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ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
WATER QUALITY STANDARDS AND EFFLUENT LIMITATIONS FOR THE CHICAGO AREA WATERWAY SYSTEM AND THE LOWER DES PLAINES RIVER: PROPOSED AMENDMENTS TO 35 Ill. Adm. Code Parts 301, 302, 303 and 304	)	R08-09 (Rulemaking-Water

REPORT OF THE PROCEEDINGS held in the above entitled cause before Hearing Officer Marie Tipsord, called by the Illinois Pollution Control Board, taken by Steven Brickey, CSR, for the State of Illinois, 100 West Randolph, Chicago, Illinois, on the 23rd day of September, 2008, commencing at the hour of 9:00 a.m.

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MS. ALISA LIU, Environmental Scientist
MR. ANAND RAO, Senior Environmental Scientist
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REPORTED BY:
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MS. TIPSORD: Good morning. My name is Marie Tipsord and I've been appointed by this board to serve as hearing officer in this proceeding entitled Water Quality Standards and Effluent Limitations for the Chicago Area Waterway

System and Lower Des Plaines River proposed amendment 35 IL Adm. Code 301, 302, 303 and 304. The docket number is R08-9. To my immediate right is Dr. Tanner Girard, the lead board member assigned to this matter. Also present, to my far left is board member Thomas Johnson. To my immediate left Anand Rao and to his left Alisa Liu from our technical staff.

This is fifth set of hearings to be held in this proceeding and the purpose of today's hearing is to continue hearing testaments from the participants, other than the proponent, the IEPA. At the close of the hearing on September 10th, 2008, we had finished with six witnesses from the Metropolitan Water Reclamation District of Greater Chicago, the District.

We will continue with the District starting with Earnest Blatchley. Am I pronouncing that correctly, Mr. Blatchley?

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MR. BLATCHLEY: Yes.

MS. TIPSORD: And then we'll go to Samuel Dorevitch, is that correct?

MR. ANDES: Yes.

MS. TIPSORD: And so on from there according to the list, the amended list filed on last Thursday, which whatever date that was. I'm drawing a blank. Sorry. The testimony will be marked as an exhibit and entered as if read. We will then immediately proceed to questions for the testifiers beginning with the Natural Resource Defense Counsel, then the IEPA, then the people, Openlands, and finally the Environmental Law and Policy Center.

Anyone may ask a follow-up question. You need not wait until your turn to ask questions. I do ask that you raise your hand, wait for me to knowledge you. After I have acknowledged you, please state your name and whom you represent before you begin your questioning. Please speak one at a time. If you're speaking over one another, the court reporter will not to able to get your questions on the record. Also note that any questions asked by a board member or

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staff are intended to build a complete record for the boards' decision and not to address any preconceived notion or bias. Same as last time. We're going to go until about 5:00 today. We'll take a lunch break, along with breaks throughout the day. A reminder, tomorrow, we are in 2025. That's good news and bad news. The good news is you don't have to go through security. The bad news is the rooms acoustics are even worse than this room. And with that, Dr. Girard.

MR. GIRARD: Good morning. On behalf of the board, I welcome everyone to hearing

day number 15 in this water rulemaking. We are grateful for your time and contribution to this activity. We look forward to the testimony and questions today. Thank you.

MS. TIPSORD: And with that, we'll go to Mr. Andes for the District.

MR. ANDES: Yes. Thank you. Before we get into testimony, we do have some documents to provide for the record responsive to the requests that were made in the last round of hearings. And I'll walk through each of them and then I can provide copies.

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The first and I think this was Environmental Law and Policy Centers request for lease documents. We provided documents with regard to one property that the District leases where there are recreational uses. It's actually a series of documents, an initial lease agreement and subsequent amendments so we have that.

MR. ETTINGER: It was Openlands that requested that. I hate reading contracts. That's why I went into litigation.

MR. ANDES: Point taken. The second document we have been asked for is information about effluent levels at Hanover Park, Egan and Kirie Treatment Plants and we've provided a table summarizing effluent data during the recreational season. Third, we were asked for copies of the raw data sheets from Geosyntec from the risk assessment and that is voluminous. We have provide that on a disc.

Next, is we were asked for any relevant citations in terms of the EPA's reliance on studies in developing water quality criteria for bacteria and for that we have a copy of the EPA's ambient water quality criteria for bacteria,

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a 1986 document.

And then, finally, during Dr. Tolson's (phonetic) testimony, he had described particularly two person jet skis and I was searching for the photos at the time that we were referring to. I have located those photos and we have copies for the record of the two person jet ski that he was speaking of. So those are the documents and we have multiple copies here. I'll be glad to -- I can take one copy out for the record.

MS. TIPSORD: Actually, if I could get at least two.

MR. ANDES: Sure.

MS. TIPSORD: Three if you have them. That would be great.

MR. ANDES: That's one, two, three.

MS. TIPSORD: Thank you.

MR. ANDES: This is a disc. One,

two, three. Three of the lease agreements.
MS. TIPSORD: Thanks.
MR. ANDES: And I'll provide those to each and everybody that want copies of those.
MS. TIPSORD: Okay. With that, we

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will start with the lease agreement. It's entitled Lease Amendment Agreement Ronan Park Expansion. I will mark that as Exhibit 83 if there's no objection, seeing none, it's Exhibit 83. Next, is a summary of the recreational season chlorinated/dechlorinated effluent chloroform May 1 through October 21st. If there's no objection, I'll mark that as Exhibit 84. Seeing none, that's Exhibit 84.
Next, is the CD ROM raw data. I'll mark that as Exhibit Number 85, if there's no objection. Seeing none, it's Exhibit 85. And then an USEPA document Ambient Water Quality Criteria for Bacteria, 1986. I'll mark that as Exhibit 86, if there's no objection.
MS. WILLIAMS: I would just like to point out for the record it's already Attachment Q to the statements of reasons. I mean it hasn't been entered as an exhibit so I don't have an objection as to making it an exhibit, but it is already part of the record.
MS. TIPSORD: Okay. Thank you. We'll mark this as Exhibit 86. And, finally, the picture of the two person jet ski we'll mark as

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Exhibit 87, if there's no objection. Seeing none, it's Exhibit 87.
MR. ANDES: If I could add just to complete the picture, a couple more things.
MS. TIPSORD: Go ahead.
MR. ANDES: A couple of issues arose in terms of questions on the risk assessment. First, the distance between various pumping stations and sampling locations and we have a letter from Geosyntec to the District clarifying those locations -- those distances. And then there were also some corrections that needed to be made in terms of particular distances in the report that were inconsistent between two pages and those corrections have been sent to the District and I have both a letter from Geosyntec to the District with those corrections on page 13 of the risk assessment report and a cover letter from the District to Illinois EPA enclosing those corrections.
MS. TIPSORD: Okay.
MR. ANDES: There are three copies of each.
MS. TIPSORD: We'll mark the

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Geosyntec consultants letter dated September 12th,

2008, corrected page 13 is the subject, as Exhibit 88, if there's no objection. Seeing none, it's Exhibit 88.

MS. WILLIAMS: Can I just, again, say for the record, Marie, this letter was dated yesterday. So obviously it hasn't actually been received.

MS. TIPSORD: You're speaking of the next couple of letters, not the letter I'm marking right now.

MS. WILLIAMS: Which letter did you mark?

MS. TIPSORD: The September 12th letter.

MS. WILLIAMS: Sorry.

MR. TIPSORD: That's okay. And it's noted for the record on the next one, which is September 22nd, but we'll do the Geosyntec first marked September 22nd and we'll mark that as Exhibit 89. If there's no objection, that's Exhibit 89. And then, finally, the letter to Marshal Wilhite from the District dated September 22nd, which the agency has obviously not yet seen,

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we'll mark as Exhibit 90, if there's no objection. Seeing none, it's Exhibit 90. Speeding towards 100 exhibits. Okay. Mr. Andes, anything else?

MR. ANDES: One more. Rain gauge data was requested for 2005 and 2006. I have that here. I have two copies --

MS. TIPSORD: Okay.

MR. ANDES: -- of this assemblage. And I don't remember who asked for this. It might have been the state.

MS. TIPSORD: Then we'll mark this whole group of rain gauge data as one exhibit and that will be Exhibit 91. And I have one, two, three, four, five, six paperclipped and then one big clipped grouping here. If there's no objection, we'll mark this as Exhibit 91. Seeing none, it's marked as Exhibit 91.

MR. ANDES: Let me clarify. Does the state possibly have the 2006 data only or 2005? I may have --

MS. TIPSORD: I have 2005 data here.

MR. ANDES: So you have six copies?

MS. WILLIAMS: We only have 2006 here.

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MR. ANDES: She has six copies of 2006.

MS. TIPSORD: Okay. So I only needs one of these.

MR. ANDES: Right. And then one of these.

MS. TIPSORD: Then let's clarify. Exhibit 91 is rain gauge data from 2005, the

entire year. So there are 12 pages here and that's Exhibit 91. Exhibit 92 will be rain gauge data from 2006, also, for the entire year so it's 12 pages, approximately. And those are both marked. And anything else, Mr. Andes?

MR. ANDES: I think that's it.

MS. TIPSORD: Okay. That would be wonderful. In that case, would you like to introduce your witness and we'll have him sworn in.

MR. ANDES: Surely. I have a copy.

MS. TIPSORD: Yes. If I could have a clean copy of his document.

MR. ANDES: This is voluminous so we put it on a disk. We have testimony, an initial copy of the testimony and then the rest is all on

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a disk.

MS. TIPSORD: Okay. In that case, I'm trying to think. What I'm going to do is mark both the disc and the testimony as one exhibit for purposes of citation later in the record. It could get quite difficult if we use two different exhibit numbers. So the pre-file testimony -- Well, let's swear him in first.

WHEREUPON:

DR. ERNEST BLATCHLEY III

called as a witness herein, having been first duly sworn, deposeth and saith as follows:

E X A M I N A T I O N

MS. TIPSORD: We will mark Mr. Blatchley's pre-file testimony and attachment on a CD ROM as Exhibit 93, if there's no objection.

MS. WILLIAMS: Can I just ask a question? I think we have everything. You said it's voluminous, but this is all I have. Does that seem right to you? When we're talking about his testimony, there's his testimony, there's an expanded testimony, there's an article. I just want to make sure that I've got everything.

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MS. TIPSORD: I also have very -- this is it.

MS. WILLIAMS: Okay. But that's all that's on that CD. Okay.

MR. ANDES: Yes. I just thought it was easier that way.

MS. WILLIAMS: I don't think so, but I understand.

MS. TIPSORD: Okay. We'll mark that as Exhibit 93. Okay. And with that, I believe the first questions then go to the Natural Resource Defense Counsel. Ms. Alexander.

MS. ALEXANDER: Good morning, Dr. Blatchley. My name Ann Alexander. I'm from the Natural Resource Defense Counsel and I'll be

asking you questions this morning --
MR. BLATCHLEY: Good morning.
MS. ALEXANDER: -- based on the pre-filed questions, which I think you have. Let's turn to the first question that I have for you, which is, do you have any formal training in the field of microbiology?
MR. BLATCHLEY: As a student, both undergraduate and graduate, I took a few classes

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that relate to microbiology, but I am not a microbiologist.
MS. TIPSORD: Mr. Blatchley, you're going to have to speak up.
MS. ALEXANDER: Would you say that you worked with microbiological data fairly frequently in the context of your research concerning disinfection engineering?
MR. BLATCHLEY: Yes.
MS. ALEXANDER: Okay. So would it be fair to say that you have a working knowledge of microbiology, but you're not a specialist in it?
MR. BLATCHLEY: Yes.
MS. ALEXANDER: Did you participate in any manner in the microbial risk assessment that was conducted by Geosyntec for the Water Reclamation District?
MR. BLATCHLEY: No.
MS. ALEXANDER: Have you reviewed that?
MR. BLATCHLEY: Yes.
MS. ALEXANDER: Did you provide any comments on it of any kind?

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MR. BLATCHLEY: Do you mean to Geosyntec in their preoperation of the report?
MS. ALEXANDER: Geosyntec or the District.
MR. BLATCHLEY: With respect to their preparation of the report or just comments after I read it?
MS. ALEXANDER: Either one.
MR. BLATCHLEY: I think we may have had some discussion afterwards, but, honestly, I don't recall.
MS. ALEXANDER: Okay. Do you recall at all the nature of the discussions that you had?
MR. BLATCHLEY: No. I'm sorry. I don't.
MS. ALEXANDER: Have you performed any research yourself specifically for the District? I'm not referring to your testimony, but research for the District.
MR. BLATCHLEY: When you say for the District, what do you mean?
MS. ALEXANDER: Have you been

retained by the District to perform any research?
MR. BLATCHLEY: No.

MS. ALEXANDER: All right. I would like to turn to your pre-filed testimony, which -- I'm sorry -- was Exhibit --
MR. TIPSORD: 93.
MS. ALEXANDER: -- 93 and I'd like to turn to page three, please, under the large heading Problems with Proposed Effluent Bacteria Limit and then under the subheading, coliform bacteria are poor indicators of disinfection ethiticity. I just want to read a little language into the record, but I would like to ask you some questions about it.
MR. ANDES: I'm sorry. What page are we on?
MS. ALEXANDER: We're on page three under the subheading regarding coliform bacteria.
MS. TIPSORD: Ms. Alexander, are you asking question number two?
MS. ALEXANDER: Yes. I'm sorry. This is question number two.
MS. TIPSORD: It might help if you identify the question.
MS. ALEXANDER: I'm sorry. Yes. The language in your testimony is, for some common

pathogens, analytical methods for measurement of their concentration do not exist or are difficult to perform. The large number of microbial species that can be found in municipal waste water also complicate quantification of potential microbial pathogens. From a practical perspective, it is impossible to measure the concentrations of all pathogens in waste water.
As an alternative, it is common to measure the concentration of available and/or infected indicators organisms in water. So my first question would be, does this basically define the reason in your view that indicator bacteria are commonly used to estimate or to estimate the presence of pathogens? Pathogens levels, I should say.
MR. BLATCHLEY: My view is that indicator organisms are just that, an indicator of the presence of pathogens. Coliform bacteria, are you asking specifically about them?
MS. ALEXANDER: I'm asking, first, more broadly about indicator organisms. I mean I should ask the foundational question. What do you consider to be in the category of indicator

organisms?
MR. BLATCHLEY: Coliform bacteria, and/or cocci. There have been people who suggested the use of a total bacterial count.

Some people have suggested the use coliphage.
MS. ALEXANDER: Are either total bacteria count or coliphage in use as in any context that you're aware of?
MR. BLATCHLEY: No. Not that I'm aware of.
MS. ALEXANDER: Okay. So the ones that are in use would be the coliform and the enterococcus?
MR. BLATCHLEY: I believe so, yes.
MS. ALEXANDER: So when you referred to indicator bacteria in your testimony, are you basically referring to coliform enterococci?
MR. BLATCHLEY: Coliforms.
MS. ALEXANDER: Coliforms. Yes. Okay. So my question, my initial question simply is, would you consider the statement that I just read into the record to essentially explain the reason why indicator bacteria are commonly used to estimate pathogen concentrations?

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MR. BLATCHLEY: Yes, I think that's the idea.
MS. ALEXANDER: Okay. Would you agree then that indicator bacteria can be a good indicator of the presence of at least some types of pathogens?
MR. BLATCHLEY: Yes.
MS. ALEXANDER: Okay. I would like to turn to the third page of your extended testimony, which unfortunately is unnumbered, but the third page of it starts with the words "the concept of an indicator organism," and then there's some bullet points.
Going to the paragraph below that, which begins although and I'll just read that language into the record. Although, no organism has been identified, but ideally or completely satisfies these criteria, as referring to the criteria listed for a good indicator organism, a number of bacterial species have been proposed to satisfy this function. Commonly used indicators include coliform bacteria, e-coli and enterococci. My question there is, would you say that coliform and enterococci are essentially the

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best indicators available in use now?
MR. BLATCHLEY: Those are two questions.
MS. ALEXANDER: You're right. That's two separate questions. Let me ask the one about in use. Are they the best in use now?
MR. BLATCHLEY: By default, they're basically the only ones in use.
MS. ALEXANDER: Okay. And would you say that they're wildly used now?
MR. BLATCHLEY: Yes.

MS. ALEXANDER: For what sorts of purposes?
MR. BLATCHLEY: Monitoring of waste water effluent microbial quality.
MS. ALEXANDER: And are they also used to make other types of determinations such as closure of beaches?
MR. BLATCHLEY: I believe so, yes.
MS. ALEXANDER: Okay.
MR. ANDES: I'd like to follow up on that. Dr. Blatchley, can you explain a little bit more? Are we talking about indicators being an indicator of presence or the levels of pathogens?

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MR. BLATCHLEY: The presence of pathogens is what is indicated by indicator bacteria or indicator organisms, more generally.
MS. ALEXANDER: Okay. Let me follow up on that. Is it your understanding that indicator bacteria are usually used to signal in some manner a threshold level above which some action is required either closing a beach or disinfection?
MR. BLATCHLEY: I believe that is the approach that is used for purposes of defining beach closures, yes.
MS. ALEXANDER: So in other words, would it be fair to say that in that regard indicator bacteria are used to signify a level in the sense that they set that threshold?
MR. BLATCHLEY: Well, I'm not involved in those decisions myself so I have to plead ignorance.
MS. ALEXANDER: I understand.
MR. BLATCHLEY: I assume that is the basis on which they are proceeding.
MS. ALEXANDER: Okay.
MR. ANDES: I'd like to follow up on

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that. From a scientific perspective, can you explain what you think those indicators tell you?
MR. BLATCHLEY: Again, the indicators indicate the presence or the possible presence of microbial pathogens. They don't necessarily indicate the absence of microbial pathogens for reasons that I'm sure we'll get into.
MS. ALEXANDER: Yes. And let me just follow up to clarify that. Am I correct in understanding that your fundamental concern as expressed in the testimony with indicator bacteria is that they are poor indicators in your view of the effectiveness of the disinfection process because they are more easily killed by disinfection than certain types of pathogens, is that correct?
MR. BLATCHLEY: Yes, that is a

concern of mine.
MS. ALEXANDER: Okay. Moving to pre-file question three, is it possible to apply levels of disinfection that kill both the indicators and some or most of the microbial pathogens?

MR. BLATCHLEY: I'm glad you added that last phrase because, yes, it is possible to apply disinfection to be effective against most microorganisms, but disinfection is not the same thing as sterilization. Sterilization is effectively impractical to accomplish.
MS. ALEXANDER: Okay. Looking at -- I'd like to turn to table two of your extended testimony which is headed UV Doses Required For 99 Percent Inactivation.
MS. TIPSORD: Excuse me, Ms. Alexander. And for the record, his extended testimony is Attachment two to the pre-file testimony.
MS. ALEXANDER: Okay. So Attachment Two to Exhibit 93. And --
MR. ANDES: I'm sorry. Where were we in that?
MS. ALEXANDER: Table two, which should be on the sixth page of it. Am I correct in understanding that this table lists doses of UV radiation that can be applied to achieve 99 percent inactivation of water bourne microorganisms?

MR. BLATCHLEY: Let me just clarify. These values -- the general answer to your question is yes. These values came from a tabulation that was assembled basically for people who are interested in UV disinfection and the values that I pulled off of here for many experiments that were conducted on -- Well, for example, with e-coli, there were many experiments that were conducted where values were reported. So the values that I'm listing here are values that were reported independently by many investigators. Is that clear?
MS. ALEXANDER: I think so. So are you saying that these are essentially the most accurate numbers that you could come up with based on the research for purposes of your extended testimony?
MR. BLATCHLEY: No. I would say these are the available numbers that I came up with. There was no attempt on my part to identify the quality of the numbers associated. They were just simply recording of values that they, themselves, had previously been recorded.
MS. ALEXANDER: So are you saying

then that you didn't review all of the underlying research that resulted in the data that's presented in table two?

MR. BLATCHLEY: That's correct.

MS. ALEXANDER: Okay. Do you have any reason to believe that the UV doses that are identified here as necessary to achieve 99 percent inactivation of water bourne pathogens are in any way not technology feasible as a general matter?

MR. BLATCHLEY: Just to clarify, are you asking is it possible to develop UV systems that will deliver this amount of radiation?

MS. ALEXANDER: That's correct.

MR. BLATCHLEY: Sure.

MS. ALEXANDER: Okay. Are any such UV systems in use that you're aware of?

MR. BLATCHLEY: Yes, many.

MS. ALEXANDER: Do you have any reason to believe one way or the other that it would not also be possible to use such a system at the District, at the District's water treatment plant?

MR. BLATCHLEY: I believe it would possible, yes.

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MS. ALEXANDER: Okay.

MR. ANDES: I would like to follow up on that. Can you compare the kinds of systems that would be required to meet the proposed standards?

MR. BLATCHLEY: What do you mean?

MR. ANDES: If we're talking about UV doses required to meet these kind of numbers, is that --

MR. BLATCHLEY: Where would we be within this range, is that what you're talking about?

MR. ANDES: Well, are we talking about systems that are more expensive than what would be required under this proposal?

MR. BLATCHLEY: I'm still confused by your question. I'm sorry.

MR. ANDES: Let's keep going.

MS. ALEXANDER: Pre-filed question number four, what is the alternative to the use of coliform bacteria and enterococci as an indicator of disinfection effectiveness? I believe that's partially been asked and answered, but I'll put it out anyway because I'm not entirely sure.

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MR. BLATCHLEY: Okay. You could use other organisms and I've identified a few total bacterial counts or coliphage as an example. You could also accompany those requirements with requirements on the characteristics of the disinfection system, meaning if -- For example, UV is used, how much UV is applied, what the

characteristics of the water are that come into the UV system. All of those could be incorporated.

MS. WILLIAMS: Dr. Blatchley, can you just explain to me quickly when we're talking about coliform bacteria here, are you talking about total when you're using that term, total coliform?

MR. BLATCHLEY: I didn't get that.

MS. TIPSORD: Ms. Williams, you're going to have to speak up.

MS. WILLIAMS: We've been using the word coliform in Dr. Blatchley's testimony quite a bit and I think I want to just understand whether we're talking about coliform or fecal coliform.

MR. BLATCHLEY: The data, for example, in table two that we just talked about,

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refers specifically to e-coli, which is a species of coliform bacteria. The majority of the data in the reports that I referred to refer to fecal coliform bacteria, which is related, but not identical. Does that answer your question?

MS. WILLIAMS: I think so.

MR. BLATCHLEY: Okay.

MS. ALEXANDER: Getting back to your testimony just now regarding the possibility of using the UV level essentially as an indicator of microbial destruction, is that method in use in any municipal waste water treatment system in the country that you're aware of? And I mean that -- I should clarify the question. I mean without also use of indicator bacteria so solely using the UV level.

MR. BLATCHLEY: Solely using that level?

MS. ALEXANDER: Yes.

MR. BLATCHLEY: I'm not aware that it is, no.

MS. ALEXANDER: Okay.

MR. ETTINGER: I'm sorry. I'm not sure I understood Ms. Alexander's question. Can I

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just follow up slightly? As I understand what your suggestion was is that the standard would be written in with the technology level rather than a fecal coliform level. Am I wrong?

MR. BLATCHLEY: No, my suggestion was both.

MR. ETTINGER: Was both?

MR. BLATCHLEY: Yes.

MR. ETTINGER: So you would be more comfortable if you were trying to design a permit if it would have both a technology requirement and an, indicator requirement?

MR. BLATCHLEY: Yes.

MR. ETTINGER: Thank you.

MS. ALEXANDER: All right. Moving to question five, again, I think that's been partially answered, but perhaps not completely so let's go there. Regarding the statement in your testimony at three, that -- and I'll quote "use of coliform as an indicator organism provides potentially misleading information regarding the performance of disinfection systems." Is what you essentially mean by that that these indicators can provide, as it were, a false reassurance of

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safety?

MR. BLATCHLEY: Yes.

MS. ALEXANDER: Okay.

MR. ANDES: Can you explain that more fully?

MS. ALEXANDER: Okay. The concern is that coliform indicator bacteria are insufficiently protective as a measure of the presence of pathogens, is that correct, in identifying your concerns?

MR. BLATCHLEY: Yes.

MR. ANDES: Please --

MR. BLATCHLEY: Do you want me to expand?

MR. ANDES: Yes.

MR. BLATCHLEY: As we examined before, coliform bacteria are very sensitive to disinfect and exposure. So the conditions of disinfect and exposure that are required to accomplish irregulatory limits like 400 CFU's per 100 ML are really fairly mild and just because you satisfy that constraint does not necessarily mean that you've inactivated the microbial pathogens that exist in the water.

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MR. ANDES: And what would be required to actually inactivate those pathogens?

MR. BLATCHLEY: Well, as an example, in water reuse applications where direct human contact is likely to take place because the water is going to be used for irrigation or whatever, under those circumstances the extent of disinfect and exposure is anywhere from five to ten times greater than what would be required to meet these regulations. So, I mean depending upon the disinfectant I suppose, would be the --

MR. ANDES: And then the cost in treating would be five to ten times higher, is that correct?

MR. BLATCHLEY: As a ball park number, yes, it would be roughly five to ten times higher.

MR. ETTINGER: If I can just ask about the indicator again. Is your problem with the 400 or the fecal? I mean if you made the number 20 as opposed to 400 would that satisfy

your objection or would it not have any effect?
MR. BLATCHLEY: There's several issues. One problem is the 400 because it

really -- that's not really very difficult to accomplish and the conditions that are required to accomplish that are really pretty mild in terms of disinfection. So the number frankly to me seems not very effective in terms of controlling microbial pathogens. Another issue is that the waste water effluents are not the only source of pathogens to the waterways and no matter what you do to the waste water effluents, if it were theoretically possible to sterilize, that still wouldn't solve the problem.
MR. ETTINGER: Leaving aside that second problem, and we understand that that's another issue here, let's assume we had a situation here where the only source of pathogens was the waste water. Is there a number less than 400 in which you would be comfortable that we did have an adequate indicator of whether or not there were pathogens in the water?
MR. BLATCHLEY: It would depend on what the intended use of the water is, but if the intended use of the water is going to be something like, you know, irrigation as is done in southern California, the limits that are applied there are

basically the limits of defection for the analytical method for coliform bacteria. So it's 2.2 per hundred ML base on the MPN method, which is essentially the limit of detection, but they also need to validate that they're getting four logs of inactivation of enterococcus viruses. And that's done basically by assuring that the conditions of disinfection are adequate to ensure that that's accomplished reliably.
ME. ETTINGER: That's the technology. How do you do that? Do you look at the -- do you have a technology requirement or how does that work?
MR. BLATCHLEY: Yes, I believe so. I don't think it's practical to monitor the enteric viruses. That's not going to be done. It can be done in a research setting, but to do it every day I think is just not -- I'm not aware that anybody does that, but I could be wrong.
MR. ETTINGER: So how do you monitor to make sure you're getting the enteric viruses if you're not counting the viruses themselves?
MR. BLATCHLEY: The approach that's used there is very similar to the approach that's

used in drinking water where the concentration of microbial pathogens is presumably low. So, again, what you do is ensure the conditions of

disinfection and the water quality approaching the disinfection are such that you would expect that an acceptable water quality would result.

MR. ETTINGER: Just so we can go and look at such a permit and see how it's done in a regulatory manner, are you familiar with any particular permit that has these sorts of conditions that you're talking about that would provide for the monitoring that you would think was adequate to protect in this irrigation situation?

MR. ANDES: We do have a copy of the compilation of the California Reuse Requirements, if that's helpful.

MR. ETTINGER: That would be something we could look at then.

MR. ANDES: Yes. I have copies.

MR. ETTINGER: Thank you.

MR. ANDES: Sure.

MS. TIPSORD: Are we going to enter that as an exhibit then?

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MR. ANDES: I'm fine with that.

MR. ETTINGER: I have no objection.

MS. TIPSORD: We might get to 100 today.

MR. ANDES: I think we're going to get there.

MS. TIPSORD: I will mark as Exhibit 94, California Health Laws Related to Recycled Water. It's a June 2001 addition from the California -- from the purple book. If there's no objection, that's Exhibit 94. Seeing none, it's Exhibit 94.

MR. ETTINGER: Could I just follow up with one other thing? You suggested or said in your testimony that part of your looking at the level would depend on the use of the waste water and then you pointed us to the irrigation situation, are you familiar with California or what others do in the swimming water situation that you were talking about?

MR. BLATCHLEY: No. Do you mean beaches?

MR. ETTINGER: Yeah.

MR. BLATCHLEY: No, I'm not.

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MR. ETTINGER: Leaving aside the irrigation situation, again, I believe you answered that you would not be comfortable using 400 fecal coliform and then we would look at the use of the water and then we went to this irrigation situation, how would your answer change if we were look at swimming as opposed to irrigation?

MR. BLATCHLEY: I'm sorry. I don't know enough about what the numbers -- Presumably,

the approach that would be used would be some sort of correlation between some monitoring organisms and the pathogens that you're concerned about, but I don't know the numbers that would be used under those circumstances?

MR. ETTINGER: You don't know whether you'd want to go to the detection level under those circumstances or not?

MR. BLATCHLEY: I'm sorry. I don't.

MR. ETTINGER: Thank you.

MS. TIPSORD: Mr. Harley.

MR. HARLEY: Keith Harley with the Southeast Environmental Task Force. Dr. Blatchley, you've talked about numeric limits that

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can appear in permits, for example, 400 coliform forming units and you've talked about approaches where you could obtain very, very low levels like 2.2. With the typical application of UV systems that you've seen, what are the levels achieved in terms of the level of colony forming units in waste water?

MR. BLATCHLEY: I think they typically shoot to be reliably under the limit that is imposed. So if the limit is 400, you can expect it going to be somewhere under 400.

MR. HARLEY: Do facilities which are subject to the 400 colony forming unit numeric limit achieve better results?

MR. BLATCHLEY: Sometimes, yes.

MR. HARLEY: And what would be the best result that they would achieve using UV under typical conditions?

MR. ANDES: Can I clarify what kind of -- are you talking about conventional disinfection? He's characterized conventional disinfection versus sort of the California example. Are you talking about conventional disinfection?

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MR. HARLEY: I'm talking about conventional disinfection.

MR. BLATCHLEY: I would guess there would be days where you have non-detect.

MR. ANDES: Would that be on a consistent basis?

MR. BLATCHLEY: No. There's a number of things that influence the concentration of viable coliform bacteria or any other organism that is going to leave a disinfecting system, including water quality that comes in. And that is not the same from day-to-day or even hour to hour. So it depends on, you know, when you collect your sample, what the characteristics of the treatment system upstream of disinfection were and a number of other things.

And, in fact, the analytical

methods that you use to quantify micro organisms also are subject to quite a bit of error. There's a fair amount of error in those analytical methods just in the numbers that we report. So it's common to see, you know, substantial variations in those numbers. So I wouldn't be surprised to see non-detects from time to time and also things that

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approach or even exceed the limit from time to time in various facilities. I think that's pretty common.

MR. HARLEY: Thank you.

MS. ALEXANDER: With respect to the 400 colony forming units standard that we're discussing, were that imposed in a situation such as the District, as has been proposed by IEPA, would you expect that there would be at least some reduction in the pathogen levels of the effluent?

MR. BLATCHLEY: Yes.

MS. ALEXANDER: So the question that we're addressing in your testimony is how to get a greater reduction, not whether there's going to be some reduction or no reduction, is that correct? It's level of safety?

MR. BLATCHLEY: That's one of the questions, yes.

MR. ANDES: And what are the other questions?

MR. BLATCHLEY: Again, the other concerns I have relate to what are the sources of pathogenic microorganisms that exist in the waterways. That would be the respective of what

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you do with the effluent that's not going to be effected by what's being proposed.

MS. ALEXANDER: Okay. We'll get to that subject a little further down. Can you explain if one had a chlorination system that was essentially designed to meet the 400 colony forming unit limit, what would have to be done to that system in order to meet a more stringent limit of the type that you discussed in your testimony?

MR. BLATCHLEY: Okay. The example that I gave in the testimony, I believe, referred to Title 22 systems in California. These are reuse systems where, again, the microbial constraints are less than 2.2 per hundred ML, which basically means non-detect and you need to demonstrate, let's say, four log units of enteric virus inactivation.

The conditions of chlorinations that are required to accomplish that, I believe, are on the order of four to five milligrams per liter of free chlorine and 120 minutes of contact time. So often times, we characterize that cholerine exposure as the product nominally of the

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concentration of the disinfectant and the exposure time or CT. So the CT value is going to be somewhere in the vicinity of 500 milligram minutes per liter.
MS. ALEXANDER: So in other words, if one has a chlorination/dechlorination system in operation and one wishes to meet a more stringent limit, it's not a question of adding a lot of new hardware, it's a question of increasing contact time and chlorine levels, am I understanding correctly?
MR. BLATCHLEY: Well, I believe that is a lot of new hardware, but, yes, you are talking about by one means or another increasing the chlorine exposure by a factor of ten roughly. So that can be done by, at least in theory, that can be done by increasing the contact time, by increasing the concentration of disinfectant that is maintained in the contact chamber or some combination of those things.
MS. ALEXANDER: And what's the new hardware that is involved in that?
MR. BLATCHLEY: A larger contact chamber. I would assume there may be new hardware
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associated with delivering more chlorine also.
MS. ALEXANDER: Same question with respect to ultra violet, if one had a system that was meeting 400 colony forming unit standard and one wanted to make that more -- wanted to meet a more stringent limit, what would need to be done?
MR. BLATCHLEY: You'll need to increase the size of the facility. I don't think it's quite as extreme as with chlorine. I would guess on the order of five times bigger and that basically means five times as many lamps or five times as much power that you can deliver in the form of germicidal UV radiation.
MS. ALEXANDER: Okay. If you're adding more power, is it necessary to add significant infrastructure other than that?
MR. BLATCHLEY: It's not just a question of electrical power, it's the lamp to deliver the power. So imagine in this room that you wanted to increase the visible light, the power of visible light in the room. You would do that by multiplying, let's say, by a factor of five. You would increase by a factor of five the number of lights that you had assuming that you
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were using the same lamp technology.
MS. ALEXANDER: So, essentially, what we're talking about to intensify the kill ratio as it were of ultra violet is a lot more light bulbs?
MR. BLATCHLEY: And related

hardware, yes.
MS. ALEXANDER: Okay. Now, is it your view that there is some level of disinfection between the level of 400 colony forming units and the, essentially, reuse level in use in California that would be appropriate in a recreational waterway system such as the CAWS?
MR. BLATCHLEY: I suppose there could be one, but I'm not sure what it would be.
MS. ALEXANDER: Okay. So is it your view that this reuse level is appropriate for the CAWS?
MR. ANDES: I don't think he's opining on that issue.
MS. ALEXANDER: I'm sorry?
MR. ANDES: If you're asking from a risk assessment standpoint because that's not his area.

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MS. ALEXANDER: But he has presented testimony all about why the current level is not appropriate and it ought to be made more stringent. So my question is --
MR. ANDES: I object to the characterization of his testimony. It should be made more stringent.
MS. ALEXANDER: I mean -- Hold on a second.
MR. ANDES: Pointing out that more stringent levels would be needed to kill most pathogens is a different issue than saying it should be made more stringent.
MS. ALEXANDER: I would point out that in the article that is attached to or made a part of Attachment two to Exhibit 93, highlighted in the conclusions is a statement considering -- Well, I'll read the statement. "It is important to consider the second central question of this research, which is under circumstances where disinfection is necessary, how should it be accomplished," and hold on one second.
MR. ANDES: But he hasn't testified that disinfection would be necessary here. We

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have to characterize his reports. They are what they are.
MS. ALEXANDER: I'm lost in the language here. Just a moment.
MS. TIPSORD: Ms. Alexander, try rephrasing your question. I think we're spending a lot of time arguing a point that can be accomplished if you just rephrase your question.
MS. ALEXANDER: Do you have any basis to believe that the reuse standard in use in California is appropriate for use in a recreational water body such as the CAWS?
MR. BLATCHLEY: I don't know.

MS. ALEXANDER: You have no basis one way or the other?
MR. BLATCHLEY: No, I'm sorry. I don't.
MS. ALEXANDER: Okay.
MR. HARLEY: Before we go on --
MR. TIPSORD: Yes, Mr. Harley.
MR. HARLEY: Then why did you feature the California reuse standards so prominently in your pre-file testimony?
MR. BLATCHLEY: I wanted to

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illustrate that there's a range of disinfection. When people say you're going to use disinfection, what does that mean? In my mind, that means a number of things. It can range from nothing, which is applied many places, to fairly extensive disinfectant exposure which is applied, for example, in the case of reuse applications in the southwest, including California. So my point was to illustrate that disinfection is not a box that fits everyone. There is a range of these applications that exist all the way from zero to very extensive.
MS. WILLIAMS: Dr. Blatchley --
MS. TIPSORD: Ms. Williams, you need to project. They need to hear you back there too.
MS. WILLIAMS: Okay. Dr. Blatchley, if you don't have an opinion on what level of treatment would be necessary for recreational waters, why are you testifying that you think 400 is not sufficiently stringent?
MR. BLATCHLEY: The research that we've done on waste water disinfection was based largely on systems that I labeled as conventional disinfection and I would include one that is

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designed to satisfy that constraint as a conventional disinfection system. Our observations of what happens to the microbial community as a result of that exposure and following that exposure suggests that it's really not very beneficial to do that and in some cases, it's actually detrimental in terms of microbial quality.
MS. WILLIAMS: Can you explain detrimental?
MR. ANDES: Do you want to use the charts?
MR. BLATCHLEY: Sure. This is going to take a minute to walk through.
MS. WILLIAMS: You know, there might be -- Do we want to save this? This might be going out of order to go down this path now.
MR. BLATCHLEY: Okay.
MS. ALEXANDER: I had a series of questions about this, but perhaps it will come up

in the context of those questions, however, people want to do it.

MS. WILLIAMS: I asked the question, but I can withdraw it at this time.

MS. TIPSORD: Do you want to withdraw it?

MS. WILLIAMS: Yes.

MS. TIPSORD: Ms. Alexander, we're back to you.

MS. ALEXANDER: All right. It appears that pre-file question six and seven have been basically asked and answered at this point. So I am going to turn to pre-file question eight, which concludes -- involves the second portion, essentially, of conclusion number two on page nine of your pre-file testimony, which I believe also gets to the question that Ms. Williams asked and the statement that I'm referencing there is the response of the bacterial community to the post-disinfection environment will be influenced by bacterial repair, recovery and regrowth. Collectively, these processes may yield diminished water quality relative to a situation that disinfection is not practiced. Is that, essentially, the subject matter you were referring to just now when you said that the effects could be detrimental?

MR. BLATCHLEY: Yes.

MS. ALEXANDER: Okay. First off, Subquestion A, do all pathogenic bacteria exhibit the same response to chlorine disinfectants as fecal coliform?

MR. BLATCHLEY: No.

MS. ALEXANDER: Okay. So in other words, they don't all have the same capacity for repair and regrowth, is that correct?

MR. BLATCHLEY: I believe that's correct, yes, but we have not investigated it. Let me just further characterize. I'm assuming that is the case.

MS. ALEXANDER: Okay. So there's been no research one way or the other that you're aware of on that point?

MR. BLATCHLEY: No.

MS. ALEXANDER: Okay. If you used a higher level of chlorine disinfection at increasingly higher levels, I should say, would you expect that there could be a change in the ability of the microorganisms to repair and regrow?

MR. BLATCHLEY: Yes, I would expect that because generally it is assumed that the

ability of an organism to repair and regrow depends on the extent to which it has been

damaged.
MS. ALEXANDER: And same question for UV.
MR. BLATCHLEY: Yes. Same response.
MS. ALEXANDER: Subquestion C under question eight, do your findings regarding regrowth in your study apply to viruses and protozoa or just fecal chloroform bacteria?
MR. BLATCHLEY: In fact, they apply to fecal chloroform bacteria and the total bacterial counts within the samples.
MS. ALEXANDER: Now, I'd like to turn, please, to table three in your study that is from Water Environment Research, which is attached to Attachment two of Exhibit 93, which is the table I will represent that purports to display the numbers that reflect the regrowth of the bacteria. My first question there is under Subquestion D.
MS. TIPSORD: I'm sorry. I'm not even sure where you're at.
MS. ALEXANDER: There is a study

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attached to Attachment Two entitled Effective Water Bourne Disinfection on Water Bourne Bacteria and Viruses by --
MR. TIPSORD: That's actually Attachment Three.
MS. ALEXANDER: I'm sorry. You're right.
MR. TIPSORD: So Attachment Three, table three, which is page 87 of that article. Thank you. Sorry.
MS. ALEXANDER: Are we there?
MR. ANDES: Yes.
MS. TIPSORD: Go ahead.
MS. ALEXANDER: Dr. Blatchley, my first question there is -- I should clarify. T equals 144 is the end of the study period, is that correct, the point at which you measured regrowth?
MR. BLATCHLEY: No. In fact, we measured every day over a period of six days. So that would be the last day in the incubation period.
MS. ALEXANDER: So when I say T equals 144 as here in this table I'm referring to the last day of the incubation period and my

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question is were the levels at T equals 144, this last day of measurement, ever higher than the undisinfected levels that existed prior to T equals zero?
MR. BLATCHLEY: Repeat the question one more time because I want to make sure I understood it correctly.
MS. ALEXANDER: Okay. Looking at the table, I'm going to do this by example. Let's

take Facility B, the one at the top. You have at the second column over from the right it states fecal coliform T equals zero, which is the point at which you began measurement, is that correct?

MR. BLATCHLEY: Yes. Actually, T equals zero in this experiment was post disinfection.

MS. ALEXANDER: Yes.

MR. BLATCHLEY: So that's when incubation started.

MS. ALEXANDER: Let's go down. Moving vertically, you have UV chlorination/dechlorination and then according to the table footnote, ORI width indicates the control sample with acidic substrates and without

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indicates without the substrates, but that was essentially without disinfection, is that correct?

MR. BLATCHLEY: Both of them were.

MS. ALEXANDER: So if we move across the table to these two numbers, ORI with and without, for Facility B you see what I would characterize as fairly high numbers. You have 2.81 times 10 to the 5th and 2.16 times 10 to the 5th, which is the fecal coliform levels in the undisinfected effluent, is that correct?

MR. BLATCHLEY: Yes.

MS. ALEXANDER: So am I correct in observing that regardless of any repair and regrowth, the numbers, the level of fecal coliform bacteria at the end of the study period at T equals 144 were always lower than the undisinfected levels, is that correct?

MR. BLATCHLEY: No. There's an example right here of where the opposite is true. Let me just clarify because I'm not sure that I'm understanding your question and actually let me just clarify the point of the experiment. The point of the experiment was to follow the dynamics of the microbial population post disinfection and

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to compare that with an undisinfected sample. So our interests were to evaluate how the microbial population responded to either the application of disinfection or the non-application of disinfection. In some cases when we evaluate the coliform concentration, for example, at the end of that experiment, the concentration of coliform bacteria in the undisinfected sample was actually higher than in the disinfected sample, meaning that after six days of incubation, the coliform concentration in the disinfected sample was actually higher than it was in the undisinfected system. Would it be clearer to look at the data just as an example?

MS. ALEXANDER: First, I'd like to clarify what is on this table because that's where

I'm getting the understanding of your research results and I'm not quite seeing what you're saying here. What I do see is that T equal zero. When you apply, for instance, chlorination/dechlorination, you get a level of 715 and then there was some regrowth and then you get 1133.

However, in the undisinfected

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effluent, you start out with a level of 2.81 or 2.16 times 10 to the 5th and you end up with levels of 5825 and 7275 respectfully. So regardless of the regrowth that appears to happen between T equals zero from 715 to T equals 144, you have higher levels in the undisinfected samples after that amount of time and, of course, they're vastly higher than the undisinfected sample at T equals zero. Are those correct observations?

MR. BLATCHLEY: Yes.

MS. ALEXANDER: Okay. Moving down to the next one you've got for UV --

MR. BLATCHLEY: Are you talking about Facility D now?

MS. ALEXANDER: Yes. For Facility D for undisinfected you have a couple of numbers times 10 to the 5th and then you move across if you don't do anything to those you end with numbers of 2718 and 1262, respectfully, correct? That's at T equal 144 in the first column over to the right. That's your -- the level of undisinfected if you just leave it sitting in the petri dish or whatever you use to come up with

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that. Here, if you disinfect with chlorination/dechlorination, you appear to have some regrowth from 61.5 which is, of course, a lot lower than these undisinfected numbers and then it regrows to 20/40.

MR. BLATCHLEY: Which is higher than the 1282.

MS. ALEXANDER: Right. Which is marginally higher than the 1282.

MR. ANDES: I'd object to marginally.

MS. ALEXANDER: Is that the one example you were referring to?

MR. BLATCHLEY: Well, Facility A as well.

MS. ALEXANDER: Right. Okay. Right. There's two examples. There's a Facility A and a Facility D. So in other words, the differences that you're referring to are essentially of that order, correct, within the same order of magnitude, but there are some marginally higher numbers in these circumstances at the end of the study period in the

undisinfected versus the disinfected, is that
correct?
MR. ANDES: I'd object to the marginally. I'd let him characterize it himself, but he can also use the chart to talk about it.
MS. ALEXANDER: Okay. Of the same order of magnitude I would say.
MR. BLATCHLEY: I think that's a fair characterization, yes.
MS. ALEXANDER: Okay. And those are the only two examples, in that correct, in this table?
MR. ANDES: Two out of four.
MS. ALEXANDER: It not's two out of four because it's specific types of disinfection.
MR. ANDES: There's four of them and there's two.
MS. ALEXANDER: There's eight examples because in both you use UV and chlorination, correct, two different types of experiments?
MR. ANDES: There's more than two situations where they're low. The point he is trying to make is in some cases the levels after disinfection are higher than the undisinfected
effluent and that point is made by the chart.
MS. WILLIAMS: Okay. Can we talk about the chart? Is this going to be an exhibit?
MR. ANDES: Yes.
MS. WILLIAMS: I thought it was a blow up of something in here, but it's not, is it?
MR. BLATCHLEY: No.
MR. ANDES: Right. And I know I do have copies of that for everyone if I can just locate them.
MS. ALEXANDER: All right. I think we're ready to go to the chart now.
MR. BLATCHLEY: Can you see it? Do you need me to move it?
MR. TIPSORD: You can tilt it this way. Turn it a little bit. And we'll wait until we get the paper.
MR. ANDES: I'm looking.
MR. BLATCHLEY: Can you see it now?
MS. ALEXANDER: Yes, I can see it.
MS. TIPSORD: We're going to wait until we get a hard copy so everyone can see it.
MR. ANDES: I'm sorry. I am unable to locate my copies, but I have copies made.
MS. TIPSORD: Okay. It's probably easier to turn it this way and we'll move down.
MR. BLATCHLEY: Is that correct? Whatever you want.
MS. TIPSORD: Just turn it this way.

MR. BLATCHLEY: Okay. So let me explain the experiment and the data and how it's being presented and then I'll kind of walk you through it. The experiment involved the collection of undisinfected samples from a number of different waste water treatment facilities, municipal waste water treatment facilities. We would have them shipped to our lab and then we would perform some form of treatment at the bench involving those samples. Now, the treatment that we would use in the case of UV or chlorine, these were disinfectant exposures, that other experiments that we had conducted, had suggested, would allow us to comply with the relevant discharge regulations. So usually it's going to be a coliform standard that we needed to meet, fecal coliform standard that we needed to meet.

So, again, what we wanted to do in these experiments was to mimic what would have

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been done at full scale, but do it in our lab under controlled conditions where we could then take those samples and then evaluate what happens to them chemically or microbiologically. In this case, what we did was we took those samples and we divided post disinfectant exposure, we incubated them for a period of six days.

And every day we would collect a sample, among the things we would do is collect a sample from that incubated sample and measure the total bacteria counts and the fecal coliform concentration, viable fecal coliform concentration. So for each one of these samples that we would collect from a waste water treatment facility, there would be a UV disinfected sample, a sample that was subjected to chlorination and dechlorination and both of those samples before we started the incubation, we add a little bit of acidic acid because we had determined that would be representative of the partially reduced substrates that these micro organisms might encounter when they were released to a receiving stream or something like that.

So we actually did two controls

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in these experiments. One control was the undisinfected sample to which we added that same substrates and that's labeled as original with and another was the undisinfected sample to which we added nothing. So that's original without. So for each sample we collect then there are four treatments that we evaluated, UV, chlorination/dechlorination, the control with a substrates and the control without the substrates. Does that make sense? It's a lot, I think.

And in each experiment what we would do, again, would be to follow the total

bacterial numbers up here and the viable coliform concentration. Okay? So there's a couple of patterns that show up in this data set and I should say also that for each facility we collected samples on four different dates and subjected them to this essay. So these are actually the averages of these four data sets.

MS. TIPSORD: Excuse me, Dr. Blatchley. I remember you talking about the transcript. People aren't going to have that. So for the record, you're pointing to the chart that's labeled Facility D St. Petersburg, which

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we'll enter as Exhibit 95 when we get a copy of it. So when you talk about the things you're discussing, you're pointing to that chart and talking about the plotting on the chart.

MR. BLATCHLEY: Should I refer to it as Exhibit 95?

MS. TIPSORD: That's fine. I just wanted to be sure that we got that in there because you started to refer to this and that and I want to make sure that everyone knows that you're referring to Exhibit 95. Go ahead. Thank you.

MR. BLATCHLEY: So these data down here that are illustrated represent the coliform concentrations and I should point out the vertical axis of Exhibit 95 there is a break and I did that intentionally because there is a several orders of magnitude difference between the concentration of viable coliforms that we measure and the total bacteria counts that we get. And that's evident here roughly 10 to the 8th whereas down here we might be 10 to the 3rd or 10 to the 4th.

So if we were to follow the coliform counts, what we observe is that the

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samples without disinfection and actually they show up above the scale over here, they tend to show some die off following disinfection. I'm sorry. Following not disinfection. So starting at T equals zero. So it's unfortunate that the T equals zero sample didn't show up with this axis break, but I believe it's somewhere over here about 10 to the 5th and following the initiation of this incubation experiment, again, the concentration of these things just gradually dies and that's pretty commonly observed with coliform bacteria.

The contrast to that would be the UV disinfected sample, which is the blue dot or triangles and, I guess, it's the pink hexagon, which represents the sample that was subject to chlorination/dechlorination. Their behavior is somewhat erratic in the case of chlorine, but generally we see a trend of increasing

concentration of those coliforms. And, actually, the general trend -- I'm not sure how you account or do this in your reporting, but the general trend is to have those two things converge.

And in this case, in the case of

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chlorination/dechlorination the concentration actually exceeded the controls at the end of the experiment. Okay? It's also important to point out what's happening with the total numbers up here. This set of inverted red triangles represent the response of the total bacterial community post disinfection with chlorine being the disinfectant and you see that after two days we have roughly an order of magnitude more bacteria than total bacteria than were present in any of the other samples.

So to clarify there was no effort that was made here to try to identify what comprises that population of bacteria. It was simply a body count with no species identification, but clearly the concentration here is higher than it is down here by roughly an order of magnitude. Does that define or does that clarify how we did those experiments and what they suggest?

MS. ALEXANDER: It's helpful and since this is the first time I have seen this chart I may need to review it and ask some follow ups, but I just want to be clear and I'm going to

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go to the chart myself looking at the fecal concentration, which is what I believe was discussed in your testimony, am I correct that this line with the pink dots represents the effect of chlorine disinfection, is that right?

MR. BLATCHLEY: Chlorination/dechlorination.

MS. ALEXANDER: Chlorination/dechlorination. And then this line here the with the gray triangles is essentially the undisinfected effluent, is that correct?

MR. BLATCHLEY: Correct.

MS. ALEXANDER: So what we have going on here you have the undisinfected effluent start off somewhere here off the chart .

MR. BLATCHLEY: It's not off the chart. It's off the lower break.

MS. ALEXANDER: Okay. Off the lower break. And then you have the disinfected effluent starting off down here and you have given this erratic pattern, they gradually converge at a point almost at the end of your study period here right before the six on the timeline and then they cross. So would it be fair to say that during all

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of the time frame prior to this convergence right

before the six, in fact, the level in the undisinfected sample is higher than in the disinfected sample?

MR. BLATCHLEY: Yes, it is, but I would say at three days you're pretty close.

MS. ALEXANDER: You're pretty close, but then you get further apart again, right?

MR. BLATCHLEY: Yes.

MS. ALEXANDER: By pretty close the distance between these two, between the disinfected pink dots and at approximately time equals three days and the gray triangle at that same point is somewhat further than the distance at T equals 144, which is day six when they have converged and crossed in the other direction, is that correct?

MR. BLATCHLEY: Sure.

MS. ALEXANDER: And would it be fair to say -- can we summarize that for the vast amount of this time except for toward the end of day five leading to day six the undisinfected numbers are substantially higher than the disinfected numbers?

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MR. BLATCHLEY: The undisinfected numbers are higher.

MS. ALEXANDER: Okay.

MR. TIPSORD: Mr. Harley.

MR. HARLEY: Do you retain the samples in containers in your lab, is that correct?

MR. BLATCHLEY: Yes, in an incubator.

MR. HARLEY: How big were those containers?

MR. BLATCHLEY: I believe they were one liter samples.

MR. HARLEY: And how did you account for differences, for example, that would occur if they had been discharged into a water which was flowing or a water where the samples were heavily diluted, did you account for those kinds of discharge conditions at all?

MR. BLATCHLEY: Again, we collected samples from a number of different facilities and the idea was to come up with an index test that would allow us to evaluate how does the microbial community respond to all of them. So we made no

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attempt to try to characterize or mimic the differences that exist in the actual receding waters because I think that the idea there was it would have complicated the subsequent analysis. We wanted to set everyone on same playing field so we could do a direct comparison on how these things, how the microbial communities responded.

MR. HARLEY: So, for example, if you

were talking about a discharge which occurred at the Calumet Waste Water Treatment Plant into the Calumet River on the southeast side you don't know six days later where that sample would be in relationship to where it was discharged, that would not be a factor in your evaluations, in your experiment?

MR. BLATCHLEY: Correct.

MR. HARLEY: Is it more likely that the lower numbers achieved in the disinfected samples on day one would be found closer into the facility than the samples found on day six?

MR. BLATCHLEY: That seems reasonable, yes.

MR. HARLEY: So if you want to protect the Chicago area waterways, for example,

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at the point of outfall, then the most relevant data that we would have from your experiment would be the data from zero to one as opposed to from five to six?

MR. BLATCHLEY: I'm not sure that I'll comfortable with that suggestion and I'm not an expert on the Chicago area waterways themselves in terms of their hydrodynamics, but my understanding is that the water in the waterways moves very slowly.

MR. HARLEY: Throughout the entire 70 plus --

MR. BLATCHLEY: Again, I'm not an expert on this, but the little bit of reading I've done on this does suggests that it does move pretty slowly.

MR. HARLEY: Thank you.

MS. WILLIAMS: Do you know how far downstream the water travels after six days?

MR. BLATCHLEY: No, I do not.

MR. HARLEY: Dr. Blatchley, are there -- I'm sorry.

MR. TIPSORD: Go ahead.

MR. HARLEY: Dr. Blatchley, are

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there other factors in the receding water that may effect the levels of -- the indicators that you measured here?

MR. BLATCHLEY: Yes, I would imagine.

MR. HARLEY: And those were not taken into account, either, in your experiment?

MR. BLATCHLEY: Again, the idea in this experiment was to have a consistent index test that could be used to compare the responses of the microbial community from many different waste water treatment facilities. So we wanted to set that as a standard that all of these tests were subjected to.

MR. HARLEY: Thank you.

MR. ETTINGER: Did you study or consider what any of the causation elements would be here that might lead to levels -- Did you look at the causation that lead you to these numbers?
MR. BLATCHLEY: No, again, these were empirical observations.
MR. ETTINGER: Okay. So sitting here you have no idea why the numbers went one way or the another because of the various CAWS?

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MR. BLATCHLEY: I guess I'm not quite sure how to answer your question, but I guess the general answer would be no.
MS. TIPSORD: Ms. Alexander.
MS. ALEXANDER: One question to clarify. Did the level in the sample disinfected with ultraviolet ever regrow to a point that was higher than the level in either of the undisinfected samples?
MR. BLATCHLEY: I guess in the data that is present in table three, which is what I guess you're referring to. I guess I don't see any examples of where that is so, but, again, the data that is presented in those tables represent an average of four experiments that were conducted in each facility. So I don't know, I don't recall all the details of all the numbers that went into this table.
MS. ALEXANDER: Do you have any reason to believe that there is data that's not presented in this table that indicates that the samples at T equals 144 for the effluent disinfectant with UV were ever higher than the samples of undisinfected effluent either with or

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without?
MR. BLATCHLEY: I'm going to give you kind of a -- how would I characterize this response? Part of the motivation for doing this study was that there had been -- there is concern that exists in the literature as to the potential for a process called photoreactivation and another process called dark repair that would follow UV irradiation.
It's also clear in the literature that microorganisms or microbial communities can repair sub lethal damage to any form of stress, at least, in theory. So our goal, one of our goals in these experiments was to evaluate to what extent was that repair going to be important with respect to UV and with respect to chlorine. In the literature, there does seem to be for whatever reason, let's say, more concern associated with photoreactivation and dark repair. In other words, the repair and recovery process is more associated with UV than it is with the similar processes that would accompany

chlorination/dechlorination or virtually any other disinfectant. So we wanted to explore whether

that was really a valid concern. And my interpretation of these data is that repair and regrowth is important with all disinfection processes.

MS. ALEXANDER: Okay. But I need to refer back to my original question. You have identified some concerns that you believe exists in the literature, but I'm asking the question specifically about the results of your study. And I'd like to know, did you ever find in any instance, whether it's reflected in this table or not, that at T equals 144 the levels in the sample disinfected with UV were higher than the levels in the sample that was not disinfected?

MR. BLATCHLEY: I'll give you I think the same answer I did before. I don't think there is any data in table two that would satisfy that condition and I don't recall any data that went into the table that would satisfy that condition either. Does that answer your question?

MS. ALEXANDER: Yes, that does answer my question. Thank you.

MR. ETTINGER: What temperature did you keep the bottles at during the six days?

MR. BLATCHLEY: I don't remember. I'm going to guess it was nominally room temperature, but I don't know. Hang on.

MR. ANDES: It should be in the report somewhere.

MR. BLATCHLEY: Each sample was --

MR. HARLEY: Can we please clarify what he's reading from for the record.

MR. BLATCHLEY: Sure. The research that I'm referring to was sponsored by the Water Environment Research Foundation and what I'm looking at is the final report for that project and it defines -- I brought it with me just because I thought there might be questions that come about about the details of the experiments.

MR. HARLEY: Is that an exhibit at this point?

MR. ANDES: I don't believe that it is. I think it was cited in his testimony and we can certainly provide it, probably on a disc, for the record. It's not a problem.

MR. HARLEY: Thank you.

MR. BLATCHLEY: If you don't mind, I'll just read the conditions of incubation. Is

that okay?

MR. ETTINGER: Yes.

MR. BLATCHLEY: Each sample was placed in a water bath incubator at 25 degrees C

under dark conditions with magnetic stirring. Does that answer your question?

MR. ETTINGER: Dark conditions, so there was no light?

MR. BLATCHLEY: Correct.

MS. ALEXANDER: One additional question on table three, is it fair to say that in every instance at T equal zero immediately post 7 disinfection the levels of bacteria or indicators were very substantially reduced at the point of disinfection?

MR. BLATCHLEY: What do you mean by very substantially reduced?

MS. ALEXANDER: Well, I'll use examples and we can characterize it if you like, but looking at Facility B pre-disinfection levels 2.81 times 10 to the 5th, 2.16 times 10 to the 5th, disinfection levels with UV and chlorine respectfully were 495 and 715. So you go from the tens of thousands to the hundreds.

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MR. BLATCHLEY: Right. So that's roughly three log units of inactivation.

MS. ALEXANDER: Okay. Same thing for Facility D. Some numbers in the tens of thousands to a number in the hundreds and a number in the tens.

MR. BLATCHLEY: Yes.

MS. ALEXANDER: Then Facility A you have numbers near 10,000 to 55 and 9 respectfully for UV and chlorination/dechlorination and Facility C, 2400 and 1900 versus .25 and 2, would you characterize those as pretty substantial reductions?

MR. BLATCHLEY: Three or four log units of inactivation, yes.

MS. ALEXANDER: Okay.

MR. ETTINGER: I have to ask one really silly question. When you say inactivation for us guys who don't have quite the same level of education, does that mean kill or does it send someone to retirement or vacation?

MR. BLATCHLEY: What we measure in the essay that we used to quantify, for example, coliform bacteria is their ability to reproduce.

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If an organism is dead, it can't reproduce, but the opposite is not necessarily true. In other words, if an organism does not have the ability to reproduce, it does not have to be dead. So what we're measuring is it's ability to reproduce or infect a host and the term used to describe that is inactivation.

MR. ETTINGER: Inactivation means no longer reproduces?

MR. BLATCHLEY: No longer capable of reproducing or in the case of a virus, capable of

infecting a host.
MR. ETTINGER: Thanks.
MS. ALEXANDER: All right. I'm going to move on now to pre-file question nine, which concerns conclusion number three on page nine in which you state in many other developed countries waste water disinfection is not practiced. It appears the frequency of these transmissions associated with water contact is not substantially different from that in the US where waste water disinfection is common. What's the basis for that statement?
MR. BLATCHLEY: Largely personal

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experience. Does that answer your question?
MS. ALEXANDER: Yes. So do I understand correctly then that you've conducted no research to back you up that conclusion?
MR. BLATCHLEY: I've never done a survey myself if that's what you mean.
MS. ALEXANDER: Are you aware of any surveys that others have done? I don't mean personal, but published.
MR. BLATCHLEY: Yes.
MS. ALEXANDER: In this specific question to recreation -- Well, hold on one second. Are these studies concerning the frequency of disease transmission associated with recreational use?
MR. BLATCHLEY: No. They're related to -- is disinfection practiced and, if so, how?
MS. ALEXANDER: Okay. So they're related to the disinfection component of your statement, but not to the frequency of disease transmission component of your statement?
MR. BLATCHLEY: Correct.
MS. ALEXANDER: Okay. Do you have any information regarding the population of

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various water recreation activities in these countries you referred to relative to the US?
MR. BLATCHLEY: Do you mean popularity?
MS. ALEXANDER: In other words, jet skiing. Do you have any information on how many people in these countries referring to jet ski or boat or engage in any other types of water recreation their engaged on the CAWS?
MR. BLATCHLEY: Empirical observations, again, based on my own experience.
MS. ALEXANDER: Okay.
MR. ANDES: Can you expand on that?
MR. BLATCHLEY: Sure. I participated in the sport of rowing for about 25 years and part of that experience involved a club that I was a member of for a year when I lived in France on the southwest side of Paris and I would

say that the popularity of or, let's say, fraction of the population that participates in rowing in France is similar to the fraction of the population that participates in rowing in the United States, perhaps even larger.

And, again, my own personal

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experience -- I don't recall ever after having rowed for 25 years I don't recall ever getting sick as a result of that, nor I do know anybody who got sick as a result of those 25 years that I would have rowed with them.

So my own personal experience suggests that it's not an activity that leads to people getting sick and water quality where the bodies of water that I rowed on were not pristine mountain lakes. Unfortunately, rowing clubs are often times positioned in places where water quality is not consistent with a pristine mountain lake.

MS. ALEXANDER: So it would be fair to say that your experience is essentially personal of rowing, the personal experience that you are referring to?

MR. BLATCHLEY: Largely, yes.

MS. ALEXANDER: Okay. Did you have occasion to take my measurements of the bacterial quality or the bacteria content of the water in which you were rowing on?

MR. BLATCHLEY: No.

MS. ALEXANDER: Okay.

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MS. WILLIAMS: Did you know if there were undisinfected effluents being discharged in the water you were rowing on?

MS. TIPSORD: Ms. Williams, we can't hear you.

MS. WILLIAMS: Were there undisinfected effluents being discharged directly into the water where you were rowing in France?

MR. BLATCHLEY: Yes, and elsewhere.

MS. WILLIAMS: And can you explain what treatments, technologies were used.

MR. BLATCHLEY: I believe the forms of treatment that they used other than disinfection are similar to what we would use in the United States.

MR. ANDES: Secondary treatment.

MR. BLATCHLEY: Primary secondary treatment, yes.

MS. TIPSORD: Can I ask you, Dr. Blatchley, where have you rowed in France.

MR. BLATCHLEY: The club that I rowed -- that I was a member of was on the southwest side of Paris downstream of Paris along the Seine. Do you want to know other than that?

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MS. TIPSORD: Yes, please.
MR. BLATCHLEY: We participated in competition at several places in France on the Seine and actually one time at Versailles at the palace. I can assure you that the water quality at the palace at Versailles is not very good.
MR. ETTINGER: It wasn't in the 1700's either.
MR. BLATCHLEY: Correct.
MR. ETTINGER: May I suggest we hold our next hearing at that location.
MR. ANDES: No objection.
MR. ETTINGER: Let me ask a few more. Are you familiar with waste water practices in Germany?
MR. BLATCHLEY: Not in detail, no.
MR. ETTINGER: Are you familiar with the Isar River Restoration Plant?
MR. BLATCHLEY: I read a little bit about it after last weeks hearing.
MR. ETTINGER: Do you know if they disinfect there?
MR. BLATCHLEY: I believe I read about it in response to a question that you raised
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and I believe they do, yes.
MR. ANDES: If I can follow up on that, what's your understanding of reasons why they're doing that?
MR. BLATCHLEY: The assertion that I made in the report is that in general western Europe when disinfection of waste water is practiced, it's practiced when the waste water is released to either a beach or a shell fish breeding ground or some other area where direct human contact is likely. And, I believe, that's true at the facility that you're discussing.
MR. ETTINGER: Do you think the entire Isar River is a beach?
MR. ANDES: Am I correct that the plan is to have swimming areas on the Isar River?
MR. BLATCHLEY: That's my understanding, but the sum total of what I know about that facility is what I read on the web.
MR. ETTINGER: What about Dublin, Ireland?
MR. BLATCHLEY: Same thing. I believe you raised that same thing about that the facility. I believe the motivation for the use of
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the UV is the same. You're talking about the Ringsend facility, I believe, it's called.
MR. ETTINGER: Have you ever seen the Liffey?
MR. ANDES: We actually have information about the Dublin and Munich situation, which we can provided for the record.

MR. ETTINGER: How about Milan, Italy?
MR. BLATCHLEY: No, I'm sorry.
MS. ALEXANDER: And just following up on your statement --
MS. TIPSORD: Wait, Ms. Alexander. Let's mark these exhibits first.
MS. ALEXANDER: I'm sorry.
MS. WILLIAMS: Before we mark them, can we have the witness explain why, you know, what if he reviews them or what the basis is? Mr. Andes said we have this information, is it the same information that you reviewed after the last hearing?
MR. BLATCHLEY: Actually, during the last hearing.
MR. TIPSORD: And you nodded yes?

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MR. BLATCHLEY: Yes, I'm sorry.
MS. TIPSORD: I've been handed WEDECO once over in Munich, which we will mark as Exhibit Number 96. If there's no objection, seeing none, it's Exhibit 96.
MR. ETTINGER: I'm sorry. Is there a question on now or are we just passing out exhibits at this point?
MR. TIPSORD: I'm marking exhibits right now. Ringsend (SBR) Waste Water Treatment Plant Overview. This is for Dublin. I will mark this as Exhibit 97, if there's no objection, seeing none, it's Exhibit 97. And Ms. William's were you satisfied with the answer?
MS. WILLIAMS: Yes.
MS. TIPSORD: Then there is no question pending.
MR. ETTINGER: Just to complete our travel around the world, are you familiar with Madrid, Spain, whether they disinfect there?
MR. BLATCHLEY: I am not aware.
MR. ETTINGER: Tokyo, Japan?
MR. ANDES: Is someone planning to produce evidence to all of this?

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MR. TIPSORD: His question is whether he knows if they do disinfecting, not that they do disinfect.
MR. ETTINGER: I have not presented any information, though.
MR. ANDES: I'm always glad to do research for you.
MR. ETTINGER: Exactly. So to complete my question on this, Tokyo, Japan, have you looked at Tokyo, Japan?
MR. BLATCHLEY: No, I have not.
MR. ETTINGER: Thank you very much.
MS. DEXTER: Could I just ask one question? When did you spend time in France?

MR. BLATCHLEY: It was '95 and '96. Just to clarify, that's when I was on sabbatical there, but I've been back to France a number of times since then.
MR. ALEXANDER: And just to follow up on your statement earlier that you, if I understood you correctly, that you are not aware of anyone having gotten sick from that you knew from the activity of rowing, do you have any reason to believe one way or the other or to know

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whether your fellow rowers were incumono (phonetic) compromised or in otherwise part of a sensitive population?
MR. BLATCHLEY: I was not aware of anyone that I rowed with who would fit either one of those categories, but I didn't ask either.
MR. ALEXANDER: I didn't expect that you did either. Turning now to your summary of conclusions, this is -- I'm sorry. Pre-file question number 10, conclusion number four on page nine, you make the statement, you're respective of any measures that are used to control microbial inputs to the CAWS for municipal waste water treatment facilities input from other sources EGCSO's and non-point sources will remain, would you say that statement is true with respect to wet weather condition?
MR. BLATCHLEY: Yes.
MR. ALEXANDER: Okay. Do you have any basis to believe that it is true also with respect to dry weather conditions?
MR. BLATCHLEY: Yes. The influence of wet weather events does not end when the rain stops. So I would guess that, yes, that is true,

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but you need to define what dry weather conditions are.
MR. ALEXANDER: Okay. Dry weather conditions -- Well, I guess one could use a lot of definitions. Let me ask you, is there a point at which you believe the contribution of wet weather is no longer significant to microbial contamination?
MR. BLATCHLEY: I'm not sure.
MR. ALEXANDER: Would, and we're just using this for purposes of discussion, you use a time frame, approximately, you know, two days would you believe that was -- do you have any reason to believe that would not be an accurate measure?
MR. ANDES: He just said he wasn't sure.
MR. ALEXANDER: All right.
MR. TIPSORD: Excuse me, Ms. Alexander, if I may. I believe Geosyntec, and if I'm misstating this I apologize, defines dry

weather was no measurable precipitation two days before or two days after. In that context, can you answer the question?

MR. BLATCHLEY: I don't expect that the inputs to the Chicago Area Waterway System will cut off after a dry weather event completely and let me just use as an example --

MR. TIPSORD: Do you mean after a wet weather event?

MR. BLATCHLEY: Yes, after a wet weather event. I'm sorry. For example, the town that I live in, there is a large river, the Wabash River, that goes between Lafayette and West Lafayette, if it hasn't rained for a week, does the dry up? Of course, not. The flow rate in the river diminishes, but it does not go away completely. So clearly there are inputs to the river that are there continuously.

MR. ETTINGER: The groundwater.

MR. BLATCHLEY: That would be one of them, yes.

MS. ALEXANDER: Are you aware that approximately 70 percent of the flow to the CAWS during dry weather comes through the waste water treatment plants?

MR. BLATCHLEY: I've read that, yes.

MS. ALEXANDER: Do you have any

reason to believe one way or the other that the inputs that's you've identified -- I should say the impacts of the inputs you identified, the CSO's and non-point sources will be significant two days or following, you know, after two days following a rain event?

MR. BLATCHLEY: I'm not sure I'd be comfortable characterizing how long it would take.

MS. ALEXANDER: And I'm asking the question now whether you have any reason to believe that the effects of a rainfall event in terms of CSO's and non-point sources would be significant two days after that rain fall event in the CAWS, do you have any reason to believe one way or the other?

MR. BLATCHLEY: No, I don't have any reason to believe one way or the other.

MS. WILLIAMS: Can I ask a follow up because I think Ms. Alexander misspoke and you answered it, but I'd like to ask a clarifying question. I believe she asked you if you knew if 70 percent is the dry weather input from the treatment plants in this case. Do you know whether 70 percent is actually the average input

from the effluent in this system, isn't the dry weather closer to 100 percent?

MR. ANDES: It's been testified to

by other parties. He said he doesn't know one way or the other.
MS. WILLIAMS: Can we all stipulate for the record that Ms. Alexander meant to say --
MS. TIPSORD: You're lowering your voice. You have to speak up.
MS. WILLIAMS: So he doesn't have an opinion about whether 70 percent or 100 percent --
MR. ANDES: His opinion doesn't matter.
MS. WILLIAMS: But you agree with that?
MR. ANDES: No, I'm not going to agree. I'm not going to recharacterize what was already testified to. What is in the record is in the record.
MS. WILLIAMS: I think he just testified that he read that 70 percent is a dry weather flow, is that correct?
MR. BLATCHLEY: I believe that was the number that I read, yes.

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MS. WILLIAMS: Okay. So you believe 70 percent is the dry weather flow for the treatment. Would you agree with me if I were to tell you that it was closer to 100 percent in dry weather, would you believe that was accurate?
MR. BLATCHLEY: Yes, it's going to be closer, but I don't know how much closer.
MS. WILLIAMS: That's fine. Thank you.
MR. ETTINGER: Let me clarify. You have not studied the Chicago Area Waterway System?
MR. BLATCHLEY: Correct.
MR. ETTINGER: You're familiar because of your studies on disinfection and these bottles in the lab?
MR. BLATCHLEY: Among other things, yes.
MR. ETTINGER: But you're not here as an expert on the flow or anything else that specifically has to do with the Chicago Area Waterway System?
MR. BLATCHLEY: Correct.
MR. TIPSORD: Mr. Harley.
MR. HARLEY: Two, I think very

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simpler questions, I hope.
MS. TIPSORD: Mr. Harley, you need to speak up.
MR. HARLEY: I'm sorry. Two simpler questions, I hope. In terms of the microbial inputs that you used in your experiments, are Chicago area municipal waste water facilities sources of those microbial inputs into the CAWS during dry weather conditions?
MR. BLATCHLEY: Yes.

MR. HARLEY: Are Chicago area municipal waste water facilities sources of those microbial inputs during wet weather conditions?
MR. BLATCHLEY: Yes.
MR. HARLEY: Thank you.
MS. ALEXANDER: I'd like to follow up now referring to page seven of your pre-file testimony. This is the second full paragraph that begins with the words the system. It states the system is defined by the Tunnel and Reservoir Plan, TARP, has yielded substantial improvements in water quality in the CAWS. It is likely that additional water quality improvements will result in the completeness of the TARP. However, this

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facility will not accomplish complete capture of waste water from CSO's, therefore, CSO events will continue to take place in the greater Chicago area, moreover, non-point source contributions to the CAWS will be largely uninfected by TARP? First question, what is the basis for your statement that CSO events will continue to take place in the greater Chicago area post TARP.
MR. BLATCHLEY: I think you had a pretty graphic illustration about that a week and a half ago.
MS. ALEXANDER: Is TARP completed?
MR. BLATCHLEY: No. I'm going to guess that it would not matter what stage of development TARP was in. The volume of water that was imposed on Chicago during that storm event would overwhelm any control system. And the point that I'm trying to make is that you can't design -- it's not practical to design any hydrologic control facility that will deal with all possible events. There's always a risk that some event will exceed what you've designed for. Look at New Orleans.
MR. ETTINGER: Not a particularly

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good example of a well designed system.
MR. BLATCHLEY: That's true. But they were content with it for a long time.
MS. ALEXANDER: Is it your belief that when TARP is completed there will be fewer CSO's than there are currently?
MR. BLATCHLEY: Yes.
MS. ALEXANDER: Have you taken any steps to quantify how much less, how many fewer CSO events there will be upon completion of TARP?
MR. BLATCHLEY: No.
MS. ALEXANDER: Okay. Do you have any basis other than events in the last couple of weeks to believe one way or the other or to be able to quantify one way or the other how many CSO events there will be post TARP completion?
MR. BLATCHLEY: No, but, again, the

point that it will never be zero.
MS. ALEXANDER: Okay. Have you taken any steps, yourself, to quantify other non-point contributions to the CAWS?
MR. BLATCHLEY: No.
MS. ALEXANDER: Are you aware one way or the other of any quantification that's been
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done of non-point contributions?
MR. ANDES: We will have other witnesses on that.
MS. ALEXANDER: Okay. And I'm asking Dr. Blatchley if he's aware of any.
MR. BLATCHLEY: No.
MS. TIPSORD: Ms. Alexander, if you're done with that line of questioning we're going to take about a ten-minute break.
MS. ALEXANDER: Okay.
MR. TIPSORD: Let's take ten minutes.
(Whereupon, a break was taken after which the following proceedings were had.)
MS. TIPSORD: I think we're ready to go back on the record. Dr. Blatchley, are you ready?
MR. BLATCHLEY: Yes.
MS. TIPSORD: Ms. Alexander?
MS. ALEXANDER: Yes.
MS. TIPSORD: Okay.
MS. ALEXANDER: I'm sorry. Just give me one moment. I'll ask the question and we
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can locate the statement if we need to, but this is pre-file question 11 and the question concerns the January 2007 article. It's Attachment 3 to Exhibit 93, the study that you co-authored and published on that date in which you state at the end in situations where direct human contact is likely or suggestive of indigenous or microorganisms that have near -- outfall area is likely. It appears that the disinfection of municipal waste water may yield some direct benefits. That's the statement I am looking to mark, but do you recognize that as a statement that you made in that article?
MR. BLATCHLEY: Yes.
MS. ALEXANDER: Is this statement referring to conventional disinfection as you have defined it in your testimony?
MR. BLATCHLEY: No. I'm referring to disinfection that would be more extensive in terms of the extent of disinfectant exposure.
MS. ALEXANDER: Are you referring to disinfection that would be as extensive as the standards being applied in California that's discussed in your testimony?

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MR. BLATCHLEY: The reuse standard?
MS. ALEXANDER: Yes.
MR. BLATCHLEY: Potentially.
MS. ALEXANDER: Are you referring to a larger universe, a range of disinfection than that or are you saying purely that the reuse standard would be beneficial?
MR. BLATCHLEY: No, I'm not saying that the reuse standard would be the standard to use here. What I'm suggesting is that there is a range of disinfection applications and I would expect that a more appropriate standard to apply here for effluent disinfection would be associated with more extensive inactivation or more extensive disinfectant exposure than would be required to meet the proposed standard.
MS. ALEXANDER: I'm referring now specifically here to your statement in the research where you stated it appears that disinfection of municipal waste water may yield some direct benefits. I believe you're testifying now that as one example of that, the disinfection to the reuse standard would yield some benefits, is that correct?
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MR. BLATCHLEY: Yes.
MS. ALEXANDER: Would disinfection to a lesser standard than the reuse standard yield some benefits?
MR. BLATCHLEY: In the general sense, yes, but I think you need to ask what is the extent of that benefit and what is the cost of that benefit.
MS. ALEXANDER: What I'm trying to do, Dr. Blatchley, is just to make sure we understand what you meant by that statement that disinfection may yield some direct benefits. Are you agreeing that disinfection that is less than disinfection to the reuse standard is included in that statement?
MR. BLATCHLEY: Potentially, yes.
MS. ALEXANDER: Okay. Would disinfection to the level proposed by IEPA also be included in that statement that disinfection of municipal waste water may also yield some direct benefits?
MR. BLATCHLEY: In my view, the disinfectant exposure that would be required to satisfy that standard would yield a marginal
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improvement in microbial quality.
MR. ANDES: If I can follow up on that? Dr. Blatchley, do you stand by your statement immediately above that in the paragraph, the conventional disinfection commonly practiced in the US is probably not as effective in

preventing communicable disease transmission as is generally assumed?

MR. BLATCHLEY: I believe that's true.

MR. ANDES: Thank you.

MS. ALEXANDER: But would you also agree that disinfection to that level may yield some direct benefit as opposed to no direct benefits?

MR. BLATCHLEY: Ideal and absolute, that's my nature and I would say the benefit would be greater than zero, yes.

MS. ALEXANDER: Okay.

MR. ANDES: If I can follow up on that? When you talk about the difference between the reductions that conventional disinfection may make with regard to fecal levels versus what it will do to control other pathogens --

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MR. BLATCHLEY: The issue is how do coliform bacteria in general, fecal coliform bacteria compare to microbial pathogens and the information that I've provided and that's available widely in the literature make it very clear that coliform bacteria is more sensitive to most disinfectants including chlorine and UV and ozone than are the vast majority of microbial pathogens.

MR. ANDES: So is it fair to say that treating for 400 using conventional disinfection may not do much to remove pathogens in the waterway?

MR. BLATCHLEY: I believe that's correct.

MR. ANDES: Thank you.

MS. TIPSORD: Mr. Harley, you have a follow up?

MR. HARLEY: In what time frame?

MR. BLATCHLEY: Actually, the dose response data referred to an immediate response. In other words, if you were to perform this experiment at the bench and we do that just because we have much more controlled conditions

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there, then you would measure the viability or infectivity immediately after exposure. Now, that's going to require a day of incubation or something like that, but the point is that you're measuring immediately. It's not the same thing as this incubation test as I referred to before. Does that answer your question?

MR. HARLEY: If that's the case, why six days?

MR. BLATCHLEY: There were a number of factors that went into six days. Among them, how many experiments could we complete with the financial resources that were made available to

us. We wanted to be able to evaluate several different facilities that had different forms of treatment that they were using. We wanted to be able to replicate those samples and we wanted to perform a period that we thought was meaningful.

MR. ANDES: Meaningful in the sense of that the purpose of the test, if I'm correct, was not to evaluate the immediate effects of disinfection, but rather to evaluate repair and regrowth?

MR. BLATCHLEY: Right. And as you

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can see here what we observe is that after period of roughly a week that there is not very much to differentiate the disinfected and the undisinfected sample. And in some cases it's less than a week where we get to that case. So it's a judgement call on our part that we felt if we incubated for 144 hours or six days that that would give us most of the information that we needed.

MS. TIPSORD: And for the record, Dr. Blatchley, when you say what we see here you were pointing to what is Exhibit 95?

MR. BLATCHLEY: Correct.

MR. HARLEY: Just one more follow up. In terms of Exhibit 95 in the context of the quote in pre-file question 11 when you're referring to the near outfall area, is it correct that the most -- the results which would most commonly replicate near outfall areas are the results which are located from zero to one day?

MR. BLATCHLEY: Those are some vague terms. Clearly, you are going to be closer to the outfall as you get closer to T equals zero. And, you know, how close you are to the outfall depends

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on the average velocity in the stream and how long you allow it to wait. So I'm not sure that I can define it any more clearly than that. I'd be guessing.

MR. HARLEY: And if you're looking at that period, the zero to one day period, it would still be your testimony that the reductions would be nearly marginal?

MR. BLATCHLEY: Reductions --

MR. ANDES: In what?

MR. HARLEY: Microbial pathogens.

MR. BLATCHLEY: I belive that's true, yes.

MR. TIPSORD: Ms. Alexander.

MS. ALEXANDER: Yes. And just to follow up with sub question B from question 11, do you have any reason to believe one way or the other that people are not engaging in water recreation near the outfalls?

MR. BLATCHLEY: No.

MR. ANDES: So, in other words, you have no knowledge one way or the other?
MR. BLATCHLEY: Correct.
MS. ALEXANDER: And you also have no knowledge one way or the other of whether anybody who is recreating in those locations might ingest water in the course of their activities?
MR. BLATCHLEY: Actually, I would guess that occasionally they do.
MS. ALEXANDER: Okay. Now, turning to pre-file question 12, this concerns a further statement in your conclusions to the January 2000 study that is Attachment 3 that in applying any disinfectant it is critical the strike a balance between minimizing risks associated with microbial pathogens and then associated with disinfection bi-products and the latest and tocological issues. And the question is, does UV disinfection create, to your knowledge, a significant level of disinfection bi-products?
MR. BLATCHLEY: I can provide you a generalization. UV disinfection generally is regarded as providing fewer disinfection bi-products than conventional chemical processes such as chlorination/dechlorination or ozonization. However, there are circumstances where there are disinfection bi-products that are generated by UV or radiation using germicidal UV radiation.
MS. ALEXANDER: Have you done any work to quantify those levels?
MR. BLATCHLEY: Yes.
MS. ALEXANDER: So I would be correct in understanding that that work has indicated that those levels are lower than levels of disinfection bi-product using chlorination?
MR. BLATCHLEY: Generally.
MS. ALEXANDER: Can you identify the work that you have done, are though published peer review studies?
MR. BLATCHLEY: Yes and no. So let me clarify. Yes, we performed a study that was published in '97 in the journal called Water Research and I think we presented it at a conference where we collected waste water effluent samples, undisinfected waste water effluent samples and, again, disinfected them at the bench so we could control disinfectant exposure and then we perform toxicity studies using an organism called sariodapia nubia using a fairly standard toxicity essay and we observed -- we basically did empirical observations of how these organisms responded to the disinfected effluent samples. Is that what you're asking about?

I'll just clarify the general results. All disinfectants that we evaluate which included chlorine, bromine, ozone and UV have the ability to influence the toxicological response as we measured it with the essay that we just described. In some cases that toxicity response goes up, meaning it's more toxic. In some cases, it's goes down and there tends to be not only a site specific, but also a time dependant variability that is associated with that. In other words, you don't get the same response every day at a facility and if you compare facilities, you get different responses there as well. But, in general, we observed less -- there was less likelihood that there would be an increase in toxicity associated with UV than there was associated with either chlorination/dechlorination or ozone.

MS. ALEXANDER: Okay.

MR. ANDES: And we have copies of that report.

MS. ALEXANDER: Do you have it now.

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Can we have that marked?

MR. ANDES: Surely. We also have copies of the chart, which I believe is Exhibit 95.

MS. TIPSORD: Correct. Here's the report and there's Exhibit 95. I've been handed a handout dealing with waste water effluent toxicity by Blatchley, et al. I'm looking for a date.

MR. BLATCHLEY: The upper right.

MS. TIPSORD: 1997. And I will mark this as Exhibit 98 if there's no objection. Seeing none, it's Exhibit 98. And to be clear for the record, the chart was admitted as Exhibit 95.

MS. ALEXANDER: I'm not obviously going to take the whole time to read the study while we sit here. If you'll give me a moment to review the abstract and I will continue with my questions.

MR. ANDES: It's pretty exciting.

MS. ALEXANDER: It is.

MS. TIPSORD: Ms. Alexander, if you'd like to finish with your questions and come back to this after lunch after you've had a chance to review it --

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MS. ALEXANDER: Yes, that's what I would like to do. Moving to pre-file question 13, how prevalent would you say disinfection is in waste water treatment, generally?

MR. BLATCHLEY: In the United States?

MS. ALEXANDER: In the United States.

MR. BLATCHLEY: I'd say it's fairly

common.
MS. ALEXANDER: Okay. What, if any, major municipalities in the nation and we'll put a number on that, population over about a million, are you aware of in the nation besides Chicago that are not currently disinfecting their effluent or are under orders to begin doing so?
MR. BLATCHLEY: I believe there are a number of facilities that practice seasonal disinfection which means for roughly half the year they don't disinfect.
MS. ALEXANDER: That's not my question, though. I mean what municipalities in that category are you aware of that do not practice any disinfection and are not under any
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orders to do so?
MR. BLATCHLEY: I'm not aware of them.
MS. ALEXANDER: Okay. Do you have any knowledge of how many communities in Illinois are practicing disinfection?
MR. BLATCHLEY: I do not.
MS. ALEXANDER: Okay. What method of disinfection is currently most common in the country?
MR. BLATCHLEY: In the United States.
MS. ALEXANDER: In the United States.
MR. BLATCHLEY: I believe it's chlorination/dechlorination.
MS. ALEXANDER: Are there any facilities that are using ultraviolet?
MR. BLATCHLEY: Sure.
MS. ALEXANDER: Okay. And other than those you've mentioned, chlorination/dechlorination and ozonization, are there any other methods of disinfection currently in use in the United States that you're aware of?
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MR. BLATCHLEY: I believe there's a small number of facilities that use bromine and there are probably some other methods of disinfections that are out there, but I think they're just a small fraction.
MS. ALEXANDER: Okay. That is going to conclude my questions for now. I'd like to review the study over lunch as you've suggested, but we can move on to the other questioners.
MS. TIPSORD: Okay. That takes us to the IEPA.
MS. DIERS: Stephanie Diers from the Illinois EPA and I'm going to begin with question one of our pre-file questions. Why would the conditions of disinfection that are required to yield a low concentration of viability coliform

not guarantee a low concentration of microbial pathogens?
MR. BLATCHLEY: The reason really is coliform bacteria are generally more sensitive to disinfectants, meaning chlorine, ozone and UV are commonly used disinfectants than are most microbial pathogens -- so the conditions that are required to accomplish effected inactivation of

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coliform bacteria do not necessarily guarantee that the microbial pathogens will have been inactivated effectively.
MS. DIERS: And, number two, is it your testimony even if waters are disinfected, those who come in contact with the disinfected water can still get sick?
MR. BLATCHLEY: Yes.
MS. DIERS: Can you just further explain that?
MR. BLATCHLEY: Sure. There is the potential for microbial pathogens to exist and that potential will always be there. So if humans are exposed to those pathogens, then they run the risk of becoming ill. My understanding is that the risk that exists right now is low.
MR. ANDES: With respect to the CAWS?
MR. BLATCHLEY: With respect to the recreational use of the CAWS, yes, I mean canoeing, kayaking, that sort of thing.
MS. DEXTER: What's the basis for that understanding?
MR. BLATCHLEY: Geosyntec did a risk

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assessment, my reading of that risk assessment were that the risks were low.
MS. DEXTER: And that's the risks we have before us?
MR. BLATCHLEY: I believe so, yes.
MS. DIERS: What would a high risk be in your opinion?
MR. BLATCHLEY: I'm sorry. I'm reluctant to provide you with a number because I just don't know the numbers well enough to know what high and low would be.
MS. DIERS: I'll go to question three. How might chlorination/dechlorination of UV irradiation be detrimental to water quality in terms of bacterial composition?
MR. BLATCHLEY: Again, that refers to Exhibit 95 and the studies that would relate to that where we evaluated the long-term response of the microbial community post disinfection. And under some circumstances, we observed that water quality was actually worse post disinfection than it was if we had done nothing at all.
MS. DIERS: And when you say some

circumstances, can you give me an example of those
circumstances?
MR. BLATCHLEY: We were not able to establish a cause and effect relationship, again, these were empirical observations, but, again, they were empirical observations that were done with effluent samples from several different waste water treatment facilities and we observed that in some cases, water quality, again, was worse post disinfection than if we had done nothing at all.
MR. TIPSORD: Mr. Harley, you have a follow up?
MR. HARLEY: To clarify, you're talking about the water qualities in your one liter samples in your lab, correct?
MR. BLATCHLEY: Correct.
MR. HARLEY: You're not talking about ambient water quality, correct?
MR. BLATCHLEY: Correct.
MR. HARLEY: Thank you.
MR. TIPSORD: Ms. Diers.
MS. DIERS: I'll go to question number four. With respect to the conventional disinfection, what recent research are you referring to on page five of your pre-file testimony?
MR. BLATCHLEY: That research, again, is the work that we did that was sponsored by the Water Environment Research Foundation.
MR. ANDES: If I can clarify, reports based on that research are included. One was Attachment 3 to your testimony, I believe. There were several reports that were generated as a result of that research.
MR. BLATCHLEY: There was three. There was a journal article, an article that was published in the Journal of Water and Environment Research. There was a proceedings article where there was a conference that was held in Arizona, the conference was called Disinfection 2005, because it was held in 2005, where those results were presented and then there is the report that I read from earlier, the full report.
MS. DIERS: And the report is going to be provided to the group on CD, is that correct?
MR. ANDES: Yes.
MS. DIERS: And are the other two that you mentioned, are they already in the record?
MR. BLATCHLEY: I think so.
MR. ANDES: The Water and Environment Research article was Attachment 3 to his testimony.

MS. DIERS: Right.
MR. ANDES: The other article I am not sure whether we've provided yet. I know it was cited, but I have copies of the other article if that is -- if the people are interested in that, too, we have copies of that as well.
MS. TIPSORD: We're interested in everything and I want to personally thank you in getting to 100.
MR. ANDES: I'd be glad to.
MR. TIPSORD: I've been handed Effects of Waste Water Disinfection on Human Health, again, Blatchley, et al.
MR. BLATCHLEY: Just as a point of clarification, you're certainly welcome to read all three of them, but just so you know what you're getting into. This report, the full report, is fairly verbose I have to say because I wrote it. Maybe that's not a cause and effect

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relationship. But, anyway, generally as you move towards the proceedings article and the referee journal article, the nature of those publications is such that there's less room for verbosity, if that's a word. There are severe restrictions on what you can publish as you move up the line so the referee journal article is an abridged version of this where a lot of the information that is presented here is simply omitted. There just wasn't room for it.
MR. TIPSORD: We will mark Effects of Waste Water Disinfection on Human Health as Exhibit 99, if there is no objection. Seeing none, it's Exhibit 99.
MS. DIERS: I'll move on to our pre-file question number five. On page eight of your pre-file testimony, you state that it is unlikely that the disinfection process as applied to CSO's or non-point sources will yield substantial reductions in the risk of disease transmission associated with water bourne microbial pathogens, why is this unlikely?
MR. BLATCHLEY: The effectiveness of a disinfection process is going to depend on a

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number of things, including the quality of the water that you impose on that disinfection process. In a general sense, the water that is going to come from a CSO is likely to have poorer water quality than the effluent that would go into a disinfection system at a waste water treatment facility and it's going to have poorer water quality in terms of a couple general, let's say, bulk parameters that we might use to characterize that water quality. That would include the concentration of particles that's present in the water as well as the concentration of dissolved

chemicals that might be present in the water. Irrespective of the disinfectant that you use, those two things are both going to diminish the effectiveness of a disinfection process.

The dissolved chemicals will represent a source of demand for the disinfectant, whether that disinfectant is a chemical or an agent like UV radiation and the particulate matter that is present is going to provide shelter for those microorganisms against the disinfectant.

MS. DIERS: I'm going to go to number nine. You state in your pre-file testimony

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that chloroform bacteria are poor indicators of disinfection ethiticity. Is this because they are easy to kill (or inactivate with chlorine)?

MR. BLATCHLEY: Yes.

MS. DIERS: And what would be a good indicator of disinfection ethiticity?

MR. BLATCHLEY: Again, as I stated before, an alternative approach would be to use perhaps more than one indicator and to use design criteria that restricts or stipulates a minimum standard that the actual disinfection must meet in terms of it's physical characteristics.

MS. DIERS: I'm going to move on to our pre-file question 12. Define minimal improvements in viral composition in control of protozoic pathogens may also be quite minimal as you use these phrases on page five of your pre-file testimony.

MR. BLATCHLEY: Okay. Just for reference, this study, the work study, was -- the central questions that we addressed in that study were, number one, should we be disinfecting municipal waste water effluents and then under the assumption that the answer to that question is

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going to be at least some times yes, then how?

Those are really kind of the focal points and so the specific disinfectant that we examined in that study were chlorination/dechlorination and UV irradiation. Chlorine is really not very effective at all for controlling protozoan pathogens. It's almost useless for controlling organisms like criptosperidum parvan or geordialadia (phonetic). So the effectiveness of chlorine against those pathogens is really -- I mean it's an issue because it's so ineffective. On the other hand, UV is very effective against those specific microorganisms and UV is a fairly broad spectrum antimicrobial agent, but there are some microorganisms, some microbial pathogens that do not respond well to UV exposure, meaning that they are not very sensitive to it. They are able to withstand relatively large doses and still be

viable. And an example of that is adenovirus. So there are some microbial pathogens and I think most of them are viral that seem to be resistance to UV exposure.

So in the study that we did, rather than evaluate human or viral pathogens, what we did was evaluate the response of some coliphage. These are bacterial viruses, meaning that they're viruses that infect human bacterial hosts rather than human tissues and what we observed is that under the conditions of conventional disinfection that correspond to either chlorination/dechlorination or UV irradiation that we really didn't accomplish effective inactivation of those phage in those experiments. So UV accomplished something on the order of two log units or two orders of magnitude inactivation and chlorine, the conditions of chlorination/dechlorination accomplished something like one order of magnitude change and when we talk about control of microbial pathogens, we're oftentimes interested in four or five log units of change in the concentration of those pathogens.

MS. DIERS: I'll move on to 16. On page five of your pre-file testimony, you state the populations of microbes in disinfected water will change with time. Many microbes have the ability to repair sublethal damage and therefore can repair post disinfection. What do you mean by populations?

MR. BLATCHLEY: Okay. Just to clarify, I think the issue is really the microbial community and how it responds. Have I answered your question? I'm not sure.

MS. ALEXANDER: I was going to ask if you could further explain about what you just said with the community?

MR. BLATCHLEY: Again, referring to Exhibit 95, what we examined was how the microbial community responded in general and we observed that some times the microbial community appeared to be worse post disinfection than if we had done nothing at all.

MS. DIERS: Moving on to pre-file question 17. Are prepared microbes as infectious as pre-disinfected microbes?

MR. BLATCHLEY: When I first read that question, my first thought was great question. So the general answer is I don't know, but let me elaborate a little bit. The essay that we performed to evaluate, for example, how coliform bacteria responds is one where we look for their ability to grow. In other words, to multiply, to reproduce. And we make no

distinction as to whether they're wounded and able to reproduce or whether they're 100 percent healthy, whatever that means.
We're simply looking for their ability to reproduce. If we had done this essay on bacterial pathogens, you could do the same study. We chose not to. Largely because I didn't want to be growing bacterial pathogens in my lab, but if we had done that, then we would have used very similar essays that looked only for the ability to reproduce or not reproduce and so that essay doesn't really tell you anything about the ability of those organisms to infect, but I would assume that if it has the ability to reproduce under the conditions of this essay, then it does have the ability to infect, but that's an assumption on my part.
MS. DIERS: I'm going to skip down to number 22 on the pre-file questions.
MR. HARLEY: I'm sorry. Could I ask a really quick follow up to that? So in terms of the disease causing potential post disinfection, we really don't know the answer to that question?

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MR. BLATCHLEY: I don't.
MR. HARLEY: Okay.
MR. ANDES: Let me follow up on that. You're using as a surrogate bourne effectivity the ability to reproduce.
MR. BLATCHLEY: The ability of fecal coliforms to reproduce.
MR. ANDES: Right. So the logic is if they reproduce, they have the ability to infect?
MR. BLATCHLEY: Yes.
MR. ANDES: And you don't know of any reason why that would be untrue of repaired fecal coliform versus unrepaired?
MR. BLATCHLEY: Correct.
MR. ANDES: Thank you.
MR. HARLEY: I think the microbial pathogens --
MR. BLATCHLEY: Right. I think the fecal coliforms are largely non-pathogenic. So I think the question and maybe I'm reading too much into this, but I think the question is that your interest is with microbial pathogens that exist in the water and how their responses might compare to

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those of fecal coliforms, for example. Is that where you're going?
MR. HARLEY: Yes.
MR. BLATCHLEY: And the answer is, I don't know. We did not investigate any microbial pathogens and their ability to either repair subject to this type of essay or their ability to cause infection in humans which would obviously be

more complicated to investigate.
MR. HARLEY: So in this situation, you use fecal coliform to --
MR. BLATCHLEY: Yes.
MR. HARLEY: But in other situations, you made a clear distinction between fecal coliform and microbial pathogens?
MR. BLATCHLEY: Yes.
MR. ANDES: With respect to the ability to cause illness.
MR. BLATCHLEY: Yes.
MS. DIERS: Going back to our pre-file question 22. On page three and four of your pre-file testimony you state, although coliform bacteria are usually plentiful in untreated municipal waste water, they are easily

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inactivated by waste water disinfectants such as chlorine, ozone and ultraviolet UV radiation as compared with many microbial pathogens. As a result, the conditions of disinfection that are required to yield a low concentration of viable coliform bacteria will not guarantee a low concentration of microbial pathogens. Is there an indicator organism that if removed will guarantee a low concentration of microbial pathogens?
MR. BLATCHLEY: I'm not aware of one.
MS. DIERS: Pre-file question number 23. On page four of your pre-filed testimony, you state disinfection systems used in municipal waste water treatment applications range from no infection at all to conditions that accomplished inactivation of nearly all microbial pathogens. For purpose of this testimony, the term conventional disinfection will be used to describe municipal disinfection systems that are designed to limit viable coliform concentrations to several hundred CFU 100 ML. On the spectrum of disinfection systems use for treatment of municipal waste water these systems deliver modest

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disinfection doses and accomplish modest microbial inactivation. If one wants to reduce microbial pathogens to make the water safer for recreation, is conventional disinfection a sufficient way to do those?
MR. BLATCHLEY: In my opinion, no.
MS. DIERS: And can you elaborate on that?
MR. BLATCHLEY: Again, the results of the work that we did as well as the results that have been reported in the literature by others indicate that the conditions that are required to accomplish that microbial standard, for example, 400 CFU's per 100 ML requires fairly modest exposure to disinfectants. The one result

of that is a fairly modest control of microbial pathogens because they are less sensitive to the disinfectants that we use than are the indicator organisms that are the basis of the regulation.
MR. TIPSORD: Mr. Harley.
MR. HARLEY: So would this subject in your mind that, in fact, a more stringent numeric limit may be appropriate to control microbial pathogens?

MR. BLATCHLEY: In general, yes. It depends where you are, what the water use is going to be, what the water quality issues are. That sort of thing. But in a general sense, yes.
MR. HARLEY: So it's possibly that Illinois EPA proposal of 400 colony forming units didn't go far enough?
MR. ANDES: Answer the question specifically with respect to recreational use.
MR. BLATCHLEY: It doesn't go far enough with recreational use, but it also doesn't go far enough in the sense that it does nothing to control other sources of microbial pathogens.
MR. ANDES: When you say it doesn't go far enough, you're saying that it doesn't reduce risk, it doesn't reduce pathogen levels?
MR. BLATCHLEY: It doesn't reduce the pathogen concentrations as much as we would like to for this type of exposure.
MR. ANDES: Let me clarify. The disinfection requirements that you've talked about in terms of, say, California are for other uses such as irrigation.
MR. BLATCHLEY: Right.

MR. ANDES: And they have extensive disinfections?
MR. BLATCHLEY: Yes. Far more extensive than would be required to meet these standards.
MR. ANDES: So these standards, in essence, will do nothing for pathogen reductions in the CAWS or very little?
MR. BLATCHLEY: It's not they will do nothing. It's that they will do very little.
MR. ANDES: And if you chose the other level, like in California, it would cost five to ten times as much?
MS. WILLIAMS: Objection.
MR. ANDES: Am I correct?
MS. WILLIAMS: I object to what he's testifying.
MR. ANDES: I'm just asking if that's your testimony.
MR. BLATCHLEY: I believe that's correct. If you were to apply Title 22 standards here to this sort of disinfection it would cost

five or ten times more.
MR. TIPSORD: More than --

MR. BLATCHLEY: More than would be required to meet the proposed standards.
MS. TIPSORD: Thank you.
MR. HARLEY: But isn't there something, a standard between 400 colony forming units and essentially detection limits that might be appropriate to safeguard recreational users?
MR. BLATCHLEY: Can we clarify? The questions is are you asking whether there is some kind of treatment requirement in between conventional and extensive inactivation that can be applied here? You can always pick a number in between. The question is there something associated with it in terms of the treatment.
MR. HARLEY: In response to your question for clarification, your witnesses testimony had suggested 400 colony forming units may not be appropriate because of the microbial pathogen component of the effluent, but the only alternative that he really explores in the testimony is the California standard, which is not recreational and which is set in a very, very low level, which is non-detect. Isn't there any standard in between that might be set as a numeric

limit that might be appropriate for recreational use.
MR. ANDES: It's a numeric limit that people would treat to.
MR. BLATCHLEY: I think the way you qualified that with the word might is how I would state it. Yes, that's possible, but I don't know what the number is.
MR. HARLEY: But 400 colony forming units, it's your testimony is not enough and the standard that would be appropriate would more likely be lower.
MR. BLATCHLEY: Yes.
MR. ANDES: So let me ask you this. Since you laid out the California process as one that would effectively treat most pathogens, is there some technology out there that treats pathogens some but not all the way or are we talking about you kill them or you don't kill them?
MR. BLATCHLEY: Well, there's never going to be -- Again, disinfection is not the same thing as sterilization. You're never going to get to a situation where the risk is completely

eliminated and a decision is going to be made at some point as to what is an acceptable risk. Does that answer your question?
MR. ANDES: Is there some technology

off the shelf that you would say "Well, here's moderate disinfection," we've talked about disinfection conventional and we've talked about extreme disinfection in California. I think the question is is there some moderate, medium disinfection out there?

MR. BLATCHLEY: Sure. There is an entire spectrum. It is a continuum effectively. You can design anywhere in between what would be conventional disinfection and Title 22 disinfection. You can do it anywhere in that spectrum.

MR. ANDES: And the question is where is that in terms of what would that do to reduce your pathogen levels, you're still going to have pathogen levels?

MR. BLATCHLEY: Sure. And, in general, as you move towards Title 22, there would be less risk associated with microbial pathogens?

MR. HARLEY: Thank you.

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MR. TIPSORD: Ms. Diers.

MS. DIERS: Moving on to pre-file question 28. On page seven of your pre-file testimony you state, moreover non-point source contributions to the CAWS will be largely uneffected by TARP. Therefore, irrespective of the effluent disinfection constraints that are imposed on the District's facilities, the potential for inputs of microbial pathogens from other sources will still remain. These inputs to the system will limit the extent to which risk of disease transmission for microbial pathogens can be used in the CAWS. My first question is to what non-point sources are you referring to?

MR. BLATCHLEY: Well, CSO's to start with, but just runoff from, you know, whatever, parking lots, roofs. I suppose there's some grass areas around as well.

MS. DIERS: So you consider a CSO a non-point source?

MR. BLATCHLEY: No, I'm sorry. I would not. I would consider a CSO to be a point source.

MR. ANDES: Here, when you're

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talking about other sources, you included CSO's?

MR. BLATCHLEY: Yes. They are certainly sources of microbial pathogens.

MS. DIERS: Do non-point source contributions have the same risk associated with bacteria as does non-disinfected effluent?

MR. BLATCHLEY: I don't know.

MS. DEXTER: Would you expect that runoff that comes from a roof or a parking lot would have bacterial or pathogenic composition of undisinfected sewage effluent?

MR. BLATCHLEY: I wouldn't drink either. That's a really difficult question to answer. I don't have an answer. I'm sorry. I would not expect, for example, run off from a roof to be sterile. That's a great way to get sick.
MS. DEXTER: Comparatively.
MR. BLATCHLEY: Right. And I don't know.
MS. DIERS: Our question 28 and 19 kind of overlap. So I'm just going to ask the last part of pre-file question 19. Do you believe generally the presence of CSO's and non-point sources is sufficient reason to conclude that

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disinfection of waste water treatment plant effluent is ineffective or unnecessary?
MR. BLATCHLEY: That contributes to it.
MS. DIERS: Okay. Our pre-file question 29. On page seven of your pre-file testimony you state, a related point that the development of disinfection processes for CSO's and non-point sources represent a difficult engineering challenge. In your opinion, does the Illinois EPA proposal require -- Strike that. Does the Illinois EPA proposal require disinfection of CSO's and non-point sources?
MR. BLATCHLEY: Not that I know of.
MS. DIERS: Would the effluent disinfection proposal represent a difficult engineering challenge?
MR. BLATCHLEY: Conceptually, I don't think it's -- the extent of disinfectant exposure that would be required is not an unusual one, what is unusual is the scale. And my guess is -- I mean I haven't done the engineering design on this, but my guess is the complicating issues associated with a system that would satisfy the

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proposed standard would be largely associated with this scale and maybe the location and lack of space and those sorts of issues, but, again, I have not looked into the details of how it would be implemented in Chicago.
MS. DIERS: Just a moment, please. I think just one more question. I think it relates back to when we were talking about Exhibit 95. And I'm not sure I was following what you were saying about the acidic acid. Can you explain how you were using that again in your research?
MR. BLATCHLEY: Sure. The objective of these experiments was to mimic what would happen in a receding stream when the effluent is discharged in a receding stream. So among the things that the microorganisms that are discharged to the receding stream are going to see are some

partially reduced substrates. In other words, food. So what we wanted to do -- and that food is going to be different in every receding stream, but for the same reasons that I talked about before we wanted to come up with a standard essay, a standard test that we could with all of these

things that would allow us to compare the results directly.

So based on a review of the literature, we decided that acidic acid at a concentration of about 15 milligrams per liter would be not only chemically representative of the reduced -- partially reduced substrates that would exist in a receding stream, but also would be representative of the concentration that we might expect to see those substrates in receding streams.

MS. DIERS: So did you add the acidic acid substrates to the disinfected samples?

MR. BLATCHLEY: Yes.

MS. DIERS: I have nothing further.

MS. TIPSORD: Are there any additional questions for Dr. Blatchley?

MS. ALEXANDER: Not at this time. I will have some after the lunch break.

MS. TIPSORD: I didn't want to necessarily take lunch this early, but we'll take an hour for lunch. We'll be back at 1:00 and finish with Dr. Blatchley so we can move on to Dr. Dorevitch.

STATE OF ILLINOIS.)
) SS.
COUNTY OF COOK)

I, STEVEN BRICKEY, being a Certified Shorthand Reporter doing business in the City of Chicago, Illinois, County of Cook, certify that I reported in shorthand the proceedings had at the foregoing hearing of the above-entitled cause. And I certify that the foregoing is a true and correct transcript of all my shorthand notes so taken as aforesaid and contains all the proceedings had at the said meeting of the above-entitled cause.

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STEVEN BRICKEY, CSR
CSR NO. 084-004675