ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:)
)
WATER QUALITY STANDARDS AND) R08-9
EFFLUENT LIMITATIONS FOR THE) Rulemaking - Water
CHICAGO AREA WATERWAY SYSTEM)
AND LOWER DES PLAINES RIVER)
PROPOSED AMENDMENTS TO 35 ILL.)
ADM. CODE 301, 302, 303 and 304)

TRANSCRIPT OF PROCEEDINGS held in the above-entitled cause at the Will County Courthouse, 14 West Jefferson Street, Joliet, Illinois, on the 17th day of November, 2008, at 9:00 a.m.

BEFORE: MARIA E. TIPSORD, HEARING OFFICER,
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MR. SHUNDAR LIN,
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E X H I B I T S

THE HEARING OFFICER: Good morning, everyone. My name in Marie Tipsord, and I've been appointed by the Board to serve as hearing officer in this proceeding entitled Water Quality Standards Affluent Limitation for the Chicago Area Waterway System and Lower Des Plaines River, Proposed Amendment to 35 Il Admin Codes 301, 302, 303 and 304. This is Docket No. RO8-9.

At the table here in the middle is Dr. Tanner Gerard, he is the board member assigned to this matter. To his immediate right is Dr. Shundar Lin, our newest board member. And to his right is board member Andrea Moore.

To my left up here is board member Thomas Johnson. And also at the table right here is Anand Rao from our technical unit.

This is the seventh set of hearings. And, actually, I think this is the 20th day of hearing. The purpose of today's hearing is to continue hearing testimony from participants, other than the proponent, the Illinois Environmental Protection Agency.

At the close of hearing on October 28th, 2008, we had finished with 17 witnesses from the Metropolitan Water Reclamation District of Greater Chicago. We will continue with the District starting this morning with Dr. Charles Melching. If we have time today, we will then proceed to Dr. Cutter Makay.

The testimony will be marked as an exhibit and entered as if read. After marking the prefiled testimony as an exhibit, we will then proceed to questions for the testifier beginning with the IEPA and then, I believe, the only other person who filed prefiled questions were the Environmental Policy Center for Dr. Melching.

Anyone may ask a follow-up question. You need not wait until your turn to ask the question.

I do ask that you raise your hand and wait for me to acknowledge you. After I have acknowledged you, please state your name, whom you represent before you begin your question.

Please speak one at a time. If you're speaking over each other, the court reporter will not be able to get your questions on the record.

Please note that any question asked by a board member or staff is intended to help build a complete record for the Board's decision and not to express any preconceived notions or bias. We will have a lunch break today, and we will proceed to around 4:15, 4:20 so that we can try to be out of here by 4:30.

With that, Dr. Girard?

MR. GIRARD: Good morning. On behalf of the Board, I welcome everyone to the 20th day of hearing in this rulemaking. I look forward to your questions and testimony today. Thank you.

THE HEARING OFFICER: Mr. Andes, do you have any exhibits this morning, or are you going right to testimony?

MR. ANDES: Right to testimony.

THE HEARING OFFICER: In that case, can we have Dr. Melching sworn in --

(WHEREUPON, the witness was duly sworn.)

THE HEARING OFFICER: Mr. Andes?

MR. ANDES: Here is a copy of the testimony.

THE HEARING OFFICER: Thank you very much.

If there's no objection, we will mark Dr. Melching's testimony as Exhibit 168 -- I'm going to double check that to make sure I have the right number.

Yes, 168. There's no objection?

Seeing none, Dr. Melching's prefiled testimony is Exhibit 168. And we can begin with the IEPA and their questions.

DR. CHARLES S. MELCHING,

called as a witness herein, having been first duly sworn, was examined and testified as follows:

EXAMINATION

BY MS. WILLIAMS:

Q. Good morning, Dr. Melching. I'm Deborah Williams, and I'm here on behalf of the Illinois EPA.

MS. DIERS: Marie, I have that we

should be on Exhibit 169. Because I have 168 as the use attainability analysis.

THE HEARING OFFICER: That's why I looked, because I thought 168 did not sound right.

You're absolutely correct, Dr. Melching's testimony is 169. I didn't turn the page over. Thank you for keeping me straight.

So I will correct that. The prefiled testimony of Dr. Charles Melching is marked as Exhibit 169.

(WHEREUPON, a certain document was marked Exhibit No. 169 for identification, as of 11/17/08.)

THE HEARING OFFICER: Go ahead, Ms. Williams.

EXAMINATION

BY MS. WILLIAMS:

Q. Well, why don't we -- we'll just start with Question No. 1 of our prefiled questions.

In what areas do you consider yourself an expert?

A. Okay.

THE HEARING OFFICER: You're trailing off again, Deb.

MS. WILLIAMS: Do you need me to repeat?

THE COURT REPORTER: No.

But it could be louder.

BY THE WITNESS:

A. I am an expert in surface water hydrology, water quality modeling and management of streams and rivers. The first two were recognized by my peers, the American Society of Civil Engineers. And I received the 2001 Walter L. Huber Civil Engineering Research Prize for my research on uncertainty and reliability analysis in water resources and environmental engineering, including especially uncertainty in rainfall runoff and stream water quality modeling.

The third is confirmed by my selection as an associate editor in the Journal of Hydraulic Research from 2002 to 2006. And the International Journal of Sediment Research for 2002 to the present.

THE HEARING OFFICER: Dr. Melching, you also need to keep your voice up, as well.

You're trailing off, and I'm not catching the last of your sentences, so...

THE WITNESS: Okay. Sorry.

All right. I'll go slower and louder.

THE HEARING OFFICER: Yes, please.

BY THE WITNESS:

A. My testimony, with respect to ecological issues, as focused on the physical habitat characteristics of the CAWS, record which my expertise in river hydraulics, in general, and my seven years of modeling hydraulics of the CAWS, in particular, gives me a solid foundation on which to comment. Further, if one is to work in the field of water quality management, one needs to become familiar with ecological indices, such as, the IBI, MBI and other macroinvertebrate indices and QHEI and other habitat indices.

For example, my work as a review team member for the Milwaukee Metropolitan Sewage District Corridor Project and as a member of the technical advisory committee on the regional water quality management plan update for the Greater Milwaukee Watersheds for the Southeastern Wisconsin

Regional Planning Commission, required review of ecological data indices. Further, my service on the PhD committees of Dr. Alena Barsoba and Dr. Neil O'Rielly, put me in contact with state of the art in-stream ecology evaluation.

Finally, during my sabbatical in China, my host was interested in developing ecological indices with Chinese conditions. And I reviewed his group's work and guided them to current references from the American literature.

Finally, I covered basic aspects of stream ecology and my course on river engineering taught at Marquette University.

BY MS. WILLIAMS:

Q. So if I understand your testimony, Dr. Melching, you're familiar through your work with habitat indices and biological indices.

Do you consider yourself an expert in those indices?

A. I consider myself an expert in physical habitat.

THE HEARING OFFICER: Dr. Melching, speak to us, not to Ms. Williams. I know that's hard.

THE WITNESS: Okay.
THE HEARING OFFICER: The acoustics are bad and we --
THE WITNESS: All right. I'm sorry. Sorry, Board.
BY THE WITNESS:
A. I consider myself an expert in the physical habitat aspects, but --
BY MS. WILLIAMS:
Q. Have you ever utilized any of these indices in the field? Have you ever, actually, done any of the measurements using any of the indices?
A. I've only reviewed these indices before.
MR. ANDES: Have you done habitat work in the field?
THE WITNESS: Yes. But I haven't calculated the -- how should I say this? I have calculated QHEIs.
THE COURT REPORTER: But I have, what?
THE WITNESS: I'm sorry, I keep looking at the question.
BY THE WITNESS:
A. But I haven't calculated QHEIs.

THE HEARING OFFICER: Just try to pretend you're teaching a class and you're speaking to the back of the auditorium.

THE WITNESS: Okay.

BY MS. WILLIAMS:

Q. So you do consider yourself a physical habitat expert?

A. Yes.

Q. What about aquatic life and the needs of aquatic life. Are you an expert on the needs of aquatic life?

A. Only so far as the habitat requirements of aquatic life.

Q. So you feel you are an expert on the physical habitat needs of aquatic life?

A. Yes.

Q. And would that be for both fish and macroinvertebrates?

A. Well, my testimony, primarily, was directed toward fish. Although, when I was in China, I was involved in some of their work on macroinvertebrates.

Q. I believe in your resume or CV it mentions work done on the lower Des Plaines UAA.

Can you explain that for us?

A. Can you remind me of which question number that was?

Q. Yes. I believe that is in Question 41.

A. So, basically, for the lower Des Plaines UAA, the Qual to E modeling of the lower Des Plaines River and some of the probabilistic analysis of the water quality sampling data were done by graduate students under my direction. But the students also primarily worked under the guidance of Professor Novatny, who was both a professor of Marquette and president of Aquanova.

Q. Just a second.

Why don't you just explain for me a little bit how that worked on a day-to-day basis. I know Dr. Novatny was employed through Aquanova to perform the lower Des Plaines UAA.

Explain, then, the role your graduate students played in that more specifically.

A. Well, there are two aspects. One was to do the Qual to E modeling dissolved oxygen in the Lower Des Plaines and look at the potential with what could be achieved in terms of dissolved oxygen.

The other aspect -- I keep forgetting the Board is here (indicting).

The other aspect was that Professor Novatny had the view that we could take the available data for different constituents and analyze that probabilistically in the probability plots to try to determine the likelihood of exceedance of standards and to compare that to allowable frequencies for those constituents that have a once-in-three-years allowance of going above that standard.

Q. But what was the role of the graduate students and yourself?

A. Well, the graduate students were developing the probability plots and developing the Qual to E model --

Q. And you were -- okay.

And did you have to approve everything?

A. Well, the final approval and primary decision was Professor Novatny's.

Q. Did you make comments --

A. Well --

Q. -- on the project?

A. -- as necessary.

Q. And were those comments incorporated into the modeling?

A. The modeling, yes, but --

Q. Okay.

A. But it was fairly straightforward. We built on previously developed Qual to E model that was done for the District back in the late '80s, early '90s. So we were just updating that, if you will.

Q. And was that earlier model developed by the university or by Aquanova?

A. Well, in fact, the earlier model was developed by CDM for the Water Reclamation District.

Q. I'm going to go to Question 3, which asks for you to explain in more detail the Duflow model, D-U-F-L-O-W model.

A. All right. The Duflow unsteady state water quality model was developed in the Netherlands by a joint effort of the Rikes water staff, National Water Authority of the Netherlands. The International Institute For Hydraulic Environmental Engineering of the Delf University of Technology, the Foundation for Applied Water Management Research

in the Netherlands, and, finally, the Agricultural University of Vaganagan.

Duflow was selected for the study for the following reasons. Several options are included in the simulation of water quality, including a sediment flux model. It was compatible with geographical information assistance, is Microsoft Windows based, including a powerful graphic interface, had a low license cost, low computational time and had been successfully applied to many European rivers.

In particular, I've worked with Duflow in the modeling of the Dender River in Belgium. The certain analysis involved hundreds of simulations for a one-year time period with very few computational problems encountered. It's indicated that the model was computation -- which is very important when simulating a complex system like the CAWS.

Finally, because the hydraulic and water quality models are directly coupled, Duflow offered computational advantages over the versions of WASP, Water Quality Analysis Simulation Program, of the USEPA available when this project started in

2000. In particular, WASP had to be run separate from its hydraulic model, and the hydraulic model was known to have computational problems when applied to river systems.

For the CAWS, the simulation of dissolved oxygen was done using the Duflow water quality simulation option that adds the Totorro and Fitzpatrick sediment flux model to the WASP 4 model. A constituent interactions in the water column.

The Duflow distinguishes the amount of transported material that flows through the water, bottom materials that are not transported with the water flow, and poor water in bottom materials that are not transported but that can be subject to similar water quality interactions to those from the water colony. Flow movement and constituent transport and transformation are two processes, and constituent transport is defined investigation dispersion.

The following constituents represented as both water and sediment components, are included in the Duflow model, Algo biomass species, suspended solids concentration, total inorganic phosphorous, organic phosphorus, total

organic nitrogen as nitrogen, ammonium as nitrogen, nitrate as nitrogen, dissolved oxygen and carbonaceous biochemical oxygen.

A combination of WASP 4 and the deterrent of Fitzpatrick's sediment flux model, represents the state of the art in stream water quality modeling.

Q. Okay, Dr. Melching, a couple of follow-up questions here.

You gave a list of water quality parameters?

A. Yes.

Q. Explain -- well, first of all, does that list include any measures of the bacteria or pathogens?

A. Well, we did add a routine to Duflow to simulate the coliform so it isn't one of the constituents normally included. But the model is written what we call in an open code format that allows you to add routines or change routines as necessary.

So we did add fecal coliform simulation to the model to calibrate that and --

Q. Anything else that was added like

that?

A. The only other thing that we added was we made it possible to directly calculate travel times. The model automatically is calculating velocities, and -- because travel time is important for a lot of reasons, we wanted that as a specific output.

And there's even one more small thing we changed too, we changed how reaeration is computed in the model.

Q. I don't think I understand. Please explain how you changed how reaeration is computed?

A. Well, in the standard application of Duflow, reaeration is computed as a function, flow velocity of flow depth as per the equation of -- if I can get this right -- O'Connor and Dobbins. And for the Chicago area waterways, because of the extreme depth, we felt it was necessary to modify that equation a little bit.

Normally it has a single multiplier, we wanted to make that multiplier variable. And this is --

Q. And what would have been the results if you had relied on the model --

A. It would have --

Q. -- as written?

A. It would have overstated the amount of aeration in the surface reaches. For many reaches, the O'Connor and Dobbins relation was used for a few reaches, in particular, the very slow reaches and deep reaches.

Q. Which ones?

A. I'd have to look that up.

Q. Could you do that?

A. In fact, I don't even know that I have that material with me.

Q. Was there a cutoff in terms of depth that you used to decide which reaches?

A. It was more a cutoff that came from the calibration as we observed and measured dissolved oxygen data from the system from the District's data. There were certain areas that the model was -- over estimated dissolved oxygen, and we came to believe that, in those reaches, it may be a function that reaeration was being overestimated.

Q. If we wanted to find out for ourselves which reaches you changed the equation for, how would we find that?

A. It should be in our reports. I sent you all -- and it would be Report No. 18 from Marquette.

MR. ANDES: The document that we're specifically referring to is -- was an attachment to your testimony; am I right? Referred to --

BY THE WITNESS:

A. No. It's referred to in my testimony, but it wasn't added as an attachment.

So pretty much --

MR. ANDES: Why don't we read the name of the report in for the record. We have this report and a number of other reports that were cited by Dr. Melching on a disk, so we can put those into the record.

THE HEARING OFFICER: Thank you. You're anticipating my next question.

MR. ANDES: Go ahead and read the title.

THE WITNESS: The title of this report is Calibration of a Model For Simulation For Water Quality During Unsteady Flow in the Chicago Waterway System and Application to

Evaluate Use Attainability Analysis Remedial Actions.

MR. ANDES: Dated?

THE WITNESS: Dated February 2006.

THE HEARING OFFICER: And that will be a part of -- let's go ahead and mark it as Exhibit 170?

MR. ANDES: Yes.

MS. WILLIAMS: Do you know how many reports are on the disk, Fred?

MR. ANDES: Not offhand.

MS. WILLIAMS: Because I just want to -- for the record, I just want to address -- I think we've been guilty of it possibly and we've had some situations where, from Fred's disk, maybe not all the files are actually on all the copies of the disk. So I think it would be helpful for the record, going back, if we at least somehow identify the number of files so that people know if they have a complete disk.

I mean, obviously, if he doesn't know, I guess we can't do it here. But in the future if we're preparing disks --

because I -- is that --

Didn't we find had that some people had not --

MS. DIERS: Yeah.

MS. WILLIAMS: In one of the disks we filed some people did not have all the files on it.

MR. ANDES: That's fine. For the future we can certainly identify what's on the disk.

THE HEARING OFFICER: If there's no objection, we'll mark the other Melching exhibit's disk as Exhibit 170.

Seeing none, it's Exhibit 170.

(WHEREUPON, a certain document was marked Exhibit No. 170 for identification, as of 11/17/08.)

THE HEARING OFFICER: Go ahead.

THE WITNESS: Okay.

BY THE WITNESS:

A. So this is coming from Table 313 of this report, which is on Page 57, if anybody wants to look for it later.

Basically, the entire Chicago

Sanitary and Ship Canal was modified from the original O'Connor and Dobbins equation. The entire Calumet Sag Channel, Bubbly Creek, the lower reaches of the North Branch, and also the North Shore Channel was reduced. Sort of the upper reaches of the North Branch remained.

The same -- when I say "upper reaches," it's between river mile 41.6 and 39.2, measured from Lockport. And then also river miles 35.35 to 37.

The main stem of the Chicago River and the Little Calumet River North, all those were at the original O'Connor Dobbin reaeration.

BY MS. WILLIAMS:

Q. Can you repeat for me which ones were kept at the original -- you said the North --

A. Yeah. Basically, you can say the North Branch between river miles 41.6 and 39.2. The North Branch between river miles 37 and 35.5, the Chicago River main stem and the Little Calumet North.

So, basically, from where the Little Calumet connects to Cal Sag Channel back to O'Brien Lock and Damn.

Q. So really, probably, most -- milewise most --

A. Yes.

Q. -- of the system was recalibrated?

A. Correct.

Q. Or the equation was changed. I don't want to put words in your mouth.

A. Recalibrated is fine.

Q. Part of Question 3 asks when the Duflow model was accepted for publication. Has it been accepted for publication?

A. Well, the Duflow approach for the estimation and the duration of storm impacts on in-stream water quality was accepted for publication in the Journal of Water Research, Planning and Management on July 16th, 2008, publication schedule for March 2009.

Q. And that would be not your work, that would be the work -- the original work or this is your work?

A. No, this is the work that Dr. Alp and I did together.

Q. So -- I mean, the question, I guess, I was trying to get at is the changes that you guys

have made, were those peer reviewed and published anywhere?

A. Not really. I mean, peer reviewed in the sense that all our reports have been reviewed by the District. Some of our reports were also reviewed by the court because we did some work for the District and the court regarding navigation issues.

Q. I don't know -- I know you explained quite a bit about the model, but I don't know if you really explained to my level of understanding what an unsteady flow water quality was. What does that mean?

A. An unsteady flow model considers the variations in flow, stage, constituent concentrations, loadings, in time, as it simulates conditions for a selected representative period. In the case of the Duflow model for the CAWS, the computations are done at a 15-minute time step using measured flow and stage values at certain gauge boundaries and tributary influence and interpellated from hourly or daily data at other boundaries and in-flow points, including CSOs and water reclamation plants.

Time, series of flow, velocity, state and constituent concentrations are computed every 15 minutes at hundreds of computational points, spaced no more than 1,640 feet apart, including each monitoring point. The results are output at a one-hour time step to reduce computational time while preserving computational accuracy.

The computed velocity between computational points was used to determine the travel time between these points.

Q. And is that the main goal of the model, to determine travel time?

A. No. The main goal of the model is to determine the effects of both dry weather and storm flows on the quality of water in the Chicago waterways. And also on movement of flood flow, hydraulics, through the Chicago -- well, the CAWS.

Q. When you were answering Question No. 3 --

A. Uh-huh.

Q. -- you stated that your work was begun in 2000?

A. Yes.

Q. Can you explain how you came to be involved in 2000, what the goal at that time was?

A. Well, I think the goal at that time was that the District, Mr. Lanyon, was aware that they needed a better management tool for their waterways relative to the old Qual 2 E model I mentioned earlier. I think he was aware of things like TMDLs, and possibly the use attainability analysis we're talking about were coming, and he wanted a tool that could consider the larger dynamics of the system and to specifically look at the storm impacts in a continuous way.

So it was an interest on the part of Mr. Lanyon and Mr. Farnan to develop such a model. And I had worked with Mr. Lanyon when I was in the U.S. Geological Survey on a number of issues around Chicago, and so I was selected to develop this model with my students.

Q. So I assume that explains why in your testimony you talk about using a period in 2001 --

A. Yeah.

Q. -- to develop --

A. Yeah. I mean, particularly with respect to 2001, as the project started, one of the

things that we all realized is that there wasn't detailed information on storm loads to the system. So we specifically requested to the District to sample CSOs over storm periods and to sample the major tributaries, the Little Calumet and the North Branch at Albany Avenue so that we had a better idea of the type of constituent loads being brought into the system so we could properly characterize and simulate those events.

Q. On Page 5 of your testimony, it states, "However, research on the CAWS shows that the effect of storm runoff and CSOs on water quality last substantially longer than the hydraulic effects of the storm."

Can you just explain what research you're referring to here?

A. This is the PhD research of Dr. Emre Alp at Marquette.

Q. Doctor who?

A. Emre Alp.

Q. Oh, Mr. Alp. Okay.

A. He was my graduate student.

THE HEARING OFFICER: Could you spell that name for the record, please?

THE WITNESS: A-L-P.
MR. ANDES: First name?
THE WITNESS: Emre, E-M-R-E.
BY THE WITNESS:
A. And it should also be noted that this work that Dr. Alp did was not funded by the District. So the development of the model and application to the UAA and so on, was done with support of the District, but the analysis of storm effects he did, basically, unfunded.
So there was a year that we were not supported by the District, which was a spinoff to create a thesis for him.
BY MS. WILLIAMS:
Q. I'm going to show you a document, just to make sure I'm clear, because there's not a date on this document that I can see. But there's a document that's in the record called Evaluation of the Duration of Storm Effects on In-stream Water Quality by Emre Alp and Charles S. Melching. Is this what you're talking about (indicating)?
A. Yes.
Q. And I believe this is Attachment 5, maybe, I hope --

MR. TWAIT: Yes.

BY MS. WILLIAMS:

Q. -- to the testimony of Adrian Namira that's already in the record.

A. And this is the paper that was printed in March of 2009.

Q. Okay. Great.

Question 6 asks, "Can you explain the impact of low velocities and very low slope limits on supplemental aeration?"

A. Primary impacts of low velocities and very low slopes is that they make supplemental aeration necessary. We can also say they made modifying the reaeration simulation in Duflow also necessary.

In my analysis --

Q. Wait. Can we stop there for a second?

A. Yes.

Q. Because you said -- because I think when you explained the modification, you said it was based on depth. So can you --

A. I also mentioned low velocity, as well.

Q. Okay.

But can you explain that interaction there, what you mean?

A. Well, what I mean is -- let me maybe finish my answer here and it may become more clear.

In 1999 -- 1998, 1999, I was charged by the U.S. Geological Survey to do a national study of all the reaeration data that the USGS had collected over about a 20-year period using gas injection methods. They inject the gas, and the rate at which that gas leaves the water is directly in proportion to the rate at which the oxygen enters the water.

So there was a database of 493 reaches, 166 streams, 23 states of USGS measurements, and then we had another data set of 124 reaches on 24 streets in seven states collected by other agencies -- so state agencies of the Michigan Department of Environmental Quality, Texas Water Resources Board, others. What we found in this study of this large national database is reaeration rate is most strongly related to the product of velocity and slope.

This product of velocity and slope can be thought of as the rate of energy dissipation.

So it's a measure of how well the flow mixes. So as oxygen enters the surface, it needs to become distributed throughout the water quality.

If the water is very stagnant, you just have a -- an equilibrium will be established between the oxygen of the air and the oxygen of the surface reaeration will stop. So if you have more mixing, more turbulence, the oxygen can move throughout the entire water colony.

So this velocity, slope gives some idea of the mixing energy of the flow. And the velocity and slope in the CAWS is, basically, off the scale, relative to the 100 other measurements in the databases. So that's why there's going to be little oxygen exchange at the water surface in this system.

Also because the CAWS is deeper than most natural systems, the distribution of a small amount of oxygen coming in from the atmosphere throughout the water may be limited because of the flow mixing indicated by the slow energy dissipation. So that's the limitation on aeration that also, then, resulted in us having to modify they existing Duflow model. And that was supported

by looking at the DO data created by the District.

Q. So can you explain whether this research for the -- was it for USGS?

A. Yes.

Q. So were all the other systems you were looking at using supplemental aeration?

A. No, these were natural --

Q. Natural, okay.

A. -- streams looking at natural aeration or reaeration of the water colony.

DR. RAO: May I ask a --

THE HEARING OFFICER: Yes.

BY DR. RAO:

Q. You mentioned this database by USGS. Were any of those streams in Illinois?

A. Many of them were.

Q. Was the CAWS also part of the database?

A. There's no measured reaeration data for the CAWS. Richland Creek, Salt Creek, I'm trying to remember what the other one was.

It's in the Peoria area, but I forget the name of it. Cedar Creek maybe it was.

So those were the sites in

Illinois that were part of the national database.

Q. Considering the unique characteristics of the CAWS data from USGS, is it your opinion that the data is representative of the CAWS?

A. Well, I mean, the physical process of mixing and aeration is not going to change because of the CAWS or other water bodies. It's a matter of the physical properties that are related to it.

So, for example, as I mentioned, the idea -- the fundamental idea of reaeration is that oxygen from the atmosphere will diffuse into the water surface because of the contact between the two. As this contact happens, if the water was very stagnant, you would get to saturation, concentration of the top layer of the water would be the same as the overlying air and reaeration would stop.

And then, as mixing occurs, then that takes this oxygen from the surface and distributes it throughout the water body. And so that physical process occurs in the CAWS in the same way as it would occur in more natural streams, like Richland Creek or Cedar Creek or the other stream I couldn't think of.

And so, what we found in our

analysis is that -- we had a set of streams that were the USGS data that we developed some relations for. And then we applied those relations to this other set of data collected by state agencies, local agencies that were published in the literature, and found good agreement that the physical processes we were able to identify were working similarly in the verification sites, as well as the calibration sites.

DR. RAO: Thank you.

BY MS. WILLIAMS:

Q. When you talk about the low velocities and low slope in this system, do you have sort of a rule of thumb or a guideline for us on what would be considered an average velocity or an average slope?

A. Well, I think the way I -- I'll term this is that -- I've got some notes here.

MR. ANDES: Are you -- if I can clarify. Are you talking about the average slope of the water bodies study in that report? Is that the question?

MS. WILLIAMS: I want a relative -- an explanation of, you know -- we're calling them low, so that's relative to something.

So what would be typical or what would be high?

MR. ANDES: The CAWS is low relative to what?

BY THE WITNESS:

A. Can you remind me which question?

BY MS. WILLIAMS:

Q. I was just following up on Question 6. This may be similar to another question later --

A. Okay.

Q. -- but I was not --

A. But that would help me, because I have the statistics there. Or Fred has it on the computer, but we could do a quick search.

Q. Let me take a look. I think there may be a more specific velocity question later on, hang on.

A. There was a specific question about the velocity.

Q. Did you look at 15C? At least it's more specific. I don't know if -- it's not, I don't think, the same question, but it's got a specific velocity.

A. I think there's one before that.

Here, let's say 15A is probably -- 15A is water velocities too low in the CAWS to support the aquatic life use as proposed by Illinois EPA.

And so that's somewhat related to Ms. Williams' question. And, basically, the discussion of flow velocities that's there, my use of one foot per second or .4 feet per second in my testimony was an attempt to try to define low velocities, that the U.S. Geological Survey has developed for the Illinois Department of Natural Resources a database of streams throughout the state where they've physically measured hydraulic reference.

So this is a tool that DNR uses for design work and analysis work. And they've evaluated, then, reach average velocities for 234 measurements at, I want to say, about 40 or 50 sites in Illinois.

And only one measurement for those 234 measurements had a velocity of less than .4 feet per second. And more than 87 percent of the measurements had velocities greater than one foot per second.

The Chicago waterway system, on

average, has velocities of less than .4 feet per second for much of the waterway. And all reaches are below one foot per second.

A typical Illinois stream, 87 percent of them greater than one feet per second, the CAWS, everywhere, less than .1 foot per second. And, even worse, the CAWS, many of the reaches, less than .4. And in the state and the natural stream, that's a very rare occurrence.

Q. Dr. --

MR. ANDES: I believe this is -- I'm sorry, I'm just going to refer to Page 10 of Dr. Melching's testimony as the relevant citations to the geological survey database.

THE WITNESS: Yes.

BY MS. WILLIAMS:

Q. Did you look in that database whether any of the segments of the CAWS were included?

A. No. There's no segments of the CAWS.

Again, this is more aimed at natural streams.

Q. Are you sure?

A. I'm pretty sure.

Q. Do you have it?

A. I have a handwritten list. It's not easily printed out.

MR. ANDES: Can you tell us where you're looking?

MS. WILLIAMS: I'm looking at a printout, and I don't think it's complete. So I don't feel comfortable putting it as an exhibit.

But it's from the web page cited in the testimony, and it shows the Chicago Sanitary and Ship Canal at Romeoville.

MR. ANDES: Do we know that that's just part of the rough cut coefficient database?

THE WITNESS: It may be. What velocity does it show for that?

And it may be that my testimony is focused on natural streams.

BY MS. WILLIAMS:

Q. Why don't I show you what I'm looking at and see if...

A. Yeah, but I think --

MR. ANDES: Can he find out what we're looking at?

BY THE WITNESS:

A. This is the database, and it is the Chicago Sanitary Ship Canal at Romeoville. But I think if you click on that, you're not going to see velocity.

And while I'm not 100 percent sure, the mannings in there may be estimated by different means than the other locations in the database.

BY MS. WILLIAMS:

Q. So if it did have the velocity and if they were around three or four feet per second, you would think that that was not a proper --

A. There's no way they're around three or four feet per second.

Q. So if that's what it did say, it would be inaccurate in your opinion?

A. Yes.

MR. ANDES: Do we have any information to showing that it is?

MS. WILLIAMS: Well, I think it's fair to ask him about the web site that he asks us and insist on wanting to go to.

MR. ANDES: But you were bringing up

numbers, and I'm just wondering are those numbers on the website?

MS. WILLIAMS: I can't -- yes. Yes.

MR. ANDES: Are you going to produce them?

MS. WILLIAMS: I don't think --

THE HEARING OFFICER: Well, wait a minute.

Mr. Essig, you've been sworn in before?

MR. ESSIG: Yes.

THE HEARING OFFICER: I assume you picked up this information?

MR. ESSIG: Yes.

THE HEARING OFFICER: And those numbers are the ones you saw when you looked at the website?

MR. ESSIG: Yes. I do not have a hard copy with me, though, for those numbers.

MS. WILLIAMS: Can we ask him just to read it? Because I estimated, so we can maybe ask him to read the exact numbers into the record.

THE HEARING OFFICER: Yes, please.

MR. ESSIG: There were, basically, four velocity values given. And they range from 3.05 per second to 4.06.

MR. ANDES: Those were on the website, but they're not being introduced as evidence themselves, because we don't have a --

MS. WILLIAMS: Yes. They've been introduced --

THE HEARING OFFICER: He's been previously sworn. He's testified to what he saw on the website that your witness gave us.

MR. ANDES: Okay.

MR. GIRARD: Can we get an exact address for the record?

THE HEARING OFFICER: It's in his testimony.

Correct? The web site is in the testimony from Dr. Melching on Page 10?

MR. ANDES: Yes.

BY THE WITNESS:

A. All right. Let's do some math then.

BY MS. WILLIAMS:

Q. Oh, no.

A. The cross-section of the canal at

Romeoville is 162 feet wide by 25 feet deep, approximately. That leads to a cross-sectional area of 4,000 square feet. Typical flow at Romeoville is on the order of 2,700 to 3,200 cubic feet per second.

So if we divide the flow by the area, so we have 3,000 divided by 4,000, it's less than one.

Q. So do you think they were using a different flow value or a different --

A. That would have to be under extremely high flow conditions. I think everybody knows 3,200 CFS is the limit.

Q. Let me -- Howard is showing me another page, and I don't think that I showed you this page.

THE HEARING OFFICER: Another page from the website?

MS. WILLIAMS: From the USGS website that provides a table of the actual values.

BY THE WITNESS:

A. These are extraordinary high flows for that site.

BY MS. WILLIAMS:

Q. So -- but they're actually measured

flows; correct?

A. I would believe so, yeah.

Q. Can we have a citation in terms of where that...

A. That is not in any way a normal flow. These flows range from 10,000 to 14,000. Again, remember, Illinois is limited to 3,200 CFS by Supreme Court decree. So this is like five times the normal flow.

Q. What do you mean? The flow isn't limited by the Supreme Court degree.

A. Oh --

Q. You're talking about the discretionary -- the diversion?

A. Well, the diversion is limited.

Q. Right.

A. And, therefore, the flow is not much different than that.

Q. I don't think that --

A. I'm saying that you're citing this as the typical velocity in the Chicago area waterways at Romeoville. It's a complete fallacy.

MR. GIRARD: Could I ask a quick question?

THE HEARING OFFICER: Uh-huh.

BY DR. GIRARD:

Q. Dr. Melching, if you have a storm event, do the velocities change?

A. Most definitely.

Q. And what happens when you have a storm event?

A. Well, what happens when you have a storm event, you do get velocities like this.

Q. Like what?

A. Like the --

THE WITNESS: Where does it say that, Fred?

BY THE WITNESS:

A. Three -- three to four feet per second during the peak flows during a storm.

BY DR. GIRARD:

Q. So when you talk about a normal flow, you're talking about some sort of average of measurements taken over a period of time; is that correct?

A. Yeah, I'm saying the typical flow that's in that waterway almost all the time. Other than extreme flow -- extreme storm conditions, such

that the Water Reclamation District needs to open the gates at Lockport or the Sluiz gates are controlling...

MR. ANDES: Dr. Melching, were these samples all taken on a three-day time period in January of 2005?

THE WITNESS: According to what it says there, yes.

MR. ANDES: Can you -- it also, I notice in here it talks about what the kind of maximum discharges are at flood level.

THE WITNESS: Yes.

MR. ANDES: Can you let us know what those are?

THE WITNESS: Nineteen thousand four sixty-six was the highest measurement from February of 1997.

MR. ANDES: So if the flood level was 19,000 and we're talking about --

THE WITNESS: That's the maximum flood level.

MR. ANDES: The maximum --

THE WITNESS: That was ever was measured at that location.

MR. ANDES: And the levels we're talking about here are 13 to 14,000, you say that's in the same general range in terms of large flows?

THE WITNESS: Yes.

BY MS. WILLIAMS:

Q. Do you know what the USGS was trying to capture, high flow or low flow or typical flows?

A. They were trying to capture flows of what they call a bangful flow. So that means that flow that just fills the waterway main channel.

So flows that didn't expand into the flood plains. That's the entire database's objective.

Q. So would that be on the high side?

A. It would be.

Q. But not extreme?

A. It would be -- no, not on the high side. This would be like the type of flow that would happen once a year, on average, or less.

Q. I'm just trying to get at, I think, whether you think -- you know, how relevant this information is to what we're looking at generally. Were they trying to look at typical flows, were they

trying to look at average flows, were they trying to look at high flows, low flows?

A. Well, for each site there is a fact of range of flows that they evaluated. None of them are extraordinarily high, none are extraordinarily small. So somewhere in the middle range.

MS. WILLIAMS: Can we have the papers? Thanks.

BY MS. WILLIAMS:

Q. Let's go back to the prefiled questions. I think we left off at No. 7.

That question states: "What is the basis for the statement on Page 5 of your testimony that Illinois EPA 'Appears to assume that the duration of storm effects on water quality lasts only as long as the causative rainfall for the period of elevated flow rates'?"

A. During his testimony on April 23, 2008, Mr. Sulsky stated, "Because, for the majority of the year, the waterways are dominated by dry weather conditions for some eruptions of CSOs and some impact." The purpose of my testimony is to illustrate that these eruptions of CSOs have a substantially longer impact on the water quality in

the CAWS than might be determined by considering only the rise and fall of the stream flow hydrograde.

Q. So it was reviewing the transcripts from April that --

A. Yes.

Q. -- had caused you to reach that conclusion?

A. Yes.

Q. On Page 7, you testify that, "The long storm effects can negatively impact the aquatic community, and these long storm effects cannot be reduced until the reservoirs of the tunnel and reservoir plan are fully online."

How will Tarp reduce the long-term storm effects?

A. Because the number of CSO events will decrease from ten to 15 per year to much less frequent occurrences with careful operation of the Tarp system, substantial DO stress will be removed from the aquatic life in the CAWS. However, habitat limitations will still prevent substantial increases of biotic diversity.

Q. When will the reservoirs be fully

online?

A. Those questions are better answered by the District or Dr. Zenz.

Q. Have you modeled these improvements from Tarp and their impacts on DO levels?

A. No simulations have been done considering the changes in flow and loads after the Tarp reservoirs are completed and in operation.

Q. Why?

A. No one's asked us to.

Q. So the District hasn't asked you to look at how these conditions will change once the Tarp project is completed?

A. The District hasn't asked us to do that, they wanted to focus on current conditions on the ground.

Q. So you can't answer how compliance results will change from current conditions after Tarp is completed?

A. I cannot answer.

Q. Do you know whether there is a different -- let me get back to Question 2 here. And I don't know that it's appropriate for you, but I know we probably won't have you back after we get

the technical engineering folks in.

A. Can I make a request?

Q. Yes.

A. Can we -- I mean, I know I'm on the spotlight, but...

That's better, thank you.

Q. Is it correct to state that the modeling work that you developed was utilized to evaluate the amount of aeration that would be necessary through supplemental aeration? Is that accurate?

A. Yes. Well, if it's one of the technologies that were evaluated.

Q. Right.

So can you explain for us whether there's a difference in the amount of aeration stations needed in the waters that have been designated as aquatic life Use B waters and the CAWS aquatic life Use A waters?

A. Can you repeat that?

Q. This is -- I'm reading from Question 2.

A. Yeah, it's Question 2. Well --

Q. I don't know if it's well-worded, but

I didn't purposely try to rephrase it or anything.

A. Well, it just seems the way you just asked it, sounded a little bit different than the way I read it.

Q. Okay.

A. But let me explain what we have done. And so we have developed what I call a rough cut integrated plan of technologies needed to achieve 100 percent compliance with the proposed standards. And in doing that, we considered what was necessary to achieve the CAWS aquatic life Use A standards in the appropriate reaches and CAWS aquatic life B standards in the appropriate reaches.

However, we didn't try to evaluate what would be necessary to get CAWS aquatic life Use B standards in the CAWS aquatic life Use A reaches. So we didn't look at the increments between those two conditions.

Or the other way around, look at what would it take to take a B to an A in those reaches. And this kind of evaluation, you know, isn't necessarily straightforward because the system is linked.

So what happens if A affects what

happens in B? So if you took the A's reaches and suddenly made them B, you might necessitate additional aeration stations in the B reaches, which previously were getting high quality water from upstream.

And so it's -- and we haven't looked at these increments, we just looked at the appropriate standard as applied for the appropriate reach.

Q. How about did you look at what would be necessary to achieve compliance with the standard that's on the books today 100 percent of the time?

A. Only, I would -- in the original works of this Report 18 that I referred to earlier, Alp and Melching 2006 that is now entered into the record, at that point in the use attainability process, we had been asked to look at a number of targets, four, five, and six milligrams per liter. However -- and so we did report some statistics for those.

However, in the end, the District asked us to look at, for the purposes of the cost work that CTE has done, to focus on five milligrams per liter 90 percent of the time and figure out what

aeration resources would be needed to achieve that specific goal. So we have some statistics for four milligrams per liter and, for that matter, for three milligrams per liter compliance.

But we didn't, necessarily, put together a program that would lead to that complete compliance with three where three is appropriate and four where four is appropriate.

MR. ANDES: Can I ask, is there water in this pitcher?

THE HEARING OFFICER: Not that we brought in. So if there's anything in it, it's been here at least since Friday.

MR. SULSKI: Don't take a chance.

BY MS. WILLIAMS:

Q. And I just want to make sure -- I think I understand, but I just want to be clear.

So your modeling work about the amount of aeration necessary, was used in developing the cost estimates; correct?

So --

A. Can you -- I mean --

Q. If changes --

A. -- which particular cost estimates are

you referring to?

Q. The CTE cost estimates.

A. But --

Q. Oh.

A. Because there are several sets of cost estimates. So just -- in --

Q. Do you know which ones were relied on in the modeling?

A. Well, I could say, you know, that -- well, what my understanding is, CTE did some initial cost estimates primarily focused at North Branch, North Shore Channel and South Branch Channel of Buffalo Creek. So in those cost estimates, we used the model to develop the necessary aeration resources of the necessary flow transfers.

And the initial cost estimates were contained in their technical memo reports that, I think, are part of the record for the submittal. I forget which attachment letters they are.

And then, they then extrapolated from that result to look at what it would take to achieve 90 percent compliance throughout the entire waterway system for the cost estimate. That one we haven't run up the full calculations.

And then what you would have seen as an estimate relative to 100 percent compliance, or what you will see from Mr. Zenz' testimony, that also is based on our modeling work where we tried to meet the proposed standards in. And that means that the earlier -- that the cost estimate for the 90 percent compliance -- and this is going to get complicated -- it's extrapolated from us trying to make, 90 percent of the time, five milligrams per liter.

And then they extrapolated that to these standards, 90 percent of the time over the entire system.

Q. Then they came back to the model to do the 100 percent?

A. Yes. Well, they --

Q. Or was the 100 percent extrapolated also?

A. No, the 100 percent is --

MR. ANDES: If you're talking about what CTE did, we might want to wait and have CTE --

MS. WILLIAMS: We won't have Mr. Melching back, though, at that time to

explain how they relate. I mean, I don't like going into this without the full picture either.

MR. ANDES: But I think you're asking what CTE did in their analysis and not what Dr. Melching did.

MS. WILLIAMS: But I won't be able to go back and ask Dr. Melching later how changes to his modeling impacted the outcome. I mean, if he understands --

MR. ANDES: Well, that question you can ask.

MS. WILLIAMS: -- it should, obviously --

MR. ANDES: That question, though, you can ask.

MS. WILLIAMS: So this is...

BY THE WITNESS:

A. Okay. But somebody is going to have to tell me what the question is now.

BY MS. WILLIAMS:

Q. I think the question before was if they come back to your model for the 100 percent compliance cost estimates.

A. Yes. And relative to the earlier model, we had made some modifications and improvements at the recommendation of CTE and the District.

We'd also -- at that point, our initial analyses were just for portions of years, and we then expanded to an entire water year for the evaluation. But the final product of our work will include a second water year then.

At the time, this summer, we hadn't worked up all the data for it. Only 2000 was considered as a quote/unquote "wet year."

And we'll be using 2003 as a dryer year in the final reports prepared for the District on this subject.

Q. I know that you said -- would you agree that in order to achieve full compliance with the standards on the books, additional supplemental aeration would be necessary?

A. Additional --

MR. ANDES: I'm sorry, can I -- I'm sorry, which standards were you asking about? I just wanted to clarify.

MS. WILLIAMS: The ones on the books.

MR. ANDES: Today? The current standards?

MS. WILLIAMS: Today.

BY THE WITNESS:

A. So that includes general use standards for portions of the North Shore Channel?

BY MS. WILLIAMS:

Q. Yes.

A. Well, again, we --

Q. We can just focus the question only on the secondary contact centers if we want --

A. Well --

Q. -- to make it simpler.

A. -- we're kind of getting conflicting questions here from -- so...

MR. SULSKI: She's doing the questioning.

BY THE WITNESS:

A. Can you repeat the question?

BY MS. WILLIAMS:

Q. Well, would it help to say I repeat that I'm asking only about the secondary contact standards and the areas were those are applicable?

A. So the question is will additional

aeration resources be necessary to meet those standards?

Q. Correct.

A. We haven't done the analysis of that, in particular.

Q. Do you have an opinion?

MS. WILLIAMS: I would like him to give us our opinion, Fred, I think it would be fine.

BY THE WITNESS:

A. Okay. I believe that, most likely on the Calumet side, the existing standards can probably be met with the existing aeration resources in place. But if we are trying to get to 100 percent compliance, four milligrams per liter in the CSSC and other portions of the North Branch, South Branch, probably additional resources will be necessary.

BY MS. WILLIAMS:

Q. Thank you.

I don't think I asked earlier whether the work -- I know we talked about the work that was done by CTE to develop supplemental aeration requirements. Was your modeling also used

with regard to determining needs for flow augmentation, as well?

A. Yes.

Q. I would like to jump ahead to a couple of questions that come later that are more focused on your model before I proceed to the remaining questions that are about aquatic life and habitat. So why don't we look at Question 26.

And that question states, "Please define a storm event as it is used in your testimony." It goes on to state, "In the exhibits attached at the end of your testimony, you present storm events that occur on one day and those that occur one week apart as single events."

Please explain how you accounted for these differences in determining the number of days it took the CAWS to recover from a storm event?

A. All right. The reason that some storm events actually involve two overflow periods that may be days apart is that the effects of the first overflow period of the first storm has not fully dissipated by the time the second overflow period starts. Unless the combined duration was listed in the exhibit.

And this is, again, related to the purpose of my testimony, which was mentioned before that illustrates that these eruptions of CSOs, have substantially longer impact on water quality in the CAWS than might be determined by considering only the rise and fall of the stream flow hydrograph and that dry weather conditions might not be as dominant as the stream flow hydrograph may indicate. Thus, since I want to illustrate the overall duration of storm loading effects on water quality in the CAWS, the fact that multiple storms are combined as a single event in the exhibit doesn't detract from my propose.

Q. Now, is there a place in your report where -- let me start again.

In your report I can find tables where you present the duration of storm effect on CBOD5 concentration. And I believe the same for ammonia.

A. Uh-huh.

Q. Can we find information in your report on the same type of effect on fecal coliform levels?

A. No. We haven't done that kind of analysis.

Q. Why not?
A. Well, again, this work was done by us or by Emre unfunded for the purposes of having a PhD thesis.
Q. Okay. So this wasn't specifically done for the District --
A. At the request of the District.
Q. And they didn't ask you to look at fecal coliform?
A. For events. I mean, we did, as I mentioned earlier, add fecal coliforms to the model and calibrate the model and make a whole lot of simulations that CTE and Limno-tech used.
Q. Do you understand how those were used then?
A. I didn't review the detail --
Q. Okay.
A. -- what they then did.
Q. Did you review any of the work on recreational uses that's been part of the District's testimony in the prior hearings?
A. I mean, when you say "any" --
Q. Right.
A. -- it's sort of --

Q. Okay. I mean, Mr. Andes has very efficiently broken out the witnesses into recreational witnesses and aquatic life witnesses. And he has put you with aquatic life witnesses.

And so, I'm just wondering, if you know, if you reviewed any of the work that was presented under recreational witnesses. If you don't know --

A. Well, I'm not sure which things -- I mean, there were some aspects of the recreational work that I was interested in, like the review of how the standards came to be, was done by the independent panel...

THE HEARING OFFICER: Dr. Melching, we're losing you.

BY THE WITNESS:

A. Sorry. I mean, I have read some of the reports related to it, but not necessarily for the recreational aspects of the CAWS, which is from my own interest as fecal coliform is also a hot button issue up in Milwaukee and one of the primary things we're looking at in the water quality management plan update. So I did review some of the things done here to try to get some insight as to

how we might attack our problem in Milwaukee.

I read some of these things but more for Milwaukee purposes than Chicago purposes.

BY MS. WILLIAMS:

Q. One of the issues I'm trying to understand better is -- I don't know what you want to call it -- but I think you used the word hydraulic damn effect --

A. Uh-huh.

Q. -- in your testimony.

A. Yes.

Q. Can you explain what you mean by that?

A. Well, I think we all know the old saying, water flows downhill. And in this case, downhill is the water surface level.

And, for example, let's look at the Stickney plant. When it discharges its very large flow, that flow is much higher than, typically, the flows coming from upstream.

The flows, at least double that from the north side plant, the tributaries may be low. So what's coming in is smaller than what's coming out.

And the Stickney plant has a

tendency, then, to kind of create a mound of water surface elevation. In my attachment to my report, I even showed figures that you can see that the water level upstream of Stickney, nominally upstream of Stickney, isn't always higher than the water level at Stickney or the water level nominally downstream of Stickney.

And so because of the fluctuations in the system and because the system is so flat, typically, you can have this effect where a portion of the Stickney flow goes upstream and then it will comb back downstream as the water levels change throughout the course of a simulation. And so effectively then, this mounding of water is restricting the ability of upstream flow to go further downstream for a time and creating some very long travel times immediately upstream of the Stickney plant, in particular.

Q. Now, did you say on Page 4 that the hydraulic damn upstream from the Stickney plant is obvious as it takes 2.5 days to go eight miles? And then, similarly with the Calumet plant, you say it's obviously, as it takes 1.5 days to go 2.3 miles, you don't mention the north side plant here.

A. Well, upstream of the north side plant, there is hardly any flow. And we specifically didn't compute any travel time information upstream of the plant. Because, in fact, the north side plant upstream and downstream is really a concept.

Q. It's really a concept?

A. Yeah, I mean --

Q. It's not reality?

A. More often than not, the north side plant is backing up into the North Shore Channel. But there are, then, other periods when it's going the other way.

And sort of the visual evidence of this is the -- and I've been at Maple Grove or at Maple Avenue on North Shore Channel near the end, near Sheridan Road in January, and it's completely on ice. And this has got warm discharge from the north side plant that is backing up and influencing that reach.

If you go all the way to Sheridan Road at that same time that I was there in -- was it 2003 or 2002, I forget now -- there was ice. So several miles upstream from the plant you still have

warm temperatures.

And so, we didn't really specifically try to compute travel time there because, in that reach, upstream and downstream changes much more often than other reaches in the system, if that makes any sense.

Q. Now, is there somewhere in the report that I can find how far upstream this effect is noticed at the three plants? Has that been modeled anywhere?

A. Well, I mean, we could find it from the modeling, but we didn't look more than just in the immediate vicinity of the plants, just to see did we see this reversal of upstream and downstream in the local vicinity plants. But we didn't figure out how far --

Q. How far. And would it be possible to use the models to do that, but that wasn't announced?

A. Yes.

Q. Do you know if you are going to make a recommendation to a field person about how far upstream to take samples that would be unimpacted? Would you be able to make a recommendation like

that?

A. Not without looking at the model results and also looking at some of the Districts' water quality sample data.

Q. The best way to go about doing that probably would be to rerun the model for that purpose; or no?

A. Well, I mean, it would be redoing a run that we've already done. But asking -- looking specifically at outflow at selected locations, is not redoing the model, per se, it's just monitoring the output at different locations.

Q. Do you know if there's anything, from an engineering point of view, that could be done to prevent this hydraulic damn effect by the District?

A. You'd have to create a larger slope in the system, and that's probably not a good idea.

MR. ANDES: You're saying you'd have to reconstruct the channel?

THE WITNESS: Or operate it in a different way so that you had higher going out at all time.

MR. ANDES: But you might not want to do that for other reasons?

THE WITNESS: That you might not want to do for diversion accounting reasons.

MR. ANDES: It might also make not such a great area for canoeing and kayaking?

THE COURT REPORTER: Of human what?

MR. ANDES: Canoe and kayaking.

THE COURT REPORTER: You can see how I can mess up the words if I can't hear them.

BY MS. WILLIAMS:

Q. Let's take a look at Question 27.

THE HEARING OFFICER: Before we do, let's take about a ten-minute break.

(WHEREUPON, a recess was had.)

THE HEARING OFFICER: I think we're ready to go back on the record.

Ms. Williams, I believe you were at Question 27.

MS. WILLIAMS: Yes.

BY MS. WILLIAMS:

Q. Question 27 asks, "Is it accurate to state that the Duflow model uses a single value of 170,000 fecal coliform colony forming units per 100 milliliters to simulate the concentration of fecal coliform discharged from CSOs on the CAWS?"

Yes or no?

A. Basically, I'm going to try to answer the whole of 27 at one time here.

Q. Okay.

A. The fecal coliform concentration of 170,000 coliform forming units per 100 milliliters was based on data for CSOs in Milwaukee after its deep tunnel system went into operation. It is the median value sampling data for the period 2001 to 2004.

This value was considered as representative of fecal coliform concentrations as the event mein concentration at the pumping stations and gravity CSOs in the model simulations for the CAWS at a time where no measured data were available to the Chicago area. Further, Pages 10 and 11 of Attachment 1 to my testimony state the following: "There were four severe rainstorms in 2001 and 2002; August 2nd, August 31st and October 13th, 2001, and August 22nd, 2002, that resulted in flow reversals from the CAWS to Lake Michigan."

During periods of flow reversals, the District is required to intensively sample the quality of water going into the lake. These data

were used to evaluate the fecal coliform concentrations and CSOs at a value of 1,100,000 coliform forming units per hundred milliliters and was found to give good results for the three of the four events.

Thus, when disinfectious scenarios were evaluated in runs with CSO concentrations of both 170,000 CFUs per hundred milliliters and 1.1 million CFUs per hundred milliliters were made for comparison. In 2006, the District collected coliform data in CSOs and concentrations were between 400,000 and 500,000 CFUs per hundred milliliters, confirming that the range in the runs reasonably bracketed the actual inflow conditions in the CSOs.

Because of the lack of data, single fecal coliform concentrations applied to both gravity CSOs and pump station CSOs during simulations. So we did consider two concentrations in the runs that were provided to CTE and Limno-tech for their work.

Q. Has there been additional data developed since that time?

A. Well, as I mentioned here, the

District did collect some data in 2006, and I haven't looked that up. But beyond that, I don't know.

Q. Question 28. And I'm not sure I recall, what I'm asking here. So if you don't know, I'll understand, but --

A. I know what you mean.

Q. Do you know what I mean? Okay.

Overall the model shows the stream will not meet the proposed standard more often than the measured value did.

A. All right. Here we go.

Your observation is correct, and this was by design in the calibration process. There was substantial of certainty regarding storm loads because flow volumes for gravity CSOs and ungauged tributaries were estimated on the basis of systemwide water balance, and a limited number of CSO event mien constituent concentrations were extrapolated in both space and time to the unsampled storm period.

Thus, we knew the Duflow model could not reproduce all measured DO concentrations particularly during storm periods. So the goal in

calibration was to be as close to the measured DO concentrations but to slightly underestimate the measured DO concentrations.

This calibration approach provides a safety factor when evaluating combinations of technologies or scenarios needed to meet proposed water quality standards. That is when we evaluated the scenarios, if we can find ones that can solve the exaggerated DO problems in the Duflow model for a particular period, we have more confidence that the proposed scenario would result in a desired DO concentration meeting the proposed water quality standards in the actual case.

If we're going to be wrong, we want to be wrong on the low side so that when we develop solutions, we have more confidence that the solution will really do what we want it to do. So this was intentional.

Q. Thank you.

In Question 29 on Page 22 of the report attached to your testimony you say, "Large storms have more homogenous CSO load than small storms."

Didn't you assume the same

concentration for all storms?

A. Okay. The assumption of constant event mien concentration applies only within each of three sub areas, north Shore Channel and North Branch of the Chicago River are one subarea, the Chicago River Mainstem, South Branch Chicago River and the Chicago Sanitary and Ship Canal are another subarea, and the Little Calumet River North and the Calumet Sag Channel are the third subarea. Further, the storms in the calibration period in 2001 tend to have different CSO event mien concentrations for each storm and each subarea because event mien concentrations were measured for most storms during that that period.

So this was that period I mentioned earlier where the District went out and collected special data for us. Storms in 2002, the verification period, and also some of the storms of 2001 outside of the calibration period, have identical concentrations for each storm but the concentrations vary by those three subareas.

And so the -- that's about the concentration. But the load is the product of concentration and CSO volume.

So even where we have the concentration is equal within a subarea, the load is going to vary positionally, depending on the volume of runoff in those areas.

So the event mien concentration may be the same for two storms, but the volume of the gravity CSOs becomes a greater proportion of CSO volume for large storms. The smaller storms may only require, or mainly require, pump stations to come online, and the -- because they are collecting large areas, it becomes necessary to overflow them.

Some of the smaller areas that are individual gravity CSOs may have not gotten enough flow to actually cause a CSO when they're still going to Tarp. But as a storm gets larger, then everybody is overflowing, and, therefore, the load starts to get spread throughout the entire system more evenly. So that's the difference between the large and the small storms.

Q. I think we can flip back now to Question 10. You make the following statement on Page 7 of your testimony.

"The long effects of storm flows on water quality also indicate that it may be

appropriate to consider wet weather standards for the CAWS."

Let's start with the first part of Question 11. When you say "wet weather standards," what do you mean?

A. Water -- well, what I mean is, water quality standards that are different during wet weather to reflect conditions that are achievable in water -- a water body under consideration.

Q. And when you say "achievable," what do you mean?

A. Well, I mean, that loadings that are going to come in a CSO system are very difficult to overcome by technologies available to us now.

Q. So you mean -- by "achievable," do you mean physically possible?

A. Yes.

Q. How would a wet weather standard assist in controlling these long-term storm effects? And the second part of that is would these standards be intended to protect recreational uses or aquatic life uses?

A. Is that one of the numbered questions?

Q. This is No. 11, yeah. I think it made

more sense to take No. 11 before the last part of ten.

A. So 11A is would these standards be intended to protect recreational uses or aquatic life?

Q. Sure. Let's try that. Let's start there. I don't have A -- I don't have letters, but that's fine.

A. I tried to break it into pieces.

Q. That makes sense. Let's start there.

A. Okay. All right.

Firstly, my testimony in this case was with respect to aquatic life uses, and it was aimed at recognizing reality. That is, even under completely natural conditions, low dissolved oxygen can occur.

And in the CAWS with the large CSO events, it is not practical to completely eliminate periods of low DO concentrations. Allowance for temporary periods of lower DO may not substantially harm aquatic life uses.

For example in the U.S. Environmental Protection Agency, the national criteria document for DO, Dissolved Oxygen, which is

Attachment X to the proposal, indicates that even larval stages of many species, including Large Mouth Bass, Small Mouth Bass and Channel Catfish, can survive short periods of low dissolved oxygen concentrations. For example, on Page 17, Small Mouth Bass larvae suffered complete mortality of sac larvae resulting from six-hour exposure to 2.2 milligrams per liter but no more mortality occurred after exposure to 4.2 milligrams per liter.

Based on these tests, four milligrams per liter may be tolerated by Small Mouth Bass with concentrations as high as 2.2 milligrams per liter. Page 18. Concentrations from 1.7 to 6.3 milligrams per liter reduced the growth of early life stages of Large Mouth Bass by ten to 20 percent.

Q. Dr. Melching, did you find anywhere that indicated that short-term levels that go down to zero could be tolerated by aquatic life?

A. No.

Q. Okay.

A. One other thing I wanted to add is that in the United Kingdom they have -- they had actually proposed DO standards that specified

allowable frequencies and durations of lower DO concentrations. And these standards were proposed for ecosystems suitable for salmonid fisheries, cyprinid fisheries and marginal cyprinid fisheries.

These standards proposed concentrations that may not be met for one hour, six hours and 24 hours no more than once per month, once per three months or once per year. So standards have been proposed not in the U.S. but in other countries that allow for these temporary lower DO values.

Q. Do they have a minimum value?

A. Yes, they do.

Q. Okay. And what are those?

A. It depends on the species of fish and the durations we're talking about.

Q. So the standard would say something like you can go below during wet weather events to another more -- another absolute minimum?

A. No. No, second --

Q. Or there would be no --

A. It's just you can go below a certain target, once per a month, once per three months or once per a year.

Q. So even to zero, possibly, under those standards?

A. Even to zero under those standards. So, basically, the standard is like this level at all times except for once per month for one hour.

Q. And these are in Europe, right, you're talking about --

A. These are in the United Kingdom, so England.

MR. ETTINGER: Excuse me. Can I ask a couple of follow-ups?

MS. WILLIAMS: Sure.

BY MR. ETTINGER:

Q. I'm Albert Ettinger. I represent the Sierra Club, Prairie Rivers Network and, perhaps, somebody else.

I had a couple of questions on this line. As I understand the thrust of your testimony, in large part, is that the effects of these CO events are actually longer than what IEPA assumes. Is that correct?

A. Yes.

Q. But now, it seems to me, you're testifying that we should consider wet weather

standards that would be applicable for an hour or six hours or something like that. Is that reasonable to do if what you're saying is that the CSO events are such that they're, basically -- it's always wet weather?

A. Well, I think by my -- what I just read off with regarding standards in the United Kingdom, I'm just giving an example of a place where they have made allowances, and some of these are up to 24 hours. But that's for their streams under their conditions.

And so it's -- I'm not saying this is what should be done in the CAWS, I'm just saying it has been done elsewhere.

Q. Well, a lot of things have been done elsewhere. But you're not saying that -- you're not saying that anything that's being done in England is necessarily applicable to the CAWS?

A. No.

MR. ETTINGER: Thank you.

BY MS. WILLIAMS:

Q. Do you know if these DO standards in England were protective of early life stages of fish as sensitive as Channel Catfish?

A. Well, again, they established specific ones for salmon, and so that would be probably more protective. And they also have cyprinid fisheries, which are less protected.

MR. ANDES: The document we're referring to is included on the disk that we provided earlier.

BY MS. WILLIAMS:

Q. So let's go back to the prefiled from Question 10.

"What are the impacts to the aquatic community associated with these long-term storm effects?"

A. Okay. The first -- I should probably have chosen a different word. I should have said, instead of long-term effects, maybe lingering effects of storm flows.

With regard to what are the impacts, no detailed study on the impacts on the aquatic community associated with lingering effects of storm pollutants have been done for the CAWS. Storm loads cause external stress on the aquatic community, including physical habitat acting on the aquatic community.

The accurate affect of all these stresses can lead to poor biotic integrity. To fully answer this question, further study will be needed.

Q. Well, let me clarify this point, because you are sort of a transitional witness for us entering into the aquatic life testimony. We have many witnesses yet to come.

And as far as you know, none of those witnesses have studied the effects of lingering -- or the lingering -- well, the effects of lingering storm affects on aquatic life into the CAWS. Is that correct?

A. Well, all I can say is that I haven't read everybody else's testimony. So I don't know what they are going to say.

But in the documents related to use attainability and to the statement of reasons supporting documents by the Agency, there's no discussion --

Q. But the Agency is not suggesting we have a wet weather standard for aquatic life use, the District is suggesting that, your testimony is suggesting that. So I want to know whether there's

going to be testimony from the District that explains what impact this would have on aquatic life?

MR. ANDES: Based on your knowledge.

BY THE WITNESS:

A. Based on my knowledge, I don't know.

MR. ANDES: We will have plenty of other witnesses, including some on wet weather standards.

MS. WILLIAMS: I mean, it's fine with me, Fred, if you suggest which witness would be best to ask, then we can simplify things with Dr. Melching as we go. I mean, I think he's answered as best he can.

MR. ANDES: Because we have a number of witnesses that discussed the issue of impacts of wet weather on water quality, including Dr. Melching, including Dr. Makay and a number of others. And then we have discussion by Dr. Friedman about wet weather standards.

So I think that you'll see this issue recurring in a number of other testimonies.

MS. WILLIAMS: Okay.

BY MS. WILLIAMS:

Q. The last sentence -- question in Question 4 says, "How can aquatic life potential vary before and after a storm event?"

MR. ANDES: I'm sorry, where was --

MS. WILLIAMS: Question 11. If you broke them up into subparts, it would be the last one.

MR. ANDES: Okay. Thank you.

BY THE WITNESS:

A. Aquatic life potential should be the same before and after a storm event on the CAWS. However, aquatic life can tolerate short periods of low dissolved oxygen and/or find locations of adequate dissolved oxygen in the system during storms.

BY MS. WILLIAMS:

Q. Do you think there are areas during storms of adequate dissolved oxygen in this water body?

A. Yes.

Q. And what levels of dissolved oxygen would you expect to see in these refuge areas?

A. Enough for them to survive, but I don't --

Q. And what amount would you think they would need to survive?

A. I think maybe we turn this question the other way around. Because we don't see massive kills, whatever is there apparently is enough.

Q. So we should set the standard for whatever is there now?

A. I'm not recommending anything about setting standards.

Q. So -- I mean, it seems like you are. It seem like you're recommending that we have a wet weather standard.

So I'm trying to understand what you're recommending that would look like.

MR. ANDES: Other witnesses will testify as to that.

BY MS. WILLIAMS:

Q. Question 12.

"On Pages 7 to 8 of your prefiled testimony, you state that variation in habitat and substrate, including shelter areas for fish, are generally absent from the CAWS."

Question A, "On what basis do you conclude that shelter areas for fish are absent from the CAWS?"

A. On the basis of 147 cross-section measurements made by the U.S. Army Corp of Engineers and used to describe the CAWS in the Duflow model and also site visits to more than 20 location on the CAWS.

Q. So do you think this conflicts at all with what you just said?

A. You're talking about two different kinds of refuges.

Q. Could you just explain?

A. Well, one refuge is a place where there's some DO, where they can have enough to survive. Another refuge is a resting area where they can hide from predators.

Q. What would we be looking for to find a refuge area with higher DO? Would you just need to sample or would there be physical characteristics that you would look for?

A. I think it's more a matter of where is the position relative to the loadings.

Q. Okay. Based on the chemical -- the

oxygen demand of the loadings and where they're located?

A. Where the loadings are entering the system. The relative position to those.

THE HEARING OFFICER: I'm sorry, Dr. Melching, I didn't hear that at all.

BY THE WITNESS:

A. Where the loadings are entering the system. The relative position to those.

BY MS. WILLIAMS:

Q. So back to this 12A.

Are you saying that in your site visits you did not find evidence of any shelter areas of habitat at all?

A. No.

Q. And which areas did you go to in your site visits?

A. I've been to -- I mean, to list them all is just to tax the memory. I've been in a number of locations in the Cal Sag, Sanitary Ship Canal, the North Shore Channel, the North Branch, the Mainstem, the South Branch. Like I said, to remember every spot --

Q. Okay. That's fine.

A. -- it's a little hard.

Q. And do you also conclude that shelter areas for macroinvertebrates are absent?

A. Well, my testimony didn't comment on shelter areas for macroinvertebrates. Nonetheless, I will try to answer this question.

Macroinvertebrates do not require the same type of physical areas as fish do. Macroinvertebrates primarily hide in the larger pore space -- in the bed. Because the bed for the CAWS, except for Bubble Creek, is either cut through solid rock, which is most of the CSSC and Calumet Sag Channel, were dug through consolidated silt and clay rather than formed by natural geomorphologic processes, the pore spaces in the bed are rather limited.

The bed of Bubble Creek has a deep, unconsolidated, unstable silt layer, which is -- well, the worst substrate for macroinvertebrates because of its instability. And the reason I say worst is some of my work in China was with a group that was taking macroinvertebrate data throughout the country, and they developed a rating system of different substrates relative to

macroinvertebrates. An unstable made it to the zero mark, and Fred's going to --

MR. ANDES: And we have an exhibit on that. The specific report that discusses the China work by weighing it out is on the disk.

And the table, which Dr. Melching is referring -- there are copies for everyone.

THE HEARING OFFICER: I've been handed information for Melching's Response to IEPA Question 13, which we'll mark as Exhibit 171, if there's no objection.

Seeing none, it's Exhibit 171.

(WHEREUPON, a certain document was marked Exhibit No. 171 for identification, as of 11/17/08.)

MR. ANDES: It actually deals with Questions 12 and 13.

BY MS. WILLIAMS:

Q. Can you explain what unstable means here?

A. It means very easily moved. It means that if you were to drop a probe into the bottom of Bubbly Creek, it would easily sink.

It means that these sediments are very easily moved when the pump station turns on. It's almost like it's a fluid run, would be another way to describe it.

Q. Is that -- so are you using that to describe the whole CAWS?

A. No, I'm using that to describe Bubbly Creek.

Q. And where would the rest of the CAWS fit in here?

A. I would say it's -- those areas that -- and I think we can't necessarily use this all the way because this is based on streams that formed under the national geomorphological processes. Much of the CAWS was physically dug by man.

Q. But not all of it; right?

A. Almost all of it.

Q. I think you've implied in your answer that all of it.

What about the Little Calumet River and the --

A. Well, the Calumet River North was also deepened and widened to handle shipping traffic

relative to natural. It's only the Little Calumet South that's still somewhat natural. But that's not part of the CAWS.

Q. Right.

A. It's part of our model.

Q. And where does the rest of the habitat fall on this rating?

A. Well, those that were dug out from consolidated materials are along the lines of the silt and sand, which is the parent material. But -- and then the solid rock --

MR. ANDES: I'm sorry, if I can clarify.

But is part of what you're saying that, relative to natural silt and sand, they are a worse substrate?

THE WITNESS: Correct.

MR. ANDES: The CAWS areas are worse than the natural areas. Is that right?

THE WITNESS: Yes.

MR. ANDES: Okay.

BY MS. WILLIAMS:

Q. Now, there are metrics that are similar to this in the QHEI, but you're referring to

a different type of index here?

A. Again, this is an index that was developed by my Chinese colleagues on the basis of their sampling in about 300 sites around China.

Q. And what's it called?

A. Well, they call it a habitat diversity index.

Q. Well, let's just walk through the rest of Question 12. We may have to come back to some of this, but...

A. Uh-huh.

Q. Question C. "Are there not enough fish shelter areas or macroinvertebrate shelter areas in the CAWS to support the aquatic life uses proposed by Illinois EPA?"

A. Well, given that, to my knowledge, there are very few shelter areas in the CAWS, I do not think that this would be sufficient to support a diverse fish community.

Q. But that's not what's being proposed; is it?

A. Well, should I give my standard answer for that?

Q. Yes, that would be good. Go to your

standard answer.

A. Well, the standard proposed here for dissolved oxygen is, in many ways, identical to the general use standard that this board has recently passed. Therefore, aren't we -- general use is necessary to lead a diverse and balanced community.

So if we're expecting DO to be the same as general use or material use as a general use, then aren't we implying we want a diverse community?

Q. So what you're saying is we need to look at the numeric criteria first to figure that out? I mean, or are you -- I mean, because the question was directed to the aquatic life use designation. The CAWS aquatic life B designation or the Use A designation.

A. Well, I guess the thing is that if we require dissolved oxygen standards that are necessary for general use, aren't we essentially saying it makes no logic to say that this waterway is less than the Clean Water Act goal but then to require it to meet in many ways the same DO standards we would impose on waterways that we say do meet the Clean Water Act.

Q. Well, don't you have --
A. So how can you separate these two things?
Q. But don't you have to separate -- don't you have to set the numeric criteria to protect the aquatic life use that you're designating. Correct? You agree with that?
A. I would agree with that.
Q. Okay.
Do you also agree that for the Use B waters, the dissolved oxygen standard is substantially different than the general use standard?
A. I say it's not substantial.
Q. And why is that?
A. Because the 3.5 minimum is the same and the four milligram per liter seven-day --
THE COURT REPORTER: I'm sorry, you have to speak louder.
BY THE WITNESS:
A. -- average of daily minimum is the same.
BY MS. WILLIAMS:
Q. How low would the minimum have to be

for it to be substantially different than the general use standard?

A. I think it's still a matter of -- I don't see that a line has been drawn between the aquatic community that's expected here and the DO standard that's appropriate for that aquatic use. So I think it still has to be driven by the aquatic use --

Q. Right.

A. -- but you need to think about what that community is.

Q. And do you have biological information that supports a conclusion that these dissolved oxygen standards are too protected?

A. Well, what I did do is, in the testimony of the IEPA, Mr. Smoger -- if I'm pronouncing his name wrong, I apologize -- certain fish species were mentioned as being things that wanted to be protected, were Channel Catfish, Small Mouth Bass and Large Mouth Bass.

BY MS. WILLIAMS:

Q. Are you talking about things that want to be protected in the dissolved oxygen criteria documents?

A. No, I'm talking about what -- again, the problem that I have is -- from the statement of reasons from the UAA, from the testimony of IEPA, I'm not sure what pieces were in their weight of evidence method. So I'm left with, as an external person, fishing through or looking through the documents trying to figure out, well, what might be components of this community.

And so mentioned in the testimony were Large Mouth Bass, Small Mouth Bass and Channel Catfish. So I said, well, the U.S. Fish and Wildlife Service developed habitat suitability indices for these species of fish, so let's find out. Is the CAWS a good habitat for these species based on what's in the habitat suitability reports of fish and wildlife?

So focusing just on the habitat side of this equation, I reviewed the habitat metrics for each of those fish species, and, basically, found that for Small Mouth Bass and Channel Catfish this is not their best habitat. The Large Mouth Bass adults, it's pretty close to their preferred habitat. For early life stages, though, it's not really a preferred habitat for any of these

fish.

MR. ANDES: And those USGS reports are included on the disk that we provided.

BY MS. WILLIAMS:

Q. I'm just looking ahead because I want to try and follow from your answer.

Question 36 asks, "Who calculated the habitat suitability index metrics for the CAWS, referred to on Page 13 of your testimony?"

Now, these weren't calculated for the CAWS, were they, or they were? This is Question 36.

A. So -- and I think this may be one of the questions where I'm not 100 percent sure I understand what you're really asking.

Q. Okay.

A. So I'm going to volunteer an answer. And if that isn't what you're really asking --

So what you see on Page 13 of my testimony, I determined these habitat suitability index metrics listed in Attachment 1 of my testimony on the basis of the habitat suitability index metric charts in the U.S. Fish and Wildlife Service reports for each species and using my knowledge of physical

conditions of the CAWS.

Q. What is the purpose of a habitat suitability index?

A. Which question number is that?

Q. Still on 36.

A. Okay. All right.

The HSI model reports can be downloaded from the U.S. Geological Survey, as Fred has mentioned there on the note. And just to make a note here, the USGS absorbed the research division of the Fish and Wildlife Service back in the early '90s.

MR. ANDES: I would also just say the web link for the USGS website, where the reports can be downloaded, in addition to some other web links that we've provided in Dr. Melching's answers, I have a list of those web links to add to the record.

THE HEARING OFFICER: I'm going to mark this as Exhibit 172. It's web links in response to IEPA questions to Melching.

There's no objection, we'll mark this as Exhibit 172.

(WHEREUPON, a certain document was marked Exhibit No. 172 for identification, as of 11/17/08.)

BY THE WITNESS:

A. So these habitat suitability index models have been developed for 157 species of animals, including birds, fish, mammals and amphibians. In particular, habitat suitability index models have been developed for around 60 species of fish --

BY MS. WILLIAMS:

Q. Are these mostly game and sport fish?

A. Yes.

Q. The USGS website gives the following statements regarding the purpose of the HSI model. This series provides habitat information on evaluating impacts of fish and wildlife resulting water and land use changes.

Models in this series reference numerous literature sources in an effort to consolidate scientific information on the species' habitat relationships. Models should be viewed as hypotheses of species habitat relationships rather than statements of proven cause and effect

relationships.

The value is to serve as a basis for improved decision making and increased understanding of habitat relationship. The HSI model -- this is not quoting the USGS site anymore, this is me again.

HSI models have been used extensively in wildlife management applications. For example, Brooks 1997 notes that I suspect more wildlife is influenced by application of HSI model and habitat evaluation procedures than most other management methods. HSI models have been used by the U.S. Environmental Protection Agency for a number of projects, for example, the Atlantic Ecology Division of USEPA used them as part of a scale of habitat assessment and the web link --

MR. ANDES: The web link is on the exhibit we just introduced.

BY THE WITNESS:

A. And I got the idea to apply HSI models to the CAWS when I was reviewing a report proposing an ecosystem remediation plan for the Lower Fox River in Wisconsin, which was done by Sesa Lu Heng (phonetic) and a group of others. They considered

HSI information for Small Mouth Bass and Walleye in their review of various remediation plans to the Lower Fox River.

MR. ANDES: That report is also included on the disk that has been provided.

BY MS. WILLIAMS:

Q. So from that answer, Dr. Melching, would you agree that this type of index is not typically used to determine biological potential for the purpose of determining obtainable aquatic life uses?

It's just yes or no. Either you agree or you don't agree.

THE HEARING OFFICER: Let him consult with his attorney, please.

BY THE WITNESS:

A. Well, I do not know of a specific case where HSI models were used to determine biological retention for the purpose of determining appropriate aquatic life use for a water body. I think the reason for that may in part be because it's my understanding that people are proposing life uses to actually establish entire communities of aquatic life rather than individual species.

But, nonetheless, because I couldn't find any discussion in the various documents before me as to what community we're actually trying to establish for the CAWS, I resorted, as I said before, to having a look at three specific species that I saw mentioned in IEPA testimony.

BY MS. WILLIAMS:

Q. Did you look for other species that were mentioned in your testimony?

A. These are the only ones that stood out to me.

Q. What about White Sucker, did you look for studies on that?

A. No, because they weren't specifically mentioned as one of the reasons DO standards were set.

Q. So you weren't looking at other important species for other numbers, like temperature standards or other standards, you were focused on DO?

A. DO.

Q. Can you explain why -- well, do you think it's appropriate -- this is Question 37 -- to

use this habitat suitability index without the chemistry measures?

A. Well, this is -- in every habitat suitability report, official wildlife service makes a little recommendation of how the models should be used. And what they say in each of those three reports is that these model are not perfect predictors.

And in each report -- actually, this is quoting myself -- I should say something along these lines, these models are not perfect predictors. And in each report for the species of interest here, a statement applies indicating species of interest may be present even if the suitability index is zero. And a habitat with high suitability index may contain few fish.

The Fish and Wildlife Service recommends that suitability indices should be compared with fish data for the water body of interest before interpreting the results. According to the physical habitat, only HSI metrics for the CAWS is a near perfect habitat for Large Mouth Bass.

And we find these species to be dominant game fish species in the CAWS. And my use

of the term "dominant" is coming from the UAA report, it's not my word.

Similarly, for the physical habitat, only HSI metrics indicate the CAWS as a poor habitat for Small Mouth Bass and Channel Catfish. And we find very few of these fish in the CAWS.

Thus, it seems that the physical habitat only metrics are agreeing with the fish data, indicating the importance of habitat to these fish species in the CAWS.

Q. So does that mean you think it is appropriate to use the habitat suitability index without the chemistry parameters?

A. Yes.

Q. Okay. Can you tell us what the habitat suitability index parameters say about dissolved oxygen for the three species you've mentioned?

MR. ANDES: What they say about dissolved oxygen?

MS. WILLIAMS: Yes.

BY MS. WILLIAMS:

Q. It would have an index for that, too;

right? Just like each of the habitat parameters --

A. I'm not not sure that's the case for all of these.

Q. Uh-huh.

A. Because many of the water --

Q. Would we be able to find it?

A. Huh?

Q. Where would we able to find it?

A. Right here (indicating). So let's look at it.

Starting out with Channel Catfish at the top of the pile. All right. Let's see.

THE HEARING OFFICER: Dr. Melching, you need to tell us what you're looking at, please.

THE WITNESS: Okay. Let me just make sure I found the spot.

All right. So this is a report entitled Habitat Suitability Index Models, Channel Catfish.

THE HEARING OFFICER: And is that on the disk that's Exhibit 170?

MR. ANDES: Yes.

BY THE WITNESS:

A. So here they give a range, starting with the zero suitability at one milligram per liter and full suitability one, at seven milligrams per liter. And it's a straight line between those two points.

THE HEARING OFFICER: Could you give us your page number, please?

THE WITNESS: It's Page 12.

THE HEARING OFFICER: Thank you.

BY MS. WILLIAMS:

Q. And what does zero suitability mean under these habitat indices?

A. Well, it means that --

Q. Does it mean depth or does it just mean --

A. It means unsuitable.

Q. It would be absent --

A. That they would choose not to be there.

Q. Not to be there. Okay.

So a Small Mouth Bass, or would you rather go to Large Mouth Bass first?

A. I'm just going by which is in the pile

here. This is the habitat suitability information for Small Mouth Bass.

This is Page 13. It also starts with the zero at one milligram per liter. It reaches one at six milligrams per liter and this one, rather than being a straight line, is a bit of a curve.

Finally -- and then this, finally, is habitat suitability index models, Large Mouth Bass. Now, here, rather than having a curve, we have a number of steps.

So if -- this is Page 10. So if the DO is frequently less than two milligrams per liter, this gets a suitability index of .1.

If the DO is usually greater than two, and less than five milligrams per liter, it's a suitability index of .4. If it's usually greater than five milligrams per liter and less than eight grams per milligrams per liter, it's a suitability index rating of .8. And then if it's often above eight milligrams per liter, it gets a suitability index of 1.

And the definition of "frequently" "usually" and "often" aren't explicitly given here,

that I can recall. So that's in the eye of the beholder.

Q. I think that you've answered 39. Oh, no, maybe not. Question 39.

"What habitat suitability index rating would represent the level at which Illinois EPA's proposed aquatic life uses for the CAWS could not be attained? How would you determine this threshold?"

A. Well, again, this is one of the questions I'm not exactly sure what you're asking. But here goes.

So as I just stated, the Fish and Wildlife Service indicates that these habitat suitability index ratings can only be properly interpreted by comparison of fish sampling data on the water body of interest.

Q. So they're not transferable between water bodies. Would you agree with that statement?

A. The rating itself?

Q. Yes.

A. Or the procedure?

Q. The rating itself.

A. Well, you would make an individual

evaluation for a given water body that would change another one.

Q. And that hasn't been done for the CAWS. Or are you saying you've done that for the CAWS?

A. Well, what I've done for the CAWS is, in general, considered -- again, using my knowledge of velocity steps, variations in water levels and some of the other physical substrate -- physical components here, made an evaluation in a general case over the entire CAWS, therefore, what you see in some of my reporting are ranges of ratings that reflect different waterways. I haven't gone point by point and location by location.

Q. But you also haven't used all the indices that you would use if you were going to do --

A. Well, again, my purpose was to comment on those things that I feel I have some knowledge of, which is physical habitat. And also --

Q. Would you say that applying habitat suitability in the indices is one of the things that you have extensive knowledge of?

A. I would say habitat suitability

application is rather straightforward. It's more a matter of having the knowledge -- as I just described in the DO's regulations, it's a straight line between one value and another that you would then compare to the reach.

Q. In -- you know, in looking at QHEI information, we've had a lot of testimony about that already. And that is a qualitative index.

A. Uh-huh.

Q. And we have had a lot of testimony about trainings that people go through in order to be certified or qualified to apply that index. Would you agree the same is true here, or if not, what's different about this?

A. Well, what's different about this is the way the indices are indicated. Maybe the best -- maybe this would be a good time to go to this one (indicating).

MR. ANDES: Just a minute, I'll get there.

THE HEARING OFFICER: Are we going to make 200 today?

MR. ANDES: One can only hope.

We are only staying until 4:15,

so...

THE HEARING OFFICER: I've been handed information for Melching Response to IEPA Question 40A. If there's no objection, we will mark this as Exhibit 173.

Seeing none, it's Exhibit 173.

(WHEREUPON, a certain document was marked Exhibit No. 173 for identification, as of 11/17/08.)

BY MS. WILLIAMS:

Q. Is this a document that you developed to respond to the question, or is part of this taken from your report?

A. Well, this is a document that I developed to respond to one of the questions. Because there seems to be a lack of clarity on how HSI metrics are determined.

So the top of this figure shows one of these HSI ratings, in this case for Large Mouth Bass, and it's related to the maximum current velocity at .8 of the depth within pools or backwaters during spawning. So this is a measure for whether it's a good area for embryo.

And so that's just a curve or a

set of lines. And below that are the average velocities that are included in the attachment.

Q. And these are modeled velocities; right?

A. These are modeled velocities averaged over July 12th to September 15th, for those reaches. And we initially calculated feet per second -- I record them in feet per second -- I converted them to centimeters per second for application up in the figure.

And so, for example, Central Street to Oakton Street, the average velocity is 10.4 centimeters per second over that entire period. Now, that's an average velocity that also includes some storm periods, which would have higher velocities.

So this average velocity is probably unbalanced, a little higher than the true .8 depth velocity in these reaches. So we're kind of biased low in the centimeters per second, or biased as a little bit high here.

But we could see that -- just reading off the chart for these average velocities, we can get the B20 metric. And essentially all the

other habitat suitability metrics have these similar figures to this, either with a combination of lines or curves, or, in some cases, specific values for a range of conditions.

Or in the case of substrate, a labeling of this substrate gets this index. So it's not like this is overly complicated or requires complex training. It's more a matter of do you have the physical information --

Q. Well, I think what I'm trying to understand, we have spent a lot of time as a group here in this room trying to learn how the QHEI indices work and apply it to this. And I'm trying to understand why you have turned to a completely different model for looking at the system and how it's relevant to what we're looking at.

A. Well, again, my reason --

Q. Is it better?

A. Well, no, it's additional information.

The IEPA talked about a weight of evidence, this is also information that could or should be considered. And again, I have no idea what community is supposed to result based on these regulations.

But it has been mentioned -- three species of fish were mentioned, so I just wonder.

Q. You were just curious, so you went and looked?

A. I was curious.

Q. Okay.

A. Is it reasonable to expect these fish to inhabit this waterway in substantial numbers.

Q. Right. And --

A. If not, why set up DO criteria to support them?

Q. And so, is it your conclusion, then, it's not reasonable?

A. Other then adult Large Mouth Bass, it is my conclusion that early life stages of those three species and adults of Small Mouth Bass and Channel Catfishes would not find it as their preferred habitat, based on habitat suitability ratings.

BY MR. ETTINGER:

Q. Excuse me. As our presence in this room shows, creatures sometimes do things that they don't prefer.

Is it possible that some of these

fish are, in fact, in the system, even though they are not in their preferred habitat?

A. Well, the data indicates otherwise.

Q. Are you saying there are no Small Mouth Bass in the system --

A. I'm saying there are very few.

Q. Excuse me. If you'll let me finish I'll let you finish.

I'm just saying are you saying there are no Small Mouth Bass in the system?

A. I'm not saying that. I'm just saying there are very few.

Q. Okay.

A. Far more Large Mouth Bass.

Q. How did the Small Mouth Bass that are there get there?

A. My guess is that they're coming -- at least some of them, are coming from Lake Michigan. My evidence for that is that Small Mouth Bass, in the District sampling data, are the fourth-most abundant fish in the Calumet River upstream of O'Brien Lock and Damn. Large Mouth Bass are the third most abundant.

Q. So it's your testimony that there is

no breeding of Small Mouth Bass going on in the Chicago area waterway system?

A. It is my testimony that there is no evidence of breeding and that they wouldn't find it as a preferred habitat.

Q. Are you aware of any findings of early life stages of Large Mouth Bass in the Chicago area waterway system?

A. It hasn't been presented in the statement of reasons for the IEPA testimony.

Q. So your understanding is there is no evidence of early life stages of Large Mouth Bass anywhere in the Chicago area waterway system?

MR. ANDES: In the record?

BY THE WITNESS:

A. In the record?

MR. ETTINGER: Fred, I'd like him to testify.

MR. ANDES: I'm not testifying, I'm talking to my witness.

MR. ETTINGER: Well, we'll go on.

Could you read back the question, please?

(WHEREUPON, the record was read by the reporter.)

BY THE WITNESS:

A. And my answer is in the documents put forward to us by the Illinois EPA, no such evidence has been presented.

BY MR. ETTINGER:

Q. Are you aware of evidence of Channel Catfish anywhere in the system?

A. Yes. There are some Channel Catfish. Again, not many.

Q. Where do you believe the Channel Catfish are coming from?

A. I do not know.

Q. Okay.

A. Because they are also not found in much population in the tributary water bodies, as well.

Q. Is it possible that there are portions of the Chicago area water system that have habitat for some of these species even though the system as a whole may be very poor for them?

A. Now, you're talking about the CAWS itself or its tributaries?

Q. Well, let's do it both ways. Do you want to include just the CAWS itself?

A. Well, I would say that tributaries, such as the North Branch outside of the CAWS, Little Calumet and its various tributaries, are more likely to have appropriate habitat for early life stages of these fish.

Q. Okay.

A. However, again, the fish data from the '90s and with this decade are not showing many numbers of those fish in those tributaries, and again, no evidence of early life stages.

Q. Well, let us -- can electrofishing equipment sample early life stages?

A. I would believe so, yes.

Q. You believe it can?

A. Yes.

Q. You believe that electrofishing equipment can sample early life stages?

A. Yes.

Q. Is early -- is electrofishing -- is electrofishing equipment as effective at sampling early life stages as it is other stages of fish?

A. I would think it would be more

effective.

THE HEARING OFFICER: Dr. Melching, we can't hear you.

THE WITNESS: Sorry.

BY THE WITNESS:

A. I would think it would be more effective. Because small fish have less ability to withstand the shock.

MR. ETTINGER: Thank you.

BY MS. WILLIAMS:

Q. I think you've answered maybe part of Question 24, but let me finish it up here.

THE HEARING OFFICER: You know what, before we go to that, it's ten after 12:00. Why don't we go ahead and take an hour for lunch and be back here by about 1:10.

We can go off the record.

(WHEREUPON, discussion was had off the record.)

THE HEARING OFFICER: See you at 1:10. Thank you.

(WHEREUPON, a recess was had until 1:10 p.m., this date.)

ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)
	)
WATER QUALITY STANDARDS AND	) R08-9
EFFLUENT LIMITATIONS FOR THE	) Rulemaking - Water
CHICAGO AREA WATERWAY SYSTEM	)
AND LOWER DES PLAINES RIVER	)
PROPOSED AMENDMENTS TO 35 ILL.	)

DATE: 11/17/08

TIME: 1:20 p.m.

APPEARANCES:

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MS. ALISA LIU, Environmental Scientist,
MR. ANAND RAO, Senior Environmental Scientist,
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MR. IRWIN POLLS.

THE HEARING OFFICER: Let's go back on the record. And, Ms. Williams, I think we're back with you.

DR. CHARLES S. MELCHING,

called as a witness herein, having been previously duly sworn and having testified, was examined and testified further as follows:

EXAMINATION (Resumed)

BY MS. WILLIAMS:

Q. I'm going to turn to Question 13. I think that was the earlier question that we skipped over.

"Explain why you think contaminated sediment prevents the CAWS aquatic life, you say, from being attainable. The same question for CAWS aquatic life Use B."

A. In my testimony, I do not discuss sediment contamination, nor have I reviewed such data. When I speak of poor substrate, I'm talking about the geomorphologic condition, sediment sizes and variation of sediment size.

Q. Okay.

A. And that, then, ties into the table that Fred previously distributed.

Q. Thank you. Question 14.

"On Page 9 of your testimony, you compare values of Macroinvertebrate Index or MBI between macroinvertebrate samples collected with a hand-operated grabbing apparatus from bottom sediments to those obtained passively from artificial substrates that are placed in water left to be colonized and then removed several weeks later. You conclude that the difference between the MBI values shows that, quote, 'CAWS substrate prevents any further improvements in water quality from translating to a better macroinvertebrate community that will not likely result in improvements in aquatic life use.'"

Is it your testimony that this condition, as you describe it, is irreversible?

A. Yes, it's my testimony that this condition is irreversible. The reason is that, as I've explained earlier, the substrate didn't result from natural geomorphic processes.

It lacks the right type of sediment types and diversity among these types to make a good habitat for macroinvertebrates.

Q. How would you define the aquatic life

use potential at the CAWS aquatic life Use A waters?

A. It is not the purpose of my testimony to propose an aquatic life use classification to the CAWS. The development of such a classification would require an extensive study of all current biological data and the collection of additional supported data.

Limno-tech is currently doing such a study to determine the biological condition of the CAWS under contract the Water Reclamation District. I recommend that the IPCB wait for the results of that study before finalizing aquatic life use classification of the CAWS.

Q. Do you think the Agency's proposal in expecting these waters to support a balance healthy benthic community?

A. The rulemaking proposal before the Board is requiring that the CAWS meet, in certain critical aspects, the general use dissolved oxygen standards in Rule R04-25. The general use standards are required for an aquatic community that meet the Clean Water Act goals.

A balanced, healthy benthic community would meet the Clean Water Act goals.

Q. Does the dissolved oxygen standard proposed relate in any way to the benthic community? Is it designed at all to protect the benthic community?

A. Well, it should have been. Because having a balanced aquatic community requires a good benthic, as well.

Q. Do you know anything about the benthic -- the dissolved oxygen needs of the benthic community in this system?

A. What it is now or what it's supposed to be?

Q. The potential. I should say the potential. Let me ask this a different way.

Doesn't the USEPA national criteria for dissolved oxygen focus on fish needs?

A. For the most part, yes. But it does also comment about needs of the invertebrates. But it assumes that if fish needs are met, the invertebrates needs also are met.

Q. Thank you.

Question D asks, "Are comparisons of MBI values between two macroinvertebrates samples valid if one sample was collected actively with a

hand-operated grabbing apparatus from bottom sediments and the other sample was collected passively from artificial substrates?"

A. Basically, in my reasoning, I followed the logic of the contractor for the use attainability analysis from the Lower Des Plaines. They made similar conclusions to those in my testimony with comparing macroinvertebrate samples collected by Hester-Dendy samplers and Ponar graph samplers in the Lower Des Plaines River.

So if we look at Attachment A to the rulemaking proposal before the Board, on Page 514 it is stated, "The greater taxa richness percent EPT abundance and percent tolerant organisms collected on artificial substrates indicate that water quality can support a more diverse benthic community if aquatic habitat was available."

So they made a similar conclusion that --

Q. Is that the same, the EPT taxa as an MBI?

A. Well -- all right. If we go on further in their discussion, comparison of MBI results between Hester-Dendy samplers and Ponar

samplers on Pages 516 and 517 that implies that the MBI results mirrors the results suggested on the basis of individual metrics.

So the three things I mentioned before are metrics and assumed and beyond. Not the total MBI --

Q. Right.

A. -- but the portions of it.

Q. So is it your testimony that the MBI includes EPT taxa as a subset?

A. Well, percent EPT.

Q. So you're saying that percent EPT is a metric in the MBI?

A. That's what I thought.

Q. Do you know what the MBI was designed to show?

A. That was supposed to be an indicator of water quality.

Q. And was it designed to indicate habitat conditions?

A. It was designed to describe the health of the community relative to water quality.

Q. Water quality. Okay.

Would you -- would it be a normal

methodology to take macroinvertebrate samples from the fine bottom sediment in calculating an MBI?

A. That is one way it is done.

Q. What other ways could it be done?

A. The other way is, what was it then that placed the artificial substrate --

Q. But when you --

A. -- Hester-Dendy sampler?

Q. But when you're taking from the actual substrate, you would go to the fine bottom sediment, that would be where you would take the samples from?

A. If there are fine bottom sediments.

Q. How do you know that if the water quality conditions were to improve in the CAWS that the MBI wouldn't also improve?

A. Well, we can look at some of the locations. So for a number of the locations -- and I think we have a couple more tables here.

MR. ANDES: Yes, we do.

THE WITNESS: Let Fred distribute them out.

THE HEARING OFFICER: I've been handed information from Melching Response to IEPA Question 14G. If there's no objection, we'll

mark this as Exhibit 174.

Seeing none, it's Exhibit 174.

(WHEREUPON, a certain document was marked Exhibit No. 174 for identification, as of 11/17/08.)

BY THE WITNESS:

A. So the numbers you see in this table are taken from the UAA study. And so these are --

THE HEARING OFFICER: Dr. Melching, just to clarify, that's the CAWS UAA?

THE WITNESS: The CAWS UAA.

Thank you.

BY THE WITNESS:

A. So MBI values between 6.1 and 7.5 indicate fair conditions. And MBI values less than or equal to six indicate good conditions for water quality.

Whereas, MBI values less than nine, the Ponar indicates very poor water quality. So at these locations we have good to fair water quality.

In the Hester-Dendy samplers, water quality sufficient to support a fair to good biotic macroinvertebrate community on those

artificial samplers. But in the sediment itself, the very, very poor -- very poor -- too many poors -- very poor community exists.

MR. ANDES: More than nine.

BY THE WITNESS:

A. Because it's more than nine, yeah, it's greater than nine.

BY MS. WILLIAMS:

Q. Weren't the macroinvertebrates obtained on the artificial substrates already present elsewhere in the stream before the sampling?

A. Hester-Dendy samplers are colonized by macroinvertebrates drifting along the flow. As such, these macroinvertebrates could have originated far upstream on the tributaries or from Lake Michigan or even the seep of station pools.

"For example, in the assessment of benthic macroinvertebrates in the Lower Des Plaines River, it was noted that the increase in taxa richness from Lockport to the Brandon Pool is likely the result of drift organisms from the Upper Des Plaines River that enters the system in the Upper Brandon Pool." This is Page 57 of Attachment A.

"The fact that these invertebrates did not also colonize the bed is evidence of poor substrate."

Q. If one finds relatively tolerant organisms living in the fine bottom sediment of the stream, does this finding necessarily mean that the physical habitat of the stream cannot support biological potential consistent with the Clean Water Act aquatic life goal?

A. The goal of the Clean Water Act is to protect and maintain the physical, chemical and biological integrity of the nation's waters. Thus the Clean Water Act aquatic live use goal is biological integrity.

And biological integrity has generally been defined as balanced communities of tolerant and intolerant species of fish and taxa of macroinvertebrates. High IBI scores and low MBI scores representing high quality aquatic communities result in intolerant species and taxa dominant the aquatic community. For example, in the UAA report for the CAWS Attachment B will make the proposal.

The following is stated on Page 4-38, "In a healthy stream, the benthic

community will include a variety of pollution sensitive macroinvertebrates, while in an unhealthy system there may be only a few types of nonsensitive and tolerant macroinvertebrates present. Further, if intolerant macroinvertebrates can colonize artifical substrates but not the actual substrate in the sediment bed, the lack of intolerant macroinvertebrates implies the balanced benthic community cannot be supported by the actual substrates."

Q. That's if you can't find them on the artificial substrate; right?

A. No. That's if you can find them on the artificial substrate.

Q. Can you read the last part of that quote again?

A. "The lack of intolerance." Oh, yeah, you're right, if you can't find the --

Q. Thank you.

A. -- in the sediment bed, but not the actual sediments.

So actually you can find the macroinvertebrates on the artificial substrates but not the actual substrates.

Q. I haven't asked Question H.

"What are the water column physical and chemical requirements, the macroinvertebrate taxa that potentially can live in the CAWS?"

A. Well, because you say "can potentially live in the CAWS" --

Q. Right.

A. -- this is a very big question.

Q. Does that mean it has a long answer?

A. Yes, of course.

Q. Okay.

A. But it's a very big question that could not be answered without a very detailed study of the physical, hydraulic and chemical conditions of the CAWS that is beyond even the current study being done by Limno-tech to determine the biological potential for the CAWS. The reason I say beyond the Limno-tech study is that Limno-tech is focusing on taxa that are important to the nonwadable habitat index developed in Michigan and being calibrated for the CAWS.

In this index, key macroinvertebrate indices include percent

Caddisflies, EPT, which is the combination of Mayflies, Stoneflies and Caddisflies taxa richness, true flies taxa richness, Stoneflies taxa richness and total taxa richness. To get an answer to this question with respect to key macroinvertebrate taxa, I recommend that the IPCB wait for its results of Limno-tech study.

MR. ANDES: So, if I can clarify, Dr. Melching, you're saying that the Limno-tech study will give results basis in key taxa, but if the question is how are we going to determine the requirements for all taxa, that would be a bigger study?

THE WITNESS: Yes.

MR. ANDES: Okay.

BY MR. ETTINGER:

Q. Can I just ask a question about the nonwadable stream study in Michigan? Is this something new that's being developed?

A. Well, this is -- Limno-tech is doing an ongoing evaluation of the habitat potential of the CAWS under contract with the District. An exact timing when it would be completed, I do not know.

Paul Friedman is the senior

advisor on that, and you'll have a chance to meet him later.

Q. Are IBI studies normally done for nonwadable streams?

A. IBI studies?

Q. Right.

A. Well, there are IBI indices available for nonwadable streams. One has been developed in Wisconsin and one has been developed in Ohio.

BY MS. WILLIAMS:

Q. So just one more question on this, follow-up.

Do you know, with regard to Ponar grab sampling, is this type of sampling selective for fine particle sediment? This is a follow-up.

Do you know if Ponar grab samples can adequately sample for coarser grain materials in the substrate?

A. Well, I'm not sure I understand the second part of your question.

Q. Okay. The first part would be fine if you could answer.

A. Yes, they are used for fine grain sediment --

THE HEARING OFFICER: Dr. Melching --
THE WITNESS: Yes.
THE HEARING OFFICER: -- we can't hear you.
BY THE WITNESS:
A. Yes, they are used for fine grain sediments.
BY MS. WILLIAMS:
Q. Can you explain why?
A. A way to get these -- get a sample up. For example, in wadable streams, it's common for the coarser grain sediments to physically sieve the sediments in place and scrape off the bottoms of rocks and other things to mobilize the -- okay.
MR. ANDES: Don't talk to her.
BY THE WITNESS:
A. So for coarser grain sediments, people have a tendency more to use, as I say, a sieve-type device or a mesh, place it downstream of where the sediments are taken and to physically agitate the bed and turn over rocks and sweep off material and let it be caught by the mesh. And the sample is taken back for classification.
For finer grain sediments, there

are not any rocks to turn over. You need to have a larger chunk of the bed to evaluate.

BY MS. WILLIAMS:

Q. And in a nonwadable stream, wouldn't you use Hester-Dendy sampling to replace the sieve method?

A. Well, not necessarily replace the sieve method. But in the absence of -- sorry.

Not necessarily just to replace it because you would also be able to use the Ponar samples under that nonwadable situation.

BY MR. ETTINGER:

Q. Can I just ask what's a Ponar?

A. Well, it's, basically, for lack of a better word, a bucket-like device that you drop to the bottom that you use to -- not necessarily round. But you drop it to the bottom, you let it sink in a little bit, close the trap and you bring it back up to the surface with sediment samples, hopefully, the invertebrates inside.

Q. Does Ponar -- do you use Ponar sampling for hard sediments?

A. Hard sediments? What's your definition of hard sediments?

Q. Rocky bottoms.

A. Well, the typical natural stream with a rocky bottom isn't going to be deep enough that you would need to use -- sorry. Typical rocky bottoms of cobbles, gravel, don't flow -- generally, don't flow so deep that you would need to use a Ponar that you can, under low flows, go in and wade.

Q. Well, let's say, for example, we had a system, imagine, in which it was a channel that was blasted through rock that had a rocky bottom --

A. Yeah, but this rocky bottom --

Q. Well, excuse me.

A. -- is a hard rocky bottom.

Q. Yeah.

A. It's not like a bunch of cobbles.

Q. I understand my mind moves so slowly that you think you can anticipate my end of my question. It will, nonetheless, make for a clearer record if you let me finish.

If you had such a system, would you use a Ponar to sample it?

A. So in this -- for example, in the Sanitary and Ship Canal and the Cal Sag Canal portions that were cut out of rock?

Q. If you had a hard bottom, could you use a Ponar to sample it?

A. I don't think you would get much good result by doing that. Because there's no sediment down there to collect.

MR. ANDES: Is that what you were asking?

MR. ETTINGER: Frankly, I've forgotten what I was asking, we got a little off course.

BY MR. ETTINGER:

Q. But let's imagine that that channel had been eroded over, say, 80 years and had fissures and things in it. How would that affect your ability to use a Ponar?

A. Well, again, since Ponar is collecting loose sediment on the bottom -- not really loose, but finer grains of sediment on the bottom -- and, for the most part, the Sanitary and Ship Canal is absent of those, it wouldn't work very well.

Q. Did you look?

A. Did I look?

Q. Yes.

A. In what --

Q. Did you look if there was any loose sediment on the bottom of these 80-year-old channels?

A. I know from experience, from people who have dived the Sanitary and Ship Canal in the city of Romeoville and Lemont, which is where the acoustic velocity meters are, that there is almost no sediment on the bottom. It is still primarily a rock -- solid rock in those locations.

Q. Have you looked at the sides of the Sanitary and Ship Canal or the Cal Sag recently?

A. Well, again, at those locations where I've talked to people who have dived -- again, at those locations where I've talked to people that have dived, that is what they have reported to me, that there is no appreciable sediment.

Q. And it is your understanding that there are no fissures in the walls on any of those channels?

A. I don't know about fissures in the walls, I'm saying there is no sediment.

Q. There is no sediment?

A. No appreciable sediment.

MR. ETTINGER: Thank you.

BY MS. WILLIAMS:

Q. What about submerged logs or other types of potential...

A. I think not.

Q. You don't think there's any logs?

MR. ANDES: I don't know if you can talk with each other.

BY MS. WILLIAMS:

Q. And that -- I mean, when you talked about people who have dived -- dove -- divers, are your -- is your testimony about almost none applicable to the North Shore Channel? Are you referring to the North Shore Channel?

A. Almost none with respect to what aspect of my testimony?

Q. Bottom sediments. Well, and also logs. I had just asked about logs specifically, too.

A. Okay. Well, my reference relative to logs there was with regard to the Sanitary and Ship Canal, Cal Sag Channel.

Q. What is your knowledge of the types of substrates in the North Shore Channel?

A. I believe it's primarily silt and clay

and sand deposits from the lakes, which came before Lake Michigan and consolidated over time.

Q. And do you know if there are any submerged logs or cobbles or bolders there?

A. Not to my knowledge.

Q. What about the Calumet River?

A. Calumet River?

MR. ANDES: Little Calumet or Calumet, or which parts are we talking about?

BY MS. WILLIAMS:

Q. The Little Calumet, north.

A. I don't know.

MR. ANDES: Well, let me ask.

The Little Calumet River North is the part that was cut out; am I right?

THE WITNESS: Yes. It's the part that was widened and deepened to permit shipping traffic.

MR. ANDES: Thank you.

BY MS. WILLIAMS:

Q. And it's your testimony you're not aware -- what is your testimony with regard to that substrate that's found there?

A. Well, with regard --

Q. I'm sorry if I missed it.
A. Well, I thought you were asking about logs. And my testimony is I don't know if there are any logs present on the basin.
Q. You don't.
A. But with regard to what the substrate is, again, it's a similar silt, sand, clay mixture, as for the North Shore Channel. Because it's dug through similar lacustrine deposits.
Q. And the Calumet Sag Channel?
A. Well, for much of it, it is dug through the solid limestone.
Q. And do you know if there are any submerged logs, cobbles, bolders, et cetera, there? Bridge abutments maybe?
A. In the rock portions, I would expect that it also has very little sediment. With regard to logs, I don't know whether there are logs down there.
Q. Question 15 asks, "Can you explain why you testify on Page 10 that the Agency's designated aquatic life uses did not take in account the full velocity in the CAWS?"
A. In my testimony, the discussion of

flow velocities was in relation to Rankin's 1989, Page 24, observation that sites with fast currents had higher IBI scores than expected by channels. That is high velocity results in higher IBI scores and low velocity results in lower IBI scores, i.e., a less diverse fish community.

Q. Did you cite to a page number?

A. Twenty-four of the 1989 report.

Q. Are the water velocities too low in the CAWS to support the aquatic life uses purposed by Illinois EPA?

A. Basically, as I mentioned before, my use of one foot per second and .4 feet per second was an attempt to define load velocities relative to your high versus low. And as noted in my testimony, these velocities are very low compared to the reach average velocity in the USGS database.

Thus, the flow velocities in the CAWS are substantially smaller than those found in natural streams throughout Illinois. This, in addition to other physical features of the CAWS, indicates that the CAWS is far from a natural stream. And to expect it to support similar biological communities as natural streams makes

little sense.

With respect to the aquatic life uses, this question is difficult to answer, because in the statement of reasons and in their testimony, the IEPA has not explicitly described the benthic macroinvertebrate in fish communities they expect to be supported by the proposed aquatic life use. However, if we consider the dissolved oxygen standards, the proposed aquatic life use standards equal, in certain critical aspects of general use dissolved oxygen standards in the Illinois recently adopted rules, then we can assume that IEPA expects the type of benthic macroinvertebrate in fish communities that would occur in the natural general use waters of the state, such an expectation is highly unrealistic for a nonnatural waterway system of a substantially degraded physical habitat, that is the CAWS as described in my testimony.

Q. Are all streams that have an average water velocity of less than four feet per second incapable of attaining the Clean Water Act aquatic life use goal?

A. As I just said, in my testimony --

MR. ANDES: I'm sorry. Can I clarify?

Zero point four?

MS. WILLIAMS: Zero point --

MR. ANDES: I think he said four.

MS. WILLIAMS: Zero point four, sorry, feet per second. Sorry.

BY THE WITNESS:

A. So as I said before, my discussion of .4 feet per second is just, again, to try to draw the line of what is high and what is low.

BY MS. WILLIAMS:

Q. So can some streams lower than that be capable of attaining the water -- the Clean Water Act goal, or no?

A. Yes.

MR. ANDES: Why do you believe that, in this case, the velocity is a factor in why the CAWS can't achieve those goals?

THE WITNESS: Well, if we look at some of the -- again, if we look at the fish species from the habitat suitability index, for Large Mouth Bass, the low velocities for adults is their preference. But for early life stages, as you saw on the table we passed out earlier, it's not so preferred to

have -- even velocities as low as the CAWS are not low enough for them.

And for the other Channel Catfish and for Small Mouth Bass -- well, Channel Catfish also likes low velocity, but there are other aspects of the physical habitat that it doesn't like.

BY MS. WILLIAMS:

Q. Is one of those aspects --

A. Some fish like low velocities, others don't. So it depends again on what the target is.

MR. ANDES: So your discussion of what's attainable here is based on velocity and a combination of other factors?

THE WITNESS: Yes. Velocity and other factors.

So, in effect, what I was trying to do when I was looking at the QHEI is -- in my first look at how things were classified by QHEI, it seem like some of the quasi rules in some of Rankin's earlier publications were not completely followed. And so --

MR. ANDES: Followed by IEPA here?

THE WITNESS: Followed by IEPA and a

recommendation before the Board. And, of course, these hard and fast rules that any number of QHEI below some threshold or above some threshold should be this way or that, you know, Rankin says, well, you know, there are other -- you need to consider the individual metrics, as well. Velocity being one of the metrics.

And the comment he made about velocity is that high velocities generally are correlated with better IBI low with lower IBI. And so I kind of tried to break down, and we'll probably touch upon it in other questions --

MS. WILLIAMS: Yeah, we're going to have to jump ahead because of how -- because I think if we're going to talk in this much detail about this document -- so let's jump ahead to Question 20.

BY MS. WILLIAMS:

Q. "On Page 11 in reference to physical habitat in the CAWS, you state six features of stream physical habitat as being determined by QHEI documentation, Rankin 1989, to be, quote, 'Primary

features of a modified warm water stream.' Can you please identify where these six factors are designated as primary factors?"

A. Well, the term "primary features" is my term to the features that appear in Exhibit 5 of the testimony, which is Table 8 from Rankin 1989. My feeling was to who on this list makes these features among myriad of possible habitat features important or primary features.

Rankin further divided these features into high influence and moderate influence. Among the ones discussed in my testimony, three are high influence, out of only four high influence features for non -- water streams and three are moderate influence features.

Q. Go ahead and explain which ones are actually high influence features.

A. I have to grab the right page here.

So I would say in Rankin's table, he calls it recent channelization, I call it permanent channelization. That was high influence.

Number two, silt and muck substrates is considered a high influence feature. The third high influence feature is cover sparse to

none.

The moderate features are the low to no sinuosity. The fair to poor --

THE COURT REPORTER: I'm sorry, I can't hear you.

BY THE WITNESS:

A. The moderate features are the low to no sinuosity, the fair to poor pool and ripple development and the lack of fast current. That would be referring to the velocity issues.

THE HEARING OFFICER: Just for the record, for point of clarification, and forgive me, I'm having a hard time, the 1989 Rankin document was in the record with part of the IEPA proposal; wasn't it?

MS. WILLIAMS: I don't think so. I have copies if you want to enter it. It seems appropriate to enter it.

THE HEARING OFFICER: Okay. I misunderstood. I thought it was already a part of the record.

Yeah, I do think we need to put that in the record.

MS. WILLIAMS: I do. I mean, it

wasn't attached, was it, to your testimony, Dr. Melching?

MR. ANDES: We have Table 8 of Rankin as an exhibit to his testimony.

If she wants to go ahead and introduce it as a separate exhibit.

THE HEARING OFFICER: That might work easier, since we're talking about it so much right now.

MS. WILLIAMS: I think it's a very important document. When I looked through and I couldn't find it in the list, I thought we should probably have it in.

THE HEARING OFFICER: I have been handed the Qualitative Habitat Evaluation Index Rationale, Methods and Application, November 6th, 1989, Edward T. Rankin, for the State of Ohio Environmental Protection Agency. If there's no objection, we will mark this as Exhibit 175.

Seeing none, it's Exhibit 175. And I will note that it is also a part of Exhibit 170.

MR. ANDES: Yes.

(WHEREUPON, a certain document was marked Exhibit No. 175 for identification, as of 11/17/08.)

MR. ANDES: So it's really important.

BY MS. WILLIAMS:

Q. Question 18 in Exhibit 5 included -- at the end of your testimony you provide a table entitled, quote, "Habitat Characteristics of Modified Warm Water Streams," and in quotations, "Warm Water Aquatic Life Use A, and Warm Water Streams," and in parenthesis, "(General use waters in Ohio)."

When you use the term "warm water aquatic life Use A," are you talking about the Chicago area waterway system aquatic life Use A waters as defined in the Agency's proposal?

A. Yes.

Q. What causes you to conclude the Agency's CAWS aquatic life Use A designated use is equivalent to Ohio's modified warm water aquatic life use?

A. I base my conclusion on the QHEI values for the various reaches assigned to the CAWS aquatic life Use A designated waters. Rankin 1989,

which is when it was distributed, indicates that the primary determinate for waters to be classified as modified warm water habitat as having QHEI values between 32 and 45.

However, waters with QHEI values between 45 and 60 can be classified as modified warm water habitat, depending on the nature of the disturbance and whether it can be mitigated. These rules that I'm referring to are for head water streams with drainage areas of 20 square miles or less.

Thus, strictly, these rules would apply only to a portion of the North Shore Channel. Rankin Attachment R to the rulemaking proposal before the Board use a similar QHEI scale when evaluating the CAWS.

For a QHEI between 46 and 59 is rated fair and a QHEI between 30 and 45 is rated poor. Thus I assume that poor equated to modified warm water habitat and some fair could also be considered modified warm water habitat, depending on the nature of the disturbance and whether it could be mitigated.

When I consider the QHEI values

for the locations in the waters designated Chicago area waterway system aquatic life Use A --

MR. ANDES: And we have a table.

THE HEARING OFFICER: I've been handed information for Melching Response to IEPA Question 18A. If there's no objection, we will mark this as Exhibit 176.

Seeing none, it's Exhibit 176.

(WHEREUPON, a certain document was marked Exhibit No. 176 for identification, as of 11/17/08.)

BY THE WITNESS:

A. If we look at this list of QHEI values, five of the ten values fall in four -- or modified warm water habitat range, four of the ten values fall in low end of the fair range that could be considered modified warm water habitat, taking into account the lower extreme nature of the individual metrics in the QHEI.

BY MS. WILLIAMS:

Q. Why do you testify that Illinois general use designation is equivalent to Ohio's warm water streams use here?

A. According to a document entitled

Summary of Ohio's Beneficial Use Designations, found at the Ohio EPA website --

MR. ANDES: That's on our page of websites.

BY THE WITNESS:

A. -- warm water habitat is defined by the baseline regulatory requirements in line with the Clean Water Act fishable goal expectations.

BY MS. WILLIAMS:

Q. Can you explain where the CAWS and Brandon Pool aquatic life Use B would fit into your table?

A. That's one of the subparts to which question?

THE HEARING OFFICER: Eighteen C, I believe, is where she -- she rephrased it little bit.

THE WITNESS: Okay. I know where we are.

MS. WILLIAMS: I didn't mean to. Oh, I just skipped this stuff, yeah.

THE WITNESS: I know where we are.

BY THE WITNESS:

A. So, firstly, as noted in my testimony,

this is not my table. It comes from Page 41 of Rankin 1989.

Secondly, I have not proposed a Use C in my testimony, therefore, I cannot answer any question regarding Use C that's coming.

BY MS. WILLIAMS:

Q. So your answer is you don't know where Use B would fit, because it's not your table?

A. It's not my table.

Q. But you added to the -- I mean, maybe I'm confused here. Let me take a look.

Okay. So -- I mean, this -- did you add the title to it? I mean, this exact table can't be directly from Rankin '89; right?

You didn't cut and paste it?

A. Well, I retyped it, that's about it.

Q. I mean, you added --

A. If I made a typo --

Q. Well, I'm not suggesting that. I just know that Rankin '89 doesn't have warm water aquatic life Use A in parentheses --

A. No.

Q. -- after -- so explain, just for the record, what you added to that table.

A. Well --

THE HEARING OFFICER: Okay. Just -- because I'm really confused, and I think it's because I need coffee this afternoon.

We're talking about Exhibit 5 to Dr. Melching's testimony as compared to Exhibit 41 -- or Page 41 of Exhibit 176 -- 175; correct?

MS. WILLIAMS: Yeah.

BY THE WITNESS:

A. As you have correctly stated -- well, Exhibit 5. As you have correctly stated, I added the warm water aquatic life Use A after modified warm water streams, that which is in parentheses.

MR. ANDES: In the heading.

BY THE WITNESS:

A. In the heading of the table.

I also added general use waters after warm water streams in the heading. The rest I think is, barring typographical errors on my part, verbatim from Rankin.

BY MS. WILLIAMS:

Q. And I'm not trying to be difficult, it's just confusing to us because we have not

equated these used in the way you have done, I don't believe, to -- between Ohio and the proposal. I'm just -- I'm not trying to be difficult, I'm just trying to be clear.

Do you believe that the Ohio aquatic life use designations have a fit you would describe as matching the CAWS and Brandon Use B waters, as we proposed them?

A. Well, I base my conclusion, again, on the qualitative habitat evaluation index values for the various reaches assigned to the CAWS and Brandon Pool aquatic life Use B designated waters. Sorry.

Rankin 1989 indicates that the primary determinant for waters to be classified as limited resource water is having QHEI values less than 32. This rule is for head water streams with drainage areas of less than three square miles.

Less strictly, this rule would apply only to a small portion of the North Shore Channel. Rankin 2004 Attachment R to the rulemaking proposal used a similar QHEI scale when evaluating the CAWS for a QHEI of less than 30 was rated very poor.

Less I assume that very poor

equated to limited resource water. And I consider --

MR. ANDES: Another table.

THE HEARING OFFICER: I've been handed, information from Melching's Response to IEPA Question 18B. If there's no objection, we will mark that as Exhibit 177. Seeing none, it's Exhibit 177.

(WHEREUPON, a certain document was marked Exhibit No. 177 for identification, as of 11/17/08.)

BY THE WITNESS:

A. So when I consider QHEI values to the locations in the water designated CAWS and in Brandon Pool aquatic life Use B, listed below, five of the ten values fall in the very poor limited resource water range. Two of the ten values fall in the low end of the poor range, that could be considered limited resource water taking into account the lower extreme nature of the individual metrics in the QHEI.

BY MS. WILLIAMS:

Q. Dr. Melching, Exhibit 177, Exhibit 176, both have lists of QHEI values that you

relied on. What's the source of the data there?
A. The use attainability analysis report.
Q. Which one?
A. For the CAWS. Attachment B.
Q. Attachment B, okay.
Did you look for any other source of QHEI values for your tables?
A. Well, I am aware that in the IEPA testimony there was some discussion that some of these values have been recalculated. And so I inquired from the District what were the appropriate numbers and the values I got back -- I'll take a look at one of my other -- a couple site changes were suggested, but those changes didn't make much sense to me.
Q. Are you referring to typos?
A. I'm not -- I'm not referring to -- supposedly we heard that some of the sites were recalculated.
Q. From Attachment B, specifically, which is what we --
A. Yeah, that is what I heard or I remembered seeing --
Q. Okay.

A. -- mentioned in the abstract of the testimony from the Agency.

Q. And what data or information do you base your testimony on Page 11 that the physical habitat of the Calumet Sag Channel and that of the CAWS aquatic life Use B are not substantially different?

A. Hydraulic and morphology of the Calumet Sag Channel and Chicago Sanitary and Ship Canal, which is in the CAWS aquatic life Use B, are virtually identical. This is reflected in the QHEI values that the similar waterways are similar.

The Calumet range from 37.5 to 42. I agree with Dr. Makay, who states on Page 12 of his -- small amount of rubble and crumbling of walls does very little to improve the overall habitat of fish and the -- I find the difference between the CSSC and Calumet Sag Channel to not be substantial.

The ongoing study to determine the biological potential for the CAWS being done by Limno-tech by the WD should shed further light on the difference between the CSSC and the Cal Sag Channel.

Q. So you don't agree that there are

areas where people can wade that are shallow?

A. I don't think they make a substantial difference.

Q. How much would there have to be for it to be substantially different percentagewise? Would there have to be a certain percentage of shallow habitat?

A. I can't give you a number.

Q. Is it your testimony there's insufficient physical habitat in the Cal Sag Channel proposed by Illinois USEPA for this?

A. Nineteen A?

Q. Yes.

A. This question is difficult to answer, because in the statement of reasons, IEPA has not -- benthic and fish communities they expect to be supported by the proposed aquatic life use to substantially be graded a physical habitat like the Cal Sag Channel.

Q. Would you apply this concept to other chemical parameters, that if a standard was proposed for these waters that was the same as the general use waters, then it must be that the aquatic community being protected is the same. Or, for

example, would you take that same position that if our standard for these waters is the same as general use, to protect the exact same aquatic community or you would have automatically proposed a different standard?

A. All I'm commenting on is with regard to dissolved oxygen, that if we are saying this is a graded water body only capable of supporting intolerant or moderately tolerant, moderately intolerant -- I forget the exact words -- that expecting or requiring general use DO doesn't make much sense. That's what I'm saying. That's what I'm testifying to.

Q. And you have said that adult Large Mouth Bass are common to the system; correct?

A. Yes.

Q. Would you agree that the ultimate dissolved oxygen standard adopted by the Board must protect organisms as sensitive as the adult Large Mouth Bass?

A. Yes. I would agree, but I would like to turn the question around. Given that large -- Attachment B as dominant game fish, common game fish, abundant game fish, that to dissolved oxygen

there must already be reasonable breeding for them, otherwise they won't be able to achieve those names, those descriptions.

Q. So would you recommend that the Board ignore the signs?

MR. ANDES: Well --

MS. WILLIAMS: Let me finish the question. If you want to object, you can object.

MR. ANDES: I'll wait.

BY MS. WILLIAMS:

Q. And instead look at what's actually occurring in the CAWS.

A. So what I'm saying is the national criteria document is for general use fishable waters. If the Agency is saying that this is not a general use water, then it's inconsistent to require DO standards that, in fact, exceed the national criteria document of USEPA.

Q. And in what way is that?

A. In terms of the minimum of 3.5 relative to 3.

Q. So does the 1986 criteria document dissolved oxygen then recommend a daily minimum of

3.5 milligrams per liter in some ways rather than 3.0? This is Question 21.

A. Well, I know. Page 38 of that document.

Q. So you think that refers to dams?

A. It says manipulatable controlled discharges and -- where's that? Here it is.

As I say, that's Page 38. They mention 3.5, but in 37 and 38 it says under the -- what they call the criteria and manipulatable discharges and where he's talking about Attachment X to the statement.

Q. Have you reviewed the work that the Agency and the Illinois Department of Natural Resources conducted in developing Illinois general use to general standard?

A. Question number?

Q. Thirty-two.

A. Yes. I have reviewed Rule R04-25 in the statement of reason and the report by Wiles and Garvey.

Q. Have you reviewed the report by the Illinois Department of Natural Resources and the Illinois Environmental Protection Agency? I can

hand you a copy and just ask you if you reviewed this report.

A. I'm just -- I'm not sure. I don't know how similar this is to Wiles and Garvey or not.

Q. This is not similar to Wiles and Garvey. This is the Agency in response to Wiles and Garvey.

A. Then I have not.

Q. You have not reviewed it.

Let's go back -- I skipped over Question C of 19C.

And it was regarding the -- it says, "Aren't the typical IBI scores a majority of the CAWS and Brandon Pool B waters less than 20?"

And are you aware that Rankin 1989 states fish IBI scores below 20 are rarely caused by habitat alone?

A. What is stated in the question is not an exact quote from Rankin. The exact quote from Page 9 is for impacts solely attributable to habitat modification IBI scores rarely 20, regardless of B.

Q. Yes. So --

A. However, to understand the important and habitat necessary to review the IBI fish

community quality scale from the UAA report Pages 4-17, and so, IBI scores between 12 and 20 are very poor. Between 20 and 29 are poor, between 30 and 39 are fair, between 40 and 49 are good and between 50 and 60 are exceptional.

Thus, a community result for IBI scores less than 20, however, the IEPA or the UAA contractors have not offered any reduction in water quality stress, such as that IBI will go above the 20 result in IBI scores referring the fair fish community range. It includes all of the recent IBI evaluations for the waters rated CAWS or aquatic life Use A.

Q. I don't think I understand that answer.

A. Well, maybe that sentence is not so good. But I'm going to go forward to one of your later questions, just because they're related to an interpretation of the figures from Rankin.

Question 43.

Q. Before we do that, I just --

A. Well, I'm not done with my answer. Can I finish?

Q. Well, you're not done, you said you're

answering it different later.

A. Well, these two questions are related. The thing I'm trying to ask in the question -- okay, the very poor range requires a combination of habitat and water quality issues to be less than 20 to be very poor. Well, if we relieve the water quality stress, what assurance did we have that suddenly we are going to jump not above poor even into fair or into good --

Q. What --

A. -- in terms of IBI range? And your Question 43 asks the question, "Based on Rankin 1989, is it possible for a QHEI score of 45 or less to be associated with fish IBI score to represent attainment of the Ohio Act?"

Q. Here we go. It's actually based on Figure 19 on Page 40 of Rankin.

It appears that a majority of the machines that should say less than or equal to 34 -- I'm sorry, that's a typo.

A. That's fine. Less than or equal to an IBI score of 25 or higher.

And my response to that question was your cutoff of 24 is arbitrary and meaningless.

It's more meaningless to interpret 19 relative to these ranges of fair, good and so on.

And if we do that, we find that you have the table to show that.

MR. ANDES: Introduce --

MR. ETTINGER: Are all of these being introduced as exhibits?

MR. ANDES: Yes.

MR. ETTINGER: See, they helped us reach our total.

MS. WILLIAMS: There are several areas that he had to follow-up.

THE HEARING OFFICER: I've been handed IEPA Question 43B, which we will mark as Exhibit 178, if there's no objection.

Seeing none, it's Exhibit 178.

(WHEREUPON, a certain document was marked Exhibit No. 178 for identification, as of 11/17/08.)

BY THE WITNESS:

A. So if we look at this table, which Fred just passed out, based on Figure 19 in Rankin, for QHEI sites less than 46, less than or equal to 45, we can see that in the poor range we have 24 in

the 20 to 23 range, 24 percent. Thirty-five percent between 24 or 27 and then we have 28 between -- 21 between 28 and 31.

So if we just say that half of those 21 percent are 28, 29 and the other half are 30 and 32.5 percent of these sites with QHEI's less than or equal to 45 are in the poor range. So right now we are very poor with the QHEI with the habitat we have now, it's a three out of four chance, approximately, we are going to end up in the poor range. And about one out of four chance we're going to get in the fair range.

So yes, being less than 20, maybe the combination of multiple stressors, but the habitat stressor is still pointing us, at best, fair.

BY MS. WILLIAMS:

Q. So this Exhibit 178, is this in Rankin somewhere?

A. Well, this is reading off of Figure 19.

Q. Do you know what page that's on?

A. Page 40, I think, according to the question.

Q. So why -- so you think it's use of this cutoff of 24 is arbitrary. I just want to understand why.

A. Well, it's arbitrary because you want to compare whether we're going to be in fair or poor or good as opposed to -- and 24 is just in the middle of the poor range.

Q. So he was arbitrary in splitting those up?

A. I think it's more how he chose to cut his data up into, apparently, like three percent to four percent steps.

Q. Would you mind looking at Page 50?

THE HEARING OFFICER: Of Rankin's 1989?

MS. WILLIAMS: Yes.

BY MS. WILLIAMS:

Q. I'm sorry, of Rankin Exhibit 175.

I'd just like you to read the last sentence there.

A. The very last sentence. "This application for the" -- am I reading the right sentence?

Q. Yes.

A. "This application for distinguishing types of impacts in Ohio, most severe impacts IBI scores less than 20, are rarely caused by habitat alone."

Q. Does that sound like a quote that we were referring to in the question?

A. It's basically -- well, it's identical to what I -- or more or less identical to what I stated from Page 9.

Q. Did you have any follow-up?

MR. ETTINGER: Well, I have a whole bunch of questions.

Actually, I don't have that many more.

BY MR. ETTINGER:

Q. But can I just ask: What's your impression of the size of the record in the DO proceeding that the Board went through in setting the current Illinois DO standards?

MR. ANDES: How many documents?

MR. ETTINGER: Yeah, how many documents?

BY THE WITNESS:

A. My impression of the size?

BY MR. ETTINGER:

Q. Is it a big record, is it a little record? Do you think you read all of it, do you think you read just a little bit of it?

A. Well, I -- okay. Now I'm getting confused here.

Are you talking about the revised rule for DO or for the CAWS in specific?

Q. The revised rule.

A. Okay.

Q. We've made a lot of reference to the dissolved oxygen standard for general use waters. I'm just asking you how much of the record you reviewed or how big do you think the record is that you reviewed for that?

A. Well, as I said, I looked at the proposal, the statement of reasons and the original -- what was it, Wiles and --

THE HEARING OFFICER: Garvey. Wiles and Garvey.

BY THE WITNESS:

A. Beyond that, I didn't look at another document.

BY MR. ETTINGER:

Q. Okay. So were you aware that we had like two years of three years of hearings on that --

A. Well, I don't have any objections with that report for general use waters in the state of Illinois.

Q. Well, that -- I don't want to --

BY MS. WILLIAMS:

Q. Are you aware that --

BY MR. ETTINGER:

Q. Are you aware that that report was not accepted in whole in setting the dissolved oxygen standard?

A. Well -- but the numbers still came out to be similar to what was in that report.

Q. Some of them did.

BY MS. WILLIAMS:

Q. Did the same numbers apply throughout the state under the general use -- except for these waters, is there one general use?

A. No, there are -- as what I saw on your Pollution Control's website, there is a long list of waters that follow a different path.

Q. That are also general use waters;

correct?

A. That are also general use waters.

Q. So when you refer to the standard proposed here for the Use A waters being similar to general use, you're referring not to the tier -- not to the enhanced tier in that rulemaking; correct?

A. Correct.

MR. ETTINGER: Are you done now?

MS. WILLIAMS: I have some more questions. They're not on DO I don't think, though. Do you went me to finish?

MR. ETTINGER: I don't really care, I'm awake now.

THE HEARING OFFICER: If -- let's put it this way, if you don't have any follow-up, we're going to continue with Ms. Williams.

MR. ETTINGER: Why don't we let her follow -- I have my whole own list.

THE HEARING OFFICER: Right.

MR. ETTINGER: And I, frankly, could use a second to review where we are on my list.

MS. WILLIAMS: Yeah. I think I can keep going. I don't think it's going to take

that much longer to get through the ones that aren't crossed off.

BY MS. WILLIAMS:

Q. So I just -- there's one here on Question B at the top of Page 90. Let's see, that would be 23B.

I think Albert already asked about evidence in the record regarding early life stages. I just was asking in this question whether you reviewed Exhibit 48 in the record. And I'll show you a copy of that.

A. I think I've seen a piece of it, but perhaps not the entire...

Q. So you weren't necessarily relying on this document when you testified about any evidence of early life stages or potential evidence of younger fish versus adult fish?

A. In my testimony relative to early life stages, I was going by the fact that the Illinois EPA could not cite definitive evidence of the existence of early life stages in their own testimony. If they can't find it...

Q. Okay. Turn to the -- this exhibit is a little confusing, because it's labeled 1F2 and

then it starts 1F14. But if you turn to the back and you were -- Page 9 of 13.

A. Okay.

Q. In the last set of -- those are data from the Calumet Sag Channel, which I think is what we were talking about this morning. Why don't we look at Large Mouth Bass.

Can you tell me from this table what the smallest size Large Mouth Bass found in the Calumet Sag Channel?

A. It says minimum three inches.

Q. Would you think that a three-inch Large Mouth Bass could have reached the Calumet Sag Channel from Lake Michigan?

A. It could have.

Q. Do you believe that's the case that this --

MR. ANDES: He just answered the question. He just answered.

MS. WILLIAMS: What did you say, Fred?

MR. ANDES: He said it could have.

BY MS. WILLIAMS:

Q. Do you believe that's what happened?

A. Well, again -- first off, I don't know

that size is necessarily an indicator of what. Right now, if you look in Lake Michigan, five-year-old White Fish are one-fifth of their average size from 1988.

So just having small fish is not necessarily a sign to indicate -- just having small fish isn't necessarily an undeniable indicator that it's a juvenile or an adult. So the three-inch fish...

Q. Have you ever been aware of a three-inch Large Mouth Bass being an adult size fish?

A. I don't know.

Q. So you don't know of any?

A. Not aware.

Q. Not aware of any.

MR. ANDES: Are you aware of any, one way or the other, in terms of --

THE WITNESS: No.

THE HEARING OFFICER: Can I ask a question? We did not have that document in front of us because I did not bring it back out here.

How many fish of that size were

found, is there an indication on the --

MR. ANDES: No.

THE HEARING OFFICER: Thank you.

MS. WILLIAMS: I have an extra one.

THE HEARING OFFICER: That's okay. I just wanted to follow up on the question.

BY MS. WILLIAMS:

Q. How many total fish were found? Does it say on there?

MR. ANDES: How many total Large Mouth Bass?

MS. WILLIAMS: Large Mouth Bass, in that segment.

BY THE WITNESS:

A. One hundred fifty-two.

MR. ANDES: And can you tell me what the maximum length was?

THE WITNESS: Fourteen.

MR. ANDES: And the average?

THE WITNESS: Eight.

MR. ANDES: So then, you might say that half are less than eight and half are above eight?

THE WITNESS: Approximately.

MR. ANDES: Thank you.

BY MS. WILLIAMS:

Q. Might it also not say that? I mean, could you have a bunch that are --

MR. ANDES: Average.

MS. WILLIAMS: I mean, yeah, it's an average, it's not a median.

MR. ANDES: It's a mien, excuse me.

BY MS. WILLIAMS:

Q. Question 31. On Page 31 of your report you say that there is, quote, "No evidence to habitat and physical characteristics of the CAWS, the supports that you used or obtained the proposed criterion, identify the evidence that demonstrates the CAWS can't obtain the proposed use or meet the proposed dissolved oxygen standards."

A. I'm going to sound like a broken record here. Because the dissolved oxygen standards for the proposed aquatic life use standards equal, in certain critical aspects, the general use dissolved oxygen standards --

MR. ANDES: Slow down.

THE WITNESS: Sorry.

BY THE WITNESS:

A. -- that was recently adopted by the Board. We can assume IEPA expects the CAWS to support the type of benthic macroinvertebrate and fish communities that would occur in the general use waters in the state.

The Agency has not shown that this type of aquatic community can be achieved in the CAWS. Instead, the UAA contractor noted on Page 53, improvements in water quality through various technologies, like reaeration, may not improve the fish communities due to lack of suitable habitat to support the fish population," end quote.

Further, my analysis of the physical habitat of the CAWS leads me to the same conclusions of the UAA contractor. Thus, the Agency should determine the composition of the aquatic community that can be obtained relative to the habitat limitations of the CAWS and develop appropriate dissolved oxygen standards for this community.

BY MS. WILLIAMS:

Q. Do you agree that waters have to be designated for the highest attainable use?

MR. ANDES: I would object. That's really a legal question about the Agency's legal obligation.

MS. WILLIAMS: I don't think it's a legal question.

THE HEARING OFFICER: We had been over what the use of "attainable use" phrase as a legal term before. I think we have covered that several times. It's a legal term of art used in --

MS. WILLIAMS: Oh, you've concluded we have determined it's a legal question?

THE HEARING OFFICER: I think we've discussed it before, and you've ended up rephrasing the question rather than --

MS. WILLIAMS: I don't think it's a legal question. If you think it's a legal question, you can grant the objection, but...

MR. ANDES: Well, waters have to be designated for the highest use attainable, that's not a legal question?

MS. WILLIAMS: I don't think so.

MR. ANDES: I think so. I think it is.

THE HEARING OFFICER: I think it's a legal interpretation of the rule.

MS. WILLIAMS: Okay. Fine. Then grant your objection.

Question 33.

THE HEARING OFFICER: Before you move on, let's go ahead and take about a ten-minute break; okay?

(WHEREUPON, a recess was had.)

THE HEARING OFFICER: We are back on the record, Ms. Williams.

BY MS. WILLIAMS:

Q. Question 42. You conclude at the end of your testimony and report that the Board should disapprove the rules proposed by the Agency.

Does this mean that you believe there should be no upgrade of these waters from where they were designated 30 years ago?

A. I think this question has things backwards. Thirty years ago, when the current designations and related dissolved oxygen standards were established, the CAWS could not meet those standards.

Now, through the tremendous

efforts of the MWRD, the USEPA, IEPA, environmental groups and others, dissolved oxygen meets the standards nearly all the time. The hard work and financial resources that went into improving the water reclamation plant facilities and operations, adding the in-stream and side-stream aeration station, completing and operating the tunnel portion of Tarp and other activities that resulted in a substantial increase in the fish abundance and species diversity.

Further, improvements can be expected once the reservoir portion of Tarp is completed. All people in Chicagoland and Illinois should be proud of these accomplishments.

It seems that because of habitat limitations, a fish community with a high IBI score of the type representing general use waters cannot be achieved in the CAWS. Limno-tech is currently doing a major project to try to determine the biological retention of the CAWS.

Once the biological potential of the CAWS is determined and agreed upon, all stakeholders should work together to achieve this potential through cooperative improvement of

facilities and operations in the CAWS pushing to raise DO standards to achieve the undefined biological community that might not be achievable -- let me start that sentence again.

Pushing to raise DO standards to achieve an undefined biological community that might not be achievable in the CAWS is poor public policy in my opinion.

Q. Did you say in that answer somewhere that aquatic life will continue to improve after the completion of Tarp?

A. I believe so. But whether it goes from poor to fair --

Q. We don't know.

A. -- we don't know.

Q. But it will improve on some level?

A. We should hope so.

Q. Is it your understanding that the original designation of these waters was based on the DO standard that could be attained?

A. You're talking about the original?

Q. Uh-huh, the original, I'm sorry.

That was sort of the impression I got from your answer, that you said the question got

it backwards, so --

A. Well, I've not reviewed documents from the 1970 or --

Q. That's fine.

A. But that's my guess.

MS. WILLIAMS: That's all I have.

THE HEARING OFFICER: Thank you, Ms. Williams. That takes us to the Environmental Law and Policy Center, Mr. Ettinger.

MR. ETTINGER: Okay.

BY MR. ETTINGER:

Q. I am Albert Ettinger again.

Some of these questions -- I've got 17 here -- have already been, sort of, beaten over the head. But we'll try and eliminate the ones that we think are there and go over the ones that we don't think we got an answer to.

The first one, was Mr. Andes' favorite question, which was, on what river did you work in Belgium?

MR. ANDES: I was going to object for relevance, but now I'm interested to hear the answer.

BY THE WITNESS:

A. Okay. As stated on Page 2 of Attachment 1 to my testimony, I did an uncertainty analysis for the water shed and stream quality models applied to the Seine, S-E-I-N-E, River in Brussels, Belgium, sponsored by the research in Brussels program. The Seine River is similar to the Chicago area waterways, in that it's a heavily modified urban stream fed by a network of combined sewers.

I also advised on an uncertainty analysis of water quality modeling for the Dender River in Belgium.

BY MR. ETTINGER:

Q. Is this Seine River the same Seine that flows through Paris?

A. Sounds similar, but completely different Rivers.

Q. Is it spelled the same?

A. The one in Paris that's the Senne, S-E-N-N-E, I think. We got a --

THE HEARING OFFICER: It's two Ns, though; right, S-E-I-N-N-E?

THE WITNESS: I think we've come to

the conclusion I don't know how to spell, not very well.

BY MR. ETTINGER:

Q. Do you know when they built a sewage treatment plant in Brussels?

A. They started construction of the south plant in 1998 about the time we were doing this project. And this project was, in fact, in support -- this was part of a larger project of modeling in support of the construction of plants in the north and south side of Brussels.

The south plant was completed around 2000, had some operational difficulties. But I think it's fully operational now.

The north plant, I'm guessing it's still under construction, but I don't know for sure.

Q. So prior to 1998 were they treating their sewage in Brussels?

A. Not at all.

Q. Question 2. How generally did you measure the duration of the effect of a CSO event?

A. Because the pollutant concentrations from a CSO cannot be isolated in a river, the effect of a CSO event was assessed using simulations

obtained from the water quality model that was specifically developed for the CAWS, coupled with the statistical method. Because of the limited measurements of pollutant concentrations during combined sewer overflow events, pollutant loading from most events had to be estimated as the average of the available benthic concentration data for the various reaches of the CAWS.

The North Shore Channel and the North Branch were represented by data at the North Branch pumping station, which was show to be statistically similar to event main concentration data at Evanston Street and Homestead Street CSOs. Chicago River Mainstem, South Branch and Chicago Sanitary and Ship Canal were represented by data collected at the raising and pumping station, which was shown to be statistically similar to the event mien concentration data at the Greenwood Street CSO. And a Little Calumet River North and the Calumet Sag Channel were represented by data collected at the 125th Street Pumping Station.

Because most storm loads, thus, were highly uncertain, we wanted to evaluate the effect of its uncertainty on the simulations. Thus,

we randomly generated the event mien concentrations for each CSO event and each pumping station assuming a log normal distribution and using the mien and standard deviation available at the concentration measurements.

MR. ANDES: Slow down.

THE WITNESS: Sorry.

BY THE WITNESS:

A. From this uncertain evaluation, the method to determine the duration of storm effects and water quality was born. Wherein, the duration of storm effects ended when the uncertainty, the variation to the simulated concentrations, ended.

Specifically on Page 6 of my testimony I explain the following. Merely considering the time for dissolved oxygen recovery decreased storm levels does not indicate the end of the storm effect because the new dry water DO concentration may have changed because of changes in temperature, sediment, oxygen, treatment plant loads, et cetera.

Dr. Emre Alp proposed and tested on the CAWS a method to determine the duration of storm effects on water quality. In his approach,

the Duflow water quality model was successively applied to different storm, five-day carbonaceous biochemical oxygen demand and ammonium as nitrogen loading, i.e., aventanine concentrations.

Randomly sampled from a distribution representative of the aventinine concentration data collected by the District at the CSO pump stations, using an uncertain analysis technique. Then the variations in the Duflow model output parameters among the successive simulations were observed.

As the variation of the model output parameters approaches zero, the system is returned to prestorm dry weather condition. Therefore, the duration between the start and end of variations in the simulated Duflow model output parameters can be defined as the duration of the storm effect on in-stream water quality for the duration of the wet weather condition.

More details are given on Pages 21 to 27, Attachment 1 of my testimony.

Q. Okay. That's a very good thorough answer, unfortunately it's a little too sophisticated for someone of my level of

intelligence.

So what I want to do is ask what did you look at? I mean, what had to return for you to decide that the storm was over? Ammonia, CBOD and DO had to be back to where they were, or how did that work?

A. Well, in fact, we reported different results for each of those three constituents. And, basically, what returned was among -- for BOD and ammonia, basically, essentially the 50 different simulations that we ran, all came back to the same concentration at the point that the storm -- the storm duration ended.

So they -- because we assumed different loadings for each simulation, the BOD or the ammonia took different values. But eventually they all came back to the same value, indicating that the dry weather flow from the plants and from the tributaries completely controlled the conditions for those two parameters.

The dissolved oxygen was a little more complicated because there's also an effect in the sediments. And that takes a very long time to dampen out.

But the effect from the sediment is generally very small at that level, on the order of a tenth of a milligram per liter.

Q. So what caused you to decide that the storm is over, that all of these things had come back to where they should be during dry weather conditions?

A. I think the DO was the one that had the longest effect. And so the summary statements, then, are based on DO. But it may only be a day or two longer than the others.

Q. Now, for a lot of that period, though, while the DO may not have been back to where it was under the simulated dry weather conditions, it might still be up to where it was healthy for aquatic life; right?

A. Based on the standards, yes.

Q. So we might have a simulated -- your model might tell you that, but for the rain, DO should be at seven but could be at six now. And you still wouldn't say the storm is over, but we'd agree there six is healthy?

A. Right. That's an example. There's not a lot of sevens and sixes.

Q. There are not a lot of what?
A. There are not a lot of sevens and sixes in the CAWS.
Q. I made up those numbers for ease of math.
A. I'm just trying to make it clear.
Q. Well, let's ask about that. Did you see any diurnal swings in DO in the CAWS? Have you looked at that?
A. It's very little. Because there's very little algal growth, particularly in the North Branch of the Chicago Sanitary and Ship Canal, the South Branch and the Mainstem. A little bit more on the Calumet side.
It might be appear to people that there are diurnal swings in the -- some of the DO data, but a lot of it can be attributed to, in fact, operations of the aeration stations.
Q. Is there aquatic growth in the North Shore Channel?
A. What kind? I mean, in terms of -- in the water column? Very, very little.
Q. Okay.
A. Chlorophyll, algae.

Q. Now, we're talking about the North Shore Channel, north of the north side treatment plant?

A. Yes.

Q. Are CSOs causing violations of the Illinois ammonia standard?

MR. ANDES: I would say that is a legal issue. But I think he can tell you what he knows.

BY MR. ETTINGER:

Q. Why don't you just tell me what you know about what ammonia levels do during CSO events.

MR. ANDES: Oh, a different question.

BY THE WITNESS:

A. That's a different question.

BY MS. WILLIAMS:

Q. I just -- so you're saying you think it's legal to say if a number is four and there's a five value found, that's a legal question? Counting, I mean --

MR. ANDES: The question is are -- causing violations.

MS. WILLIAMS: -- violation. Right. Of a number.

MR. ANDES: That's a legal term, "violation."

MS. WILLIAMS: Well, is that --

MR. ETTINGER: I withdrew the question.

BY MR. ETTINGER:

Q. It's presumed the knowledge of the Illinois ammonia standard. I don't really care -- that's not real tough, but, in this case, we'll -- just tell me what happens to ammonia levels during CSO events.

A. Well, they become higher than what would be going on during normal discharges from the treatment plants. How much higher depends on location in the system and relative magnitude of a CSO event.

I'd have to look at some of the numbers to get a sense of it. But, you know, primarily what I would have answered to your original question was that, basically, we didn't compare our ammonia simulation results against the standard. Our primary focus has been to look at DO compliance or DO performance, I guess.

Q. Well, I guess I was confused. There

are a bunch of charts and things here --

A. Yeah.

Q. -- talking about recovery regarding ammonia standard and then I assumed those were significant. What do those -- what does -- did your ammonia study tell you of relevance to our proceeding here today?

A. I think in relevance to our proceeding here today, it's just one other evidence of the duration of loading effect on the storms. So it's offered in the same vein as the DOD and the DO issues on the storm duration.

Q. Do you think that the levels of ammonia that you saw caused by the CSOs that you studied have any effect on aquatic life in the CAWS?

A. Again, as I said, we didn't evaluate that.

Q. I guess my problem is I'm not sure what effect means then. What is the effect of ammonia relating to CSO that we're concerned about here?

MR. ANDES: Well, maybe I can clarify. Is the issue you were looking at, in terms of duration of effect, the changes

in pollutant levels?
BY THE WITNESS:
A. Well, I guess, maybe I want to go to a more general answer, if you'll allow me.
BY MR. ETTINGER:
Q. Yes, please.
A. And I'm not, at this point, trying to take a direct comment on IEPA or anybody else. I think, in general, people have the impression the rain comes, the water goes up, the water comes back down, the storm effect is over.
And so, we get the statement that I quoted before about the eruption of CSOs. And the point of the testimony relating to ammonia and BOD and DO and duration of the effects is just to make the case that there is still a lingering effect of the loading that carries on well beyond the point at which the flow returns to normal dry level flows.
Q. Right. And what I'm trying to clarify is when you say effect, you mean there's a change in an ammonia number we can look at.
A. Right.
Q. But you're not saying that that change in the ammonia number has any relevance to the

aquatic life in the Chicago area waterway system?

A. It could have if we compared against the standard, which is a function of temperature and pH. And so --

MR. ANDES: But your analysis did not look at impact on aquatic life. Am I right?

THE WITNESS: No, it did not.

MR. ANDES: Okay.

BY MR. ETTINGER:

Q. So when you say effect, we just mean ammonia number. We're not suggesting that there's any effect on that ammonia on anything?

A. Again, it would take specifically looking at the standard against the simulated results of that bioevent for me to give you a clear answer. There may be times when ammonia is too high.

Q. How high did the ammonia level get?

A. Let's see if I can pull that out of the documents here.

Okay. So I'm now looking at Page 61, Technical Report 18, which was entered earlier today as part of the proceedings.

On this page there are three

figures of three example locations in the waterway system. One is North Branch Chicago River at Diversey Street, another is the Chicago Sanitary and Ship Canal at Harlem Avenue, and the third is the Calumet Sag Channel at Ashland Avenue.

And these were just chosen at random to express typical results. Otherwise we'd have a pile of figures that no one would want to see.

So North Branch at Diversey Street, and this is for the period July 12th to November 9th, 2001, simulated NH4 or ammonium concentrations on the order of 1.5 to 1.6, the maximum ammonia concentration. Chicago Sanitary and Ship Canal at Harlem, the highest concentration is about .75 milligrams per liter.

But the typical dry weather value is somewhere between 1.5 and .25, maybe even .1 and .25 during dry weather. And the Calumet Sag Channel to Ashland, again, it maxes out at .8 milligrams per liter. And the dry weather values are on the order of .1 to .2.

So those two locations may be an increase, at most, of maybe four times the dry

weather value, at Diversey Street maybe four to five times the dry weather value.

Did that help.

Q. Yes, it does.

Did you ever take pH measurements in any of those locations?

A. We didn't. But I believe the District has them available.

Q. Do you have any reason to believe that the pHs were up around nine or higher?

A. I haven't actually looked at them, so I can't comment. But it would be unusual.

Q. So would it be unusual for those ammonia levels to have been a problem, that you've just repeated?

A. Well, this is where not knowing Illinois standards, I can't comment.

Q. Okay.

A. I mean --

Q. Well, neither of us have memorized the ammonia schedule, but -- we'll leave it at that.

I think we have asked this question a few times, but -- in some ways, but -- seven. Have CSO events negatively impacted the

aquatic community and any parts of the Chicago area waterway system?

A. To my knowledge, no biological study has been done showing a direct link between CSO events and the quality of the aquatic community in the CAWS. There are multiple environmental stressors that negatively impact aquatic communities in the CAWS.

Many sources have similar effects on the aquatic community. For example, change, percentage of composition in the tolerant groups, decreased number of species.

Currently analytical methods are not available for separating the impacts of an individual stressor, such as a CSO effect from other stressors. Some not all CSOs result in very low DO concentrations, and it is reasonable to assume that these periodic low DO concentrations are a stressor to the aquatic community.

However, it may not be the primary stressor when compared to the poor habitat, particularly substrate, in the CAWS.

Q. Well, let's ask about this primary stressor concept. How does that work?

Does it -- does only the primary stressor matter to the aquatic community?

A. I think in the end the primary stressor is going to limit what can be achieved. So it's like a model is only as good as its weakest link or a baseball team or a football team.

So a primary habitat -- habitat, per se, is the main limitation in the waterway, then we can only get as far as habitat will allow us.

Q. Have you heard or aware of a situation in which an effect can act symbiotically with another effect, so, for instance, a fish would die if it was -- had both high ammonia levels and high temperature levels, when it wouldn't, based on just one or the other?

A. I think, in most of the regulations, they try to account for that by focusing on which one they think might be the worst. But, yes, symbiotic effects are possible where multiple stressor can affect. But then separating which one you need to relieve is difficult.

Q. On Page 24 of your report you state that the long-term effects can negatively affect the aquatic community, and that these long-term

effects -- I'm sorry, I should say of CSOs, cannot be reduced until the reservoirs of the tunnel and reservoir plan are fully online. Is it your testimony that there have been no benefits to the aquatic community from the partial completion of Tarp?

A. It is not my testimony that there have been no benefits to the aquatic communities from the partial deletion of Tarp. I'm merely comparing the current conditions to the anticipated future condition with the Tarp reservoirs fully online.

BY MS. WILLIAMS:

Q. So will additional phases of Tarp have additional benefits to the aquatic community, or are you just comparing current condition to the final? Wouldn't there -- they're incremental?

A. Well, I mean, the remaining increments are building two reservoirs, so it's not like there's a whole lot of steps left.

MR. ETTINGER: Why don't I ask Question 10 -- if you were done, I'm sorry.

MS. WILLIAMS: Yeah, I'm done. Sorry, Albert.

BY THE WITNESS:

A. I don't know if I completely answered your question. I'm just saying that, you know, as I mentioned before, that we would expect that when Tarp comes online that things will continue to improve.

But whether that gets us much from the current very poor IBI, how high into the poor or into the fair range, is unknown at this point.

BY MR. ETTINGER:

Q. How will completion of Tarp benefit aquatic life? Question 10.

A. Because the number of CSO events will decrease from ten to 15 per year to less frequent CSO occurrence, careful operation of the system, the substantial DO stress will be removed from the aquatic life in the CAWS. However, habitat limitations will still prevent substantial increases, in my opinion, in biodiversity and integrity.

Q. Are there parts of the CAWS that could meet the proposed IEPA DO standards almost all of the time?

MR. ANDES: I actually think that

Mr. Dennison is going to be presenting data on DO.

MR. ETTINGER: Then we will wait. I withdraw that question.

BY MR. ETTINGER:

Q. Let me skip down to 13.

Did the 1980s Fish and Wildlife Service study of habitat suitability you discuss on Pages 13 to 14 of your testimony deal with the entire CAWS?

A. Okay. The -- let's try to be clear here.

The Fish and Wildlife Survey Service studies were national studies of habitat suitability compiled from the literature from many sources and also additional field data collection by field agents of the service. So these curves, such as I passed out earlier, were compiled on a national level.

So the application to the CAWS was only something I did now relative to this testimony.

Q. Okay. I believe we've asked 14.

Fifteen. Can substrate be improved through any technique?

MR. ANDES: Can I ask, just to clarify that, are you saying are there any techniques that could be used, generally, to improve substrate?

MR. ETTINGER: Correct.

MR. ANDES: Okay.

BY THE WITNESS:

A. Well, in the general case, yes.

For example, an independent expert panel evaluated the 2001 proposed remedial action plan for the Lower Fox River in Green Bay, Wisconsin. They recommended that sediment capping -- I'm sorry.

They recommended that sediment capping would be beneficial, not only as a way to contain the PCB contaminated sediments but also a properly designed cap could improve habitat. And this is in the report that Fred has --

MR. ANDES: It's on the disk.

BY THE WITNESS:

A. -- on the disk.

However, such an approach would not be a good solution for the CAWS. Placing a cap of improved substrate on the bottom of the CAWS

would substantially raise the bottom of the channels further, restricting the already limited hydraulic capacity of the CAWS to efficiently pass storm flows downstream.

This would most likely result in an increase in frequency of flow reversals to Lake Michigan, and increase local flooding in basements of buildings near the CAWS.

BY MR. ETTINGER:

Q. Would that be true of the entire CAWS?

A. In terms of limiting the making a flood issue?

Q. Yes.

A. Yes. Because the whole system is linked together.

And, for example, the ability to evacuate flows from Chicago through Lockport during floods is highly limited by the Sanitary and Ship Canal from Sag Junction to Lockport. That's sort of -- you've got a two-lane freeway converging into one lane.

And so, whatever happens there causes backups in the other two channels. And then if the other two channels get less efficient than

the water from North Shore Channel, South Branch and so on, can't evacuate down the CSSC above Sag Junction.

So the hydraulic efficiency of the entire system is interconnected. If you place restrictions anyplace, it's going to reduce our ability to avoid back flows or flow reversals.

Q. How much sediment did they put in the bottom of the Fox River flowing up to Green Bay?

A. Well, I mean, that is just a proposal. That was, in fact, only partially adopted.

So mainly they used sediment dredging. And in a few limited areas, they are going to place caps.

And I haven't seen the design specs or details of those caps.

Q. Finally, on Pages 36 and 37 of your report, you suggest that meeting the IEPA DO standards would be a poor use of public money in view of other needs.

Have you determined how much more it would cost to meet the proposed IEPA standards than it would cost consistently to meet the present standards?

A. No.
Q. I just have a couple little follow-up questions on things that were said earlier today.
Did you look at the effect of barge traffic on reaerating any portion of the CAWS?
A. No.
Q. You discussed the effect or velocity or lack of velocity on the ability to meet general use standards. Would that testimony also be applicable to lakes?
A. Well, the dynamics of lakes are a bit different than the Chicago area waterways. For example, much of the mixing that occurs in the lakes is in the wind action on a relatively large surface that's directly accessible by the -- here the canal is down below the surface in a walled situation, so the wind isn't as big of a mixing process.
Q. So you're not suggesting that the general use standards should be suspended as to every lake?
A. No.
Q. And what about side channels of rivers?

A. Pardon?
Q. What about side channels of rivers? Side channels of, say, the Illinois River, are they capable of getting general use waters, or would you say that they're low velocity precludes them from ever meeting general use standards?
A. It depends on the amount of exchange between those side channels and the main channel. For example, what we found in the simulation is Bubbly Creek, basically, assumes the concentration of the channel nearby during dry weather periods.
So even with the relatively low exchange between the Sanitary and Ship Canal and Bubbly Creek, it's still enough to bring those two, more or less, into agreement.
MR. ETTINGER: That's it.
THE HEARING OFFICER: Anything else for Dr. Melching?
Okay. Let's go off the record.
(WHEREUPON, discussion was had off the record.)
THE HEARING OFFICER: Let's go back on the record then.
I want to thank everyone. We will

begin in Des Plaines with Dr. Makay, and, hopefully, then, also get to Ms. Wassick.

I doubt sincerely that we will get to Dr. Dennison after that. So I think we'll say that we will go to Dr. Makay and Ms. Wassick and that's it in Des Plaines.

That means that we don't have to carry everything for everybody else.

MS. WILLIAMS: Oh, I would think we'd want Mr. Dennison to be --

MR. ANDES: I'd be fine with planning to bring him.

THE HEARING OFFICER: You have over a hundred questions for Dr. Makay. I'm just saying, we only did 40-some today.

MS. WILLIAMS: Right. There is a lot of stuff --

MR. ANDES: I'll plan on having him anyway.

THE HEARING OFFICER: All right. We'll have Dr. Dennison, as well.

All right. Thank you all very much. We are adjourned.

STATE OF ILLINOIS)
) SS:
COUNTY OF COOK)

I, SHARON BERKERY, a Certified Shorthand Reporter of the State of Illinois, do hereby certify that I reported in shorthand the proceedings had at the hearing aforesaid, and that the foregoing is a true, complete and correct transcript of the proceedings of said hearing as appears from my stenographic notes so taken and transcribed under my personal direction.

IN WITNESS WHEREOF, I do hereunto set my hand at Chicago, Illinois, this 25th day of November, 2008.

Certified Shorthand Reporter

C.S.R. Certificate No. 84-4327.