occur, however, over the course of approximately three weeks.

For example, from May 1st at around 6,000 down to May 22nd around, oh, 2,500 CFS you have that -- the same decrease -- or the same flow change over a three-week period that you see daily under project operations.

So just to reiterate, daily we're seeing about a 3,000 CFS difference between max and min, under a run-of-river operation you would see that 3,000 CFS change, but it would occur over approximately a two- to three-week period.

A couple other things to note is at the tail end of this particular year, 2009, we see some daily fluctuations for the project operation scenario. Those are a result of project management activities that are going on in the Platte River upstream of Duncan, so I just wanted to note some of the variability that does occur in the hydrograph that are not related to the project.

Kind of blow up this area, on the left there on slide 209, this is just a blowup of what I just described where daily we're seeing about a 3,000 CFS differential between the maximum, minimum daily flow, and we see about a 3,000 CFS change in flow over a three-week period. So just kind of wanted to bring that to folks' attention.

Here is the synthetic hydrograph that we developed down at Louisville. This is the seasonal hydrograph, and the point of these graphics are to show kind of the dampening effect as we moved downstream. The further downstream you get from the project, the lower magnitude change you see in that daily flow.

Again, we're on slide 210. Down at Louisville the difference between the maximum and minimum gets reduced around 2,500 CFS as opposed to the roughly 3,000 CFS we saw upstream at site four. But, again, you see similar trending over a three-week period that we saw daily under project operation. So, again, we see a difference of around 2,500 CFS that occurs daily under project operations versus a 2,500 CFS change in flow over approximately a three-week period.

I'm on slide 211 now. Similar to what we had done with the flow, we took the synthetic hydrograph and we put it into our steady state model that we calibrated to get an idea of how the stage changes over time, so we developed a synthetic stage hydrograph.

So we looked at the maximum, minimum and mean stage for a wet, dry and a normal year. We did it at both the gaged and the ungaged locations, and we did it annually and seasonally.

I will again -- this shows site three, which is upstream of the tailrace, and you can see the daily stage fluctuations that occur at site three, again, which is upstream of the tailrace, so it would be unaffected by the project. You see kind of a slight stage fluctuation due to natural river conditions.

This is the seasonal graphic at site three. By season that was defined, you know, in previous correspondence as being from May 1st until August 15th. You see a slowly declining trend in the stage, because we have a declining trend in the flow from the flow hydrographs. You see an increase in the stage that is occurring -- again, I'm on slide 213. Each one of the horizontal lines represent a foot in stage. So over the course of, oh, about a month, we saw decrease in stage of approximately a foot. At the tail end in the July time frame, we see kind of a daily stage fluctuation. Again, those are from activities that occurred upstream of Duncan.

Here we are again at site four, and this is the annual stage hydrograph that was developed. And I'm going to go by this one pretty quickly, go straight to slide 215, which is the seasonal stage variation. I'm going to build it up again similar to what I had done with the hydrographs.

This is the -- under current operations, this blue dotted line represents the minimum daily stage. The blue solid line comes in clear in the upper left-hand corner for some odd reason, as does the dash line. Son of a gun. Is there any way we can fix that on the fly? It didn't do that at home.

GARY LEWIS: Try it again.

PAT ENGELBERT: Well, imagine that superimposed on top of that.

LISA RICHARDSON: Do you want to take a couple minutes, Pat, and see if George or Wendy could fix it?

PAT ENGELBERT: That's a bad deal. I wish I was John Madden and could just circle it and slide it down.

George, do you want to grab the computer quick and see if you can fix it?

Now would be a good time to visit our concession stand.

I think what you'll see is the -- a little precursor, you'll see that as the flows decrease, the difference in stage increases, which represents a trend that as flows get lower, the magnitude of the stage differential gets greater.

GEORGE HUNT: I think it's working.

PAT ENGELBERT: We're back on now.

LEE EMERY: How far is Louisville downstream from site four?

PAT ENGELBERT: It's probably -- North Bend is probably 30 miles downstream, Louisville would be another probably -- it's probably 60, 70 miles downstream. I've got the exact river miles in my book I can get you when I'm done.

LEE EMERY: That's fine.

RICHARD HOLLAND: Louisville is river mile 17, North Bend is like 57, and the power canal is about 101.

PAT ENGELBERT: Louisville is the last gage on the Platte before the confluence with the

Missouri.

We're fixed. George waved his magic wand and we're back.

Here is the stage differential, the mean daily stage that has occurred is a solid blue line, and then the dashed blue line is the maximum daily stage based on our synthetic hydrographs and our calibrated model.

Now I'm going to dump hopefully right on top -- okay, the yellow dotted line is the run-of-river minimum daily stage, solid line is mean daily stage, and a dash line is maximum daily stage.

A couple things again to note what I was describing earlier is that the daily change in stage is approximately one foot what we've modeled.

What's interesting is that one foot gets closer to a little over a foot and-a-half as flows -- as flows decrease from roughly 5 and 6,000 CFS down to that 2, 3,000 CFS, you see a greater difference in the maximum and minimum stage. So as flows go down, you see a greater differential in stage.

You know, you're kind of -- as flows go up, you're kind of submerging some of the sandbar features and other things which is what explains that.

Again, naturally you see about a one foot decrease in stage over that, well, approximately three-week period what you're seeing daily under current operations. So that's what that particular slide shows.

Here we are down at Louisville. Again, you see kind of a dampening effect. We're showing slightly less than a foot in stage differential, where before we were showing a little over a foot, but it stays pretty consistent. It doesn't seem to be as affected by the dryer -- you know, the lower flows, because you've got the influences of the Elkhorn River and Salt Creek down at Louisville, so, again, you have some dampening effect as you work downstream.

Here we wanted to include this in the report. This is a flow hydrograph of the North Bend gage between Thanksgiving of this past year and December 11th of this past year. Just wanted to note the natural flow variability that is occurring. This is a time when the project was not in operation. They had -- they shut the diversion gates due to the presence of frazil ice.

GEORGE WALDOW: Slide 217.

PAT ENGELBERT: We just wanted to note that there is some daily flow variability when the project -- you know, even without the project, so --

Here's kind of a summary of the statistics of those previous slides. This is based on the annual 2009, the normal year, the annual hydrograph. The difference in flow between maximum and minimum upstream of the tailrace return, so this is the average difference between the daily max and min over the course of the year is approximately 840 CFS. Downstream that is increased to approximately 3,700 CFS. So that's the average difference between the daily max and min over the course of the year.

This would include -- you know, we saw early on under the dry weather condition, the nonstorm condition, that difference was around 3,000. That gets much larger as you go through the storm event, and then back down to what I would consider the dry weather.

For run-of-river operations, the 840 stays the same. Again, it's unaffected. But that difference under a run-of-river scenario, the maximum and minimum difference is around 1,000 CFS.

Going to the stage or the water surface elevation difference, the average difference between the maximum and the minimum stage upstream of the tailrace return is around four-tenths of a foot. Downstream it's about 1.3 feet.

Under run-of-river operations, the four-tenths is essentially the same, but the difference downstream of the tailrace is around -- a little under -- a little over a quarter of a foot.

Another interesting thing to note, as we look at current operations, maximum minus a run-of-river max. This gives us an idea of what the average difference would be for the maximum stages that would occur under the two scenarios is about three-tenths of a foot downstream of the tailrace return. So those are some statistics we pulled together based on the study that we did on an annual basis.

Going into a seasonal basis, those numbers are a little bit lower when we're looking just between May 1st and August 15th. The difference in flow upstream is around 890 CFS, downstream of the tailrace the difference between max and min on average over that season is around 3,600 CFS.

The stage difference under for current operations, upstream and downstream, four-tenths of a foot upstream of the tailrace, downstream about

1.4 feet is the mean daily difference between max and min.

For run-of-river, the discharge goes from -- stays around 900 CFS upstream, but it's around just under 1,100 CFS downstream of the tailrace.

The stage for run-of-river operations is between four-tenths and three-tenths upstream to downstream.

Again, wanted to note that the maximum stage for current ops compared to the maximum stage for run-of-river seasonally is approximately three-tenths of a foot on average over the course of that season.

Okay. Any questions on the current operations hydrographs versus the run-of-river hydrographs, or the current operation stage hydrographs versus the run-of-river hydrographs, and the associated differences, does anyone have any questions over that?

Again, we summarized them just for the normal year for the purposes of this presentation. The remaining information is in there for wet and dry, for the wet years and dry years.

So I'll just kind of summarize the results similar to what I had talked about. We're on slide 220.

The difference between maximum and minimum, daily water surface elevation is larger under current operations than under a run-of-river condition.

Similar differences for the run-of-river condition are seen except over a, you know, two- to three-week period as opposed to daily.

The largest differences do occur in a dry year under those low flow conditions.

Downstream differences are less. Those gages that are downstream have less variability than do -- in the near vicinity due to that dampening effect that we discussed.

And the average annual difference in water surface elevation is typically less than a foot. That's looking at wet, dry and normal. So when you look at all three of those, it's around approximately one foot.

That's all that I have for our hydrograph comparison due to hydrocycling. I'm going to turn it over now to Matt Pillard unless you guys have more questions, or any questions. I'll turn it over to Matt Pillard who will talk about the nest inundation analysis that we performed.

MATT PILLARD: Objective two of this study was to determine the potential for nest inundation due to both hydrocycling, current operations, and run-of-river operations. A task here that we looked at was looking at nesting season sandbar inundation heights.

And so I won't go through all the methods here. We really built on everything that Pat had developed relative to synthetic hydrographs and those types of things to utilize for this particular study. So we used the same synthetic hydrograph that Pat developed for years 2003 through 2009.

We looked at just site four for this particular study downstream of the tailrace. I believe in your -- in CD that's attached to the study plan -- or the study results, we do have some site five results in there as well. They were nearly identical, so for the purposes of analyzing just go to site four. And we did that for both again current operations and a run-of-river condition.

So what we did here is we established a benchmark flow, and how we did that, we did that for the pre-nesting season for both species. And so we looked at -- for that the highest daily flow prior to birds arriving. So we went from February 1st to April 25th for plovers, and then May 15th -- February 1st to May 15th then for terns. And so we used that highest daily flow as a benchmark as a pre-nesting season surrogate for potential nesting elevation.

And as you can see here, it's kind of an example then. Here for this particular -- this is site four, I'm on slide -- I can't see what slide number I'm on.

LISA RICHARDSON: Two, twenty-four.

MATT PILLARD: Two, twenty-four. This is site four downstream of the tailrace in 2005. And so the highest daily flow prior to April 25th was for a -- current conditions was on February 5th, and again for the run-of-river condition it was on February 5th as well, so those would be for this particular example the two benchmarks that were established. And then we build on that for the next missions of the study.

So what we did then we used that benchmark flow compared to subsequent sub-daily flows during the nesting season. So then we looked, you know, for each year then from April 25th through July 31st for piping plovers, and May 15th then through August 15th for least terns.

And what we then did was try to determine how many times for both operation conditions, you know, did that -- was that benchmark exceeded.

We also then -- you know, as we started looking at the data, realized that one event might have a series of exceedance of a benchmark. You know, a storm event comes, it exceeds that benchmark for three or four days, and then again you go below the benchmark. So we also then looked at how many events might have occurred during the nesting season just for comparative purposes.

And obviously those events would be the same for both conditions, it's just another way to kind of look at those exceedance events.

So, again, here is an example then using that same site four in 2005. You know, here would be an occurrence of an event of which we had four separate days that exceeded this benchmark for both current operations and run-of-river. And, again, another event that had three exceedances. Again, the benchmarks were exceeded for both current operations and run-of-river respectively. Third event and a fourth event. So that's kind of how we looked at the data for each year for each species.

And then a couple of assumptions here. Kind of things that this study -- you know, the benchmarks isn't really related to any particular elevation. We could have derived a stage from that, but we chose just to look at these flows from a benchmark perspective.

Habitat may be available out there above that particular benchmark. Again, we didn't look at -- compare the benchmark to any of the cross sections that we had done. This is purely looking at flows.

We understand that birds can and do nest above the highest -- you know, above that benchmark flow, and they might choose a nest below that benchmark flow. Really we just wanted to use that as a baseline to compare how often might that particular benchmark get exceeded throughout the course of a nesting season.

And then, you know, we also -- you know, we also assume that there would be a 60-day period that would be required for successful nesting attempt. We use that to -- as we looked at when subsequent benchmarks exceeded, you know, might there be the potential for renesting.

And so results here -- now, generally as you remember back in the graphs, I have to go backwards for this -- I went backwards to slide 226 briefly.

Generally you can see, and not surprising per Pat's discussion of the hydrographs, that current operations obviously has a higher benchmark, you know, than the run-of-river condition. And really all subsequent daily flows are going to be typically higher than the run-of-river condition.

There were a few cases, you know, most likely due to a daily change in operation where a run-of-river flow might have been higher than a current operation flow, but fairly consistently current operations had, you know, higher flows than did run-of-river. Not surprising. Pat kind of already covered that piece.

What's kind of interesting to us anyway is that there were a number of years in which the benchmark that occurred during that pre-nesting season was never exceeded during the nesting season, and that occurred more often than we would have expected. And, again, that's for both conditions.

So for 2003 to 2006, that benchmark was not exceeded for least terns, and in years 2004 and

2006, that benchmark was not exceeded for the piping plover.

The other thing that we found is that there were a number of years in which the number of exceedances of that benchmark for each operation were identical. So, you know, 2007 through 2009, the number of exceedances for least terns for current operations was the same number of exceedance that we had for run-of-river conditions. And for piping plovers the identical exceedances occurred in 2005 and 2007 through 2009. So that really left us with -- I guess here is an example I guess we showed. Site four, you know, same number of exceedances in this particular year.

I think what we, you know, really ended up then one year where we had somewhat of a difference between the two operations, and that happened to be in year 2003 for piping plovers in which in that particular year there were 12 exceedances of the run-of-river benchmark, and four exceedances for the current operations. And I think we have that example here.

So this is site four, 2003. The benchmark was established on March 8th, and it was roughly 7,800 CFS. And the benchmark happened to be just much lower for the run-of-river condition in a pre-nesting situation.

So as we went through the nesting season, you can see that there were a number of occurrences here where the run-of-river condition exceeded, and actually in this particular block the current operations was less than run-of-river. Again, that might have been due to closing their gates due to high flow when they have large storm events.

So this -- the one example where the run-of-river condition happened to have more exceedances in this year than would have the current operations condition.

So really, you know, kind of to summarize, there were -- in this particular -- in -- the benchmark that we used, there were no instances where current operation exceedance could have been avoided on a run-of-river. So actually what we then did is we looked at -- you know, after the pre-nesting season benchmark, might have there been a potential to avoid that exceedance if a run-of-river operation were then performed after the birds arrived. And from the years we selected and the benchmark that we used, we didn't find any.

You know, normal season flow events during the nesting season, you know, really they create potential for nest inundation throughout the whole nesting season. We also kind of looked at when did these events occur. When you look at all the different years there is, you know, exceedance events in May and June and even in July. So those exceedance events can occur for both operations really throughout the majority of the nesting season.

And, you know, getting kind of back to the first one, we didn't have any -- we didn't find any times in project operations cause an exceedance of a benchmark flow that could have been avoided on a run-of-river condition.

So I guess before I go forward, are there any questions?

So this is objective three. And this is to assess the effects, if any, of hydrocycling, current operations, on sediment transport parameters. And there were some associated tasks here that we looked at. Pat is going to cover these for us.

PAT ENGELBERT: As Matt said, objective three is to assess the effects, if any, that hydrocycling has on sediment transport parameters.

What we did is we looked at our synthetic hydrographs for current operations and run-of-river, and we evaluated -- we performed our sediment transport calculations taking our sediment discharge rating curves and marrying with the hydrographs to see what our resultant sediment transport calculations are.

The tasks associated with that again is we calculated what the sediment transport is, we evaluated the indicators, total sediment transport dominant, effective discharge. We looked to see how the channel characteristics associated with those indicators, how those changed between current ops and run-of-river, and we compared the regime analysis for current ops and run-of-river.

I'm now on slide 234, and this is a summary table showing the sediment transport calculations at the ungaged sites, sites three, sites four and sites five.

One of the things that we wanted to note is there is a difference in the sediment transport calculations between using daily data and the sub-daily data. So we just wanted to note that in general you get slightly -- it looks like -- in general you get slightly higher values of sediment transport using the sub-daily data than using the daily data. Okay. It looks to be slightly higher data.

These are the values for I believe 2009. The first table shows the values for just using the 2009 hydrographs for current operations and run-of-river. And we'll focus on the sub-daily data that was necessary to use in order to evaluate the effects of hydrocycling.

But looking at site three, upstream of the tailrace, we have effective and dominant discharge in the range around 2,500 CFS. And the total sediment transported is around 1.1 million tons.

Going downstream of the tailrace return, that dominant and effective discharge goes to approximately 4,700 CFS for the dominant discharge, and 5,600 CFS.

The total sediment transport capacity at site four under current operations is around 3 million tons per year.

Okay. Looking at the same parameters for the run-of-river condition, the dominant and effective discharge is approximately 4,600 CFS and 4,800 CFS, with capacity at site four downstream of the tailrace return of around 2.8 million tons per year.

Okay. Similar trends we see at the site five near North Bend, the dominant discharge and the effective discharge were around 42 and 4,500 CFS, and the total sediment transport capacity is around 2.3 million tons for current operations, and it's very similar results for the run-of-river operations.

That is for just evaluating the 2009 hydrograph.

Next we look at 2003 to 2009 to get a longer term feel for how this would respond. Here are the sediment transport indicators, that being total sediment transport effective and dominant discharge for current ops and run-of-river.

At site three, again, just focusing on the sub-daily data, we're about 2,400 CFS for the effective and dominant discharge, with a total sediment capacity of around a million tons.

Looking at site four, the dominant and effective discharge is roughly around 4,000 CFS for current operations -- that is -- for run-of-river it's slightly lower, 3,900 and 3,400. And the total sediment transport capacity is also slightly lower at about 2.4 million tons. That's the average annual sediment transport capacity. And, again, those values are similar to what we would see at the North Bend gage.

Okay. We plotted those -- kind of plotted those spacially on the map so you can see the trending from upstream to downstream.

LEE EMERY: Figure 236.

PAT ENGELBERT: I'm going to focus on the '03 to '09 stuff so we get kind of a longer term feel for it.

At site three the sediment transport capacity is around a million tons. Downstream of the tailrace it's about 2.5 million tons. And then again working our way downstream. That was for current ops. For the run-of-river condition, we've got at site three still about a million tons, but the downstream of the tailrace it's about 2.4 million tons under run-of-river condition as opposed to going back to slide 236, 2.53 million tons. So you have a slight decrease in the total sediment that is being transported on an annual basis. And, again, working our way downstream.

So in summary, in summarizing those results, the sub-daily values, the sub-daily hydrograph values that we used result in slightly -- they have slightly higher sediment transport results than do the daily values.

A couple things, the short-term values differ from long-term values by up to 40 percent. So if you're looking at just a year versus that six-year trend, that's why we -- you know, we tend to focus on sediment transport calculations looking at a long-term trend as opposed to an annual basis.

And then last the total sediment transport capacity is slightly higher for current operations than what we see on a run-of-river condition.

So any questions on just the sediment transport calculations that were performed comparing current operations to run-of-river?

Next I'm going to go into kind of the channel characteristics and how those differ between current ops and run-of-river for the dominant discharge, so --

LEE EMERY: Paul, any questions?

PAUL MAKOWSKI: As you move downstream, I notice that the capacity does not necessarily increase, and that the biggest deficit or the largest capacity -- I really haven't had time to think about it. Is there a quick explanation?

PAT ENGELBERT: Well, there is a couple things that -- you know, at site four, and we kind of alluded to it a little bit earlier. Developing the sediment discharge rating curves for the sites was based on the one survey. When you look at the other parameters, one of the more important ones, that being the D-50, that was based on linear interpolation, so I'm assuming the combination of those two are what's slightly skewing those transport capacities at site four.

PAUL MAKOWSKI: So should the comparisons be between the run-of-river and the current operations versus spatially?

PAT ENGELBERT: That comparison would -- I think would be a relative comparison, but if we're comparing site three to four to five to six spatially, that gets a little trickier just because we use the one single year survey values.

But the comparison that we showed in the table did show site four run-of-river versus current operations, which is probably, you know, a reasonable comparison between those two conditions.

PAUL MAKOWSKI: I'll have to continue to think about it.

PAT ENGELBERT: Okay. Any other comments, questions, Lee, anybody? I know it's exciting.

GEORGE WALDOW: I'll give you one. George Waldow, HDR. Your third bullet point there, there is a reason for that; would you share that? Would you share the reason for the third point conclusion?

PAT ENGELBERT: The third point is the total sediment transport capacity is slightly higher for current operations than it is for run-of-river. And the reason for that is the sediment transport relationship is a nonlinear relationship. The highs aren't offset by the lows when you're looking at a daily hydrocycling thing, so the mean does not give you the average between the high and the low, because the high is a little bit higher than the low is lower, if that makes any sense at all.

So basically because the high point transports more, and it's not offset by the low point, the mean daily does not give you the average of those two. So during the hydrocycling, the higher transports more than what is offset by the low, so it's slightly higher than the mean -- what the mean discharge would give you.

Any questions on that, more confusion?

Okay. With that I'm going to move on.

What we did next is we took the -- similar to what we had done in the past, we took the dominant discharges and we compared them to the widths and depths associated with those dominant discharges, and we compared them for current operations and a run-of-river condition.

Okay. This is for 2009.

LEE EMERY: Slide 239.

PAT ENGELBERT: The effect -- the effective and dominant discharge, you can see that for current operations because the -- you know, the discharge is slightly higher. You have slightly greater wetted widths under current operations than you do under the run-of-river condition.

JEFF RUNGE: Sorry, Pat. Question here. Did you take the effective and dominant discharges and run that through the HEC-RAS model as far as like to get those numbers?

PAT ENGELBERT: We generated these numbers from the RAS model using those relationships that I showed this morning. So it would be an average of all the cross sections for a range of flows. But it's a good question, because we did take a look at for that dominant discharge what would the width and depth be, and it fell right on where we expected because we used the model to generate those relationships. We used the model to prove the model. Unfortunately it wasn't really a validation.

We used the model to generate the relationships, so in going back and running that discharge in there we would expect it to prove out what the relationship showed.

JEFF RUNGE: The values that you used to prove those would be the -- you ran the effective discharge for all the multiple -- well, in this case just for 2009, a single flow value, the effective discharge to come up with those numbers, and then the dominant discharge a single value for both operations, and that came up with those values?

PAT ENGELBERT: Right. And it was based on that relationship -- using the best fit relationship between that range of depths and velocities and widths that we had gotten from the model.

JEFF RUNGE: Okay.

PAT ENGELBERT: So from this graphic you see the width is slightly smaller for a run-of-river condition than it would be for current operations.

Similarly, the depth is slightly greater. Again, this is looking at 2009. Slide 240, the depth is slightly greater for current operations than a run-of-river condition.

Here is a graphic showing the 2003 through 2009 hydrographs looking at the widths and depths. The bars go from left to right sites three, four and five for effective discharge, and then sites three, four and five for the dominant discharge.

Similar to what we saw in 2009, the widths are slightly smaller under current ops than run-of-river as are the depths.

So in summary, for looking at the channel characteristics versus the sediment transport calculations, the channel widths and depths are slightly smaller for a run-of-river operation than for current operations. Again, that goes back to we have slightly greater sediment transport under current ops than we do under the run-of-river.

The last thing that we did is we compared the current operations' dominant discharges to run-of-river operations' dominant discharges, and we plugged those in our regime graphics to see if that would cause a transition from one regime to another.

So looking at a regime analysis -- again, this is Chang's graphic.

LEE EMERY: Figure 244.

PAT ENGELBERT: We plotted the current ops and run-of-river dominant discharges on the regime graphics, and it showed that it's still within -- clearly within that braided regime.

Similarly, to Lane's relationship, our graphic shows that for both current ops and run-of-river from a sediment transport perspective, it's still well within the braided regime.

So in summary, the regime analysis, current operations and run-of-river operations are both well within the braided river morphology, with neither transitioning from one regime to another, to another morphology.

So just to summarize the results from objective three, the run-of-river operation would carry less sediment than current operations, and the channel would likely be slightly smaller in a run-of-river operation as compared to a current operation.

LISA RICHARDSON: Can you give us just an idea of how much smaller the width would be and how much smaller the depth? Is it -- I was looking at your slides, it's pretty minor.

PAT ENGELBERT: The depths would be, you know, in the order of tenth of a foot maybe over this long-term average, you know, and the widths would maybe be in the order of 30 to -- 20 to 30 feet, something like that. We've got the numbers in the tables in the report, but we thought it would be easier to see in a presentation graphically using bar charts. So probably in the order of, you know, 20 to 30 feet, something like that.

Any questions on the sediment transport calculations that were performed comparing the current operations to a run-of-river operation?

GARY LEWIS: Pat, a comment on those widths. Bear in mind that's the wetted width. It may or may not have anything to do with examining widening. It's the wetted width for that discharge. The discharge is lower, it has a less wetted width than the higher discharge, so these are the wetted widths, not the channel widths. I think it's important to distinguish those two.

PAT ENGELBERT: Any questions on that?

JEFF RUNGE: That's a difference between the two, but as far as applying an effective or dominant discharge, which is a channel forming discharge, I guess I don't see -- you know, I guess why did you select the effective or dominant discharge as the measure to compare between the two, run-of-river and --

PAT ENGELBERT: You know, it goes back to the original definitions that it is those discharges, the effective and the dominant that are ultimately resulting in the shape of the river, so in evaluating what their widths and depths would be, what the river is pushing it toward, what it's trending toward, we used those values to see what the width and depth relationships were -- or what the width and depth values were relative to that particular discharge.

JEFF RUNGE: Yes, except you mentioned that those are channel forming discharges, but this is a fixed bed. I mean, there is no channel evolution that's predicted as a result of that. It's just -- you know, it's static, it's just changing wetted width, it's not predicting how that results in the change or evolution of the channel itself.

PAT ENGELBERT: That's a good point. These models are a fixed bed, rigid bed model. However, the relationships, for example, at the gaged sites, the relationships are based on, you know, general trends of the width and depth relationship over a wide variety of discharges. Similarly with this model -- we did look at two points in time, it was the best information that we had, and that's our best estimation of what that width and depth would be looking at two points in time.

I mean, you see differences in widths and depths just between the June and September surveys, so it's the best estimate that we have based on the data we had available.

It's a good point. Clearly it's a limitation that's noted in the report.

Anything else, any other questions, comments, observations?

With that I'm going to turn it back over to Matt Pillard who's going to talk about objective four.

LEE EMERY: Slide 248.

MATT PILLARD: Okay. Objective four was to identify the material differences in potential effects on habitat of the interior least tern, piping plover, and pallid sturgeon.

The task associated with this objective were to look at the effects of hydrocycling on interior least tern, piping plover, pallid sturgeon, and isolation of backwaters and side channels.

The methods that were done to perform this were a literature review and a comparison to other river systems. We looked at the Peters and Parham's discharge versus habitat relationship. We evaluated the lower Platte River stage change study. We did a comparison of the cross sections that were performed in the early summer and late summer. And we looked at habitat evaluation using the HEC-RAS model that was developed.

So to begin with the methodology for the comparison to other rivers, we looked for rivers that were within the range-wide survey population counts, rivers that had some flow alterations and structures on them, and the rivers within the interior of the country, meaning we weren't looking at coastal areas.

We compared the habitat characteristics of these systems. We looked at the flow operations of those systems compared to project operations, and we looked at the population counts from those range-wide surveys downstream of the structures on these other rivers.

The rivers that were chosen to look at for interior least terns were the Red River below the Denison Dam, the Arkansas River below the Keystone Dam, Missouri River below Fort Randall Dam, and

Missouri River below Gavin's Point.

For piping plover we looked at Missouri River below Fort Randall and Missouri River below Gavin's Point.

And for pallid sturgeon, the other rivers that were looked at were the Yellowstone River below the intake, the Missouri River below Fort Randall Dam, and again Missouri River below Gavin's Point. And this is just a graphic, slide 252, kind of shows geographically where these locations are.

Again, for terns and plovers we already went over the four rivers we're going to look at. This table here kind of shows -- the next two slides actually, 254, 255, which show kind of summary differences between these systems.

I guess the main things to point out are the Platte River below the Loup tailrace is a braided system. Most of the other systems are meandering below the structure. The Red River had some braided system above the dam, but it moves to meandering downstream.

Another kind of point to point out is the flows here on the Platte River were very similar to the Red River. The other dams, Missouri River and -- you know, obviously had much higher flows somewhat close to the Arkansas River.

And then population counts. You know, we're seeing lots more birds using the Red River and the Missouri River below Gavin's Point than the other three rivers, just for points of reference.

And then I guess finally here it's the -- here's kind of a look at the systems that are in place, and, you know, just -- you know, the Loup project is smaller in general than any other projects in terms of the amount that they put through the system.

So given all that, that makes it -- obviously because these systems are all different, and we have different things going on, it makes it really difficult to compare what projects are -- project operations and their effects here versus what's happening on these other rivers with larger dams and larger flows.

Some of the things that we did find out through discussions with folks on these systems and review of literature associated with these other rivers, particularly here on Fort Randall, their operations have shown that flow releases at higher rates during early nesting has encouraged birds to nest higher. That was through personal communication with -- oh, shoot, I have it here. Greg Pavelka.

Some of the literature reviews that we looked at, Leslie, a study in 2000 on the Arkansas, I believe, show that daily hydropower operations, you know, were not found to be affecting birds, whereas some periodic high flows was found to be beneficial for nesting.

Again, hard to compare these systems. These were just the results of what these other studies were. And here because our project -- the Loup project doesn't really have an effect on large flows like some of these other systems. They don't control larger flood events. The project's effects from daily hydrocycling on sandbar formation are, you know, different compared to what these other systems do just because of the way the systems operate.

Now we get into some issues on pallid sturgeon, and, Scott, it's time to wake up in the back corner.

If there are any questions on the lit review piece on the birds, we can handle these kind of at the end. Scott is going to go over a few number of things associated with the pallid for us.

SCOTT STUEWE: Well, as Matt stated earlier, we looked at the intake dam on the Yellowstone River, the area below Fort Randall Dam on the Missouri River, and Gavin's Point Dam below it as well.

The thing we needed to look at -- or we were directed to look at, of course, was the substrates, the flows, temperatures, turbidities, and we tried to put them in a table here for your review as well.

We saw everything from zero NTUs up to 6,400 NTUs. And I don't know, I looked at the Platte over lunch, it looks like it's like 6,400 today.

But as you can see, there is a very wide range in flows that we needed to look at, so it made a comparison rather difficult at best.

Describe a little bit of what the dams are doing presently, hydropower facility at Gavin's Point. Primarily at Gavin's Point they use it for flow control and water level fluctuations on the Missouri.

Again, it's a large reservoir, so you have hypolimnetic releases, which is not what happens with the Loup.

The same thing kind of like at Fort Randall. Daily releases for power generation, which I guess you would equate back to what the Loup does. Again, it's in a large reservoir, again hypolimnetic releases.

The intake dam on the Yellowstone is different. It's kind of like the diversion that we have on the Loup as it -- water is diverted through an irrigation canal. It was noted that this does cause some entrainment of fish, and once they get in there they can't get out.

As for the Loup, very little entrainment. They are coming up through the system since we were talking about the pallid.

LEE EMERY: Slide 261.

SCOTT STUEWE: A very wide range of habitat is utilized by the pallid sturgeon. Not necessarily because it's the best, but it's what's available. So we've seen the collections are -- for pallids have been deep water, shallow water, gravel, cobble, sand. They evidently can be collected anywhere. And as the studies go further with USGS and through the University of Nebraska-Lincoln, they are going to narrow those down even further.

They seem to prefer sand and fines

particularly as young, but they have been collected over the gravel and cobble areas. They think that this may be some response to spawning. In personal communication and with some reports from DeLonay with USGS, they have been -- seem to be gravitating towards the revetment areas on the outside corners of the Missouri River.

Stream bottom velocities have been highly variable, anywhere from zero to 4.2 meters per second, which, you know, you can say that's twelve foot per second, just round it off. Normally what we've seen in the Platte is around two foot per second.

Depths have ranged from approximately two foot in depth to 45 feet, and they are collecting these fish particularly in the Missouri River behind entrainment structures.

Again, water temperature, they are highly variable. They can be found in anywhere from 32 to 86 degree Fahrenheit water. They don't particularly like the 90 degree water.

Turbidity ranges anywhere from 12 to 6,400 NTUs.

Slide 262. There has been recent spawning detected by DeLonay on the Missouri River. There has been tracking that has occurred over the last two years. They are getting a better handle on where this may be occurring, though they have not been able to catch the fish in the act.

Pallid sturgeon has not been observed spawning in the Platte River, though there has been Scaphirhynchus species larvae that have been collected. Naturally the shovelnose and the pallid intermingle.

Other evidence of spawning has been observed along the revetments below the Gavin's Point area. They had hoped that they could detect them up in the cobble area, but at this point they haven't been able to do that.

We'll go into a little bit what we think may be happening. It's all hypothesis. But pallid captures have been on the rise in the rivers. It seems to be indicative of the increased stocking efforts that have occurred since 2000. These fish have been tracked particularly with University of Nebraska's studies. They have shown with these fish, they are marked fish and they can track them back to those hatchery sites where they were produced.

They are essentially being captured on

sandbars and sandy substrate within the Platte River area. Naturally there is not a whole lot of cobble and gravel in this area.

There is no direct evidence providing a link between hydrocycling and the reproductive behavior of pallid sturgeon. It's been theorized that with the releases, particularly from these hypolimnetic releases from the deeper lakes, such as Gavin's Point and Fort Randall, is that the temperatures are colder than what those fish can respond to.

DeLonay theorizes a combination of a rise in temperature and a rise in flow induces spawning activity.

LEE EMERY: Have any of the pallid sturgeon stocking occurred in the Platte River in the vicinity of the project?

SCOTT STUEWE: No, they haven't stocked in the Platte, but what they are seeing are the stockings from the Missouri.

RICHARD HOLLAND: There have been stockings in the Platte River.

SCOTT STUEWE: When did those occur?

RICHARD HOLLAND: 1996, -4, somewhere in there. There was a small group of fish stocked at

Two Rivers. That's about river mile 42. There was another stocking that was done at this part of telemetry study. There was another stocking associated with the University telemetry study I believe in around 2000.

LEE EMERY: Could you provide that information for the record?

RICHARD HOLLAND: I can see about getting it.

LEE EMERY: That would be great. Stocking with what size?

RICHARD HOLLAND: These were -- I would have to check.

LEE EMERY: It would be interesting to know that information.

JOHN SHADLE: Large enough to track.

SCOTT STUEWE: Thanks. I've been told we probably ought to just close from here and start up again tomorrow morning on this.

STEPHANIE WHITE: We're ahead of schedule and we're early on time. I think if you've got some pressing questions that you would like to ask, we certainly can do that.

Is there anything you would like to ask Matt or even Scott? Otherwise I think we can continue this conversation in the morning at 8:00 sharp.

(4:33 p.m. - Adjournment.)

** ** ** **

C E R T I F I C A T E

STATE OF NEBRASKA)
) ss.
COUNTY OF DOUGLAS)

I, Mary Lou Dubbelde, RPR, CRR, CSR(IA), CCR, General Notary Public within and for the State of Nebraska, do hereby certify that the foregoing was taken by me in shorthand and thereafter reduced to typewriting by use of Computer-Aided Transcription, and the foregoing two hundred and twenty-eight (228) pages contain a full, true and correct transcription, to the best of my ability;

That I am not a kin or in any way associated with any of the parties to said cause of action, or their counsel, and that I am not interested in the event thereof.

IN WITNESS WHEREOF, I hereunto affix my signature and seal the 7th day of March, 2011.

____
MARY LOU DUBBELDE, RPR, CRR
GENERAL NOTARY PUBLIC

My commission expires:

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