In The Matter Of:

In the Matter of the NorthMet Project
Permit to Mine Application - 60-2004-37824

Evidentiary Hearing before Judge LaFave
March 28, 2023
Volume 2 - 3-28-23

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BEFORE THE OFFICE OF ADMINISTRATIVE HEARINGS
OF THE STATE OF MINNESOTA
FOR THE DEPARTMENT OF NATURAL RESOURCES
EVIDENTIARY HEARING - VOLUME 2 - MARCH 28, 2023

In the Matter of the NorthMet Project
Permit to Mine Application

OAH DOCKET NO. 60-2004-37824

Met, pursuant to Notice, at 9:00 a.m. in the morning at the Office of Administrative Hearings, 600 Robert Street, St. Paul, Minnesota, on March 28, 2023.

BEFORE: JUDGE JAMES LAFAVE
REPORTER: LISA A. BLANKS, RPR, CSR, CRR

APPEARANCES:

Minnesota Department of Natural Resources
Jon W. Katchen, Bryson C. Smith, Holland & Hart

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PolyMet Mining, Inc.
Monte A. Mills, Aaron Knoll, Farah Famouri, Greene Espel, Jay C. Johnson, Kathryn Kusske Floyd, Venable LLP

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MCEA, Friends of the Boundary Waters Wilderness, Duluth for Clean Water, Center for Biological Diversity, Friends of the Cloquet Valley State Forest, Save Our Sky Blue Waters and Save Lake Superior Association (collectively the Conservation Organizations)
Ann E. Cohen, Melissa Lorentz, Heidi Guenther

***

Water Legacy
Paula Maccabee

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Fond du Lac Band of Lake Superior Chippewa
Frank Holleman, Vanessa Ray-Hodge, Sonosky, Chambers, Sachse, Endreson & Perry
Sean Copeland, Ian Young
Fond du Lac Band Attorneys

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WHEREUPON, the following proceedings were duly had and entered of record, to wit:

I N D E X - V O L U M E

JUDGE LAFAVE: Good morning. My name is Jim Lafave. I'm the administrative law judge from the State Office of Administrative Hearings, and we've reconvened for day 2 in the evidentiary hearing in the matter of the NorthMet Project Permit to Mine Application. This is OAH Docket Number 60-2004-37824. I would remind folks to please silence their cell phones.

Mr. Radue, I remind you that you are still under oath, sir.

Mr. Holleman, you may proceed with your cross.

MR. HOLLEMAN: Could I ask one housekeeping question first, Your Honor?

JUDGE LAFAVE: Yes, sir.

MR. HOLLEMAN: So we had, obviously, opening statements at the beginning of the hearing. Do you anticipate that you'll give us time for closing statements at the end?

JUDGE LAFAVE: If you'd like the opportunity, I'd be happy to allow for closing statements.

MR. HOLLEMAN: Okay. Thank you. I'll get back to you.

JUDGE LAFAVE: Very good. You may

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proceed.
MR. HOLLEMAN: Thank you.
TOM RADUE,
called as a witness herein, having been previously sworn to speak the whole truth and nothing but the truth, was examined and testified as follows:
CONTINUED CROSS-EXAMINATION
BY MR. HOLLEMAN:
Q. And good morning, Mr. Radue. I promise this isn't the Hotel California. You can't check out anytime you want, but you will be able to leave eventually, and I only have a few short questions for you.
So, first, I wanted to make sure I understood some of your testimony from yesterday. Is it your testimony that you were not involved in the water flow modeling through the flotation tailings basin?
A. No, my testimony was that I did not perform the modeling.
Q. Thank you.
And did I understand correctly, for that reason, you can't really speak to the details of what was included in the model?
A. Not to all the details, no.
Q. Okay. Thank you. That's helpful.

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So now I'd like to look more specifically at some of the elements of your prefiled testimony. So in your direct prefiled testimony, page 56, lines 904 to 915, you describe the role that organic matter can have in ponds, including specifically the role of the growth of algae in the Sibley Quarry in Michigan.
So am I correct that you don't know the rate of water seepage through the algae layer in that quarry?
A. I do not.
Q. And am I correct that you don't know the hydraulic conductivity of that layer of algae?
A. I do not.
Q. When discussing what materials were in the Sibley Quarry, and this is specifically on lines 912 to 913, you say that there was "granular drainage material" in the quarry. Am I right about that?
A. That's correct.
Q. So that granular drainage material, that isn't flotation tails, correct?
A. It is not.
Q. And that material isn't, to your knowledge, regulated under the Minnesota Reactive Mine Waste Rule; is it?

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A. It is not.
Q. Thank you.
So now flipping to another portion of your direct testimony, this is page 46, line 724 to 726, and I believe you say that "The methods proposed for the project's bentonite amendments mimic the approach normally required at solid waste management facilities in Minnesota and other states."
Am I correct that none of these facilities you had in mind are nonferrous metallic mining facilities?
A. That's correct.
Q. And am I correct that the solid wastes at the management facilities you had in mind are not reactive mine waste?
A. That is correct.
Q. And as a result, is it your understanding that none of those facilities were governed by the Reactive Mine Waste Rule?
A. That is correct.
Q. Now, flipping to yet another portion of your testimony; this time, your rebuttal testimony. On page 20, lines 374 to 376, you describe the mixing of cement with coal ash at a basin where you were

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the senior geotechnical engineer. That cement wasn't creating a barrier to prevent the infiltration of water into the coal ash; was it?
A. It was not.
Q. Is it correct that that cement was being mixed to stabilize the coal ash in the basin?
A. That is correct.
Q. Thank you.
I'd like to point to another example; this now on pages 24 to 25 of your rebuttal testimony. This is on lines 457 to 459, and you say that you had personally observed the injection of powdered lime into wastewater treatment plant sludge. And this lime was not being injected to create a barrier of water infiltration into the sludge; was it?
A. It was not.
Q. And am I correct that it was also being injected to stabilize the sludge?
A. That is correct.
Q. And as a general matter, neither coal ash nor wastewater treatment plant sludge are reactive mine waste; are they?
A. That is correct.
Q. One question further on your prefiled testimony. On

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page 64 of your direct prefiled testimony, lines 1063 to 1066, you say that LTV fine tailings and slimes "could be used in place of bentonite if the latter did not meet performance expectations." PolyMet has never provided any description of how it would apply LTV fine tailings and slimes as a cover on the flotation tailings basin; has it?

A. Not to my recollection.

Q. To your recollection, is this the first time that anyone has ever proposed using LTV fine tailings and slimes for this purpose?

A. I don't know the answer to that.

Q. Okay.

MR. HOLLEMAN: That concludes my cross-examination. Thank you.

JUDGE LAFAVE: Thank you very much. Ms. Maccabee.

MS. MACCABEE: Thank you, Your Honor.

CROSS-EXAMINATION

BY MS. MACCABEE:

Q. Good morning, Mr. Radue. I'm Paula Maccabee, and I represent WaterLegacy. Let's start by just talking a little bit about the existing tailings basin. We use the phrase "tailings basin" as a term of art.

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Isn't it correct that the LTV tailings basin is actually an elevated land form like a hill?

A. It is, that's correct.

Q. And I'm going to show you now, it's a schematic drawing from the final EIS. Let's get there. That is page 0715517 in the EIS. So this is the schematic drawing. And can you see -- isn't it correct that these three cells are the LTV?

A. That's correct.

Q. And isn't it also correct that cell 2W is taller than the other two cells, cell 1, which is in the front, which is south; and cell 2, which is in the back, which is north, on the eastern side of cell 2W?

A. That is correct.

Q. And isn't it correct that by the time the flotation table clearing space is built out, that that flotation tailing space will be about the same size, the same height as -- rather, as cell 2W?

A. That is correct.

Q. And, now, let's turn to the next page. I want to get a few more details to make sure I understand it in the record.

Looking at the highlighted portion -- and isn't it correct that the cell 2W is the largest cell, with about 14 -- 1450 acres?

A. That's what it says there. That sounds about right.

Q. And it also says there that cell 180 is about 900 acres. Is that about right, too?

I'm sorry, 980 acres. I misspoke.

A. That's what it says. It sounds about right.

Q. And for cell 2E, where it says here it's at 620 acres, does that also sound about right, based on your knowledge?

A. It does.

Q. And when the flotation basin is completed, the NorthMet flotation basin's plan is to cover both cell 1A and 2B, correct?

A. That is correct.

Q. Now, let's look at the permit to mine application, and that is Exhibit 210.

And that's the one right there, the Lidar, which is 65451.

So if you could scroll that down a little bit.

Have you seen this drawing before?

A. I have not.

Q. Are you familiar with how to read a cross-section like this?

A. I am.

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Q. Okay. And looking at this cross-section from the permit to mine application -- and you can see the writing is pretty small -- but the data is taken from 2010 and 2011. Can you see that, Mr. Radue?

A. Where are you looking?

Q. I'm looking at the notes on the bottom left.

A. Okay, I see them.

Q. And so would this have been at least about ten years after the LTV plants ceased operations?

A. That's correct.

Q. Okay. And let's look back at the -- if you could scroll up again so we can see the field illustration.

Is it correct that the taller outline, where it says "tailings," that is a depiction of the cell 2W at the existing tailings basin?

A. Again, where are you looking?

Q. The taller outline, right in the middle there -- where it says "tailings," but that is a depiction of the existing cell 2W?

A. It may be. I see no indication of where this cross-section is located, so it's difficult for me to say.

Q. Well, you know the site, don't you, Mr. Radue?

A. I do.

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Q. And so you can see that the existing surface on the west -- on the east side, there is a taller surface, and there is a lower surface, and then there's a higher surface.
Does that help you get oriented a little bit to the direction from where the plot (ph) is taken? It's based on the fact that you know the site.
MR. MILLS: I'm going to object on foundation to all the questions about this document. He says he's never seen it before.
MS. MACCABEE: Your Honor, he said he knew how to read a Lidar document, and he said yesterday in conversation with Mr. Katchen that he's familiar with the site itself.
JUDGE LAFAVE: The objection is overruled.
You may answer, if you know.
THE WITNESS: Would you scroll up so I can see the bottom of the picture again? Typically, there would be a plan B that would show where this cross-section was taken. So I don't know where this cross section was taken.
BY MS. MACCABEE:
Q. Just looking at this cross-section, you said you

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can't tell where it is. Is that what you're saying? You don't know the site well enough to determine that the tailings on the site in the permit to mine application include the LTV on a -- existing cell W on the western side and the existing cell 1E on the eastern side, you don't know the site well enough to make that decision?
MR. MILLS: Object to form, foundation.
JUDGE LAFAVE: Go ahead, Ms. Maccabee.
THE WITNESS: I can see it's a cross-section of the same.
JUDGE LAFAVE: Please wait until we rule on the objection, sir.
Ms. Maccabee.
MS. MACCABEE: I'm just asking the witness if, based on his understanding of the site, he can identify the forms there because of his knowledge of the site and knowledge of the location of cell 2W and cell 1E in the permit to mine application.
JUDGE LAFAVE: The witness can answer, if he knows.
THE WITNESS: Well, I can see it appears to be a cross-section of the site with tailings indicated in the cross-section. I just don't know

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where, geographically, that cross-section is at the site.
BY MS. MACCABEE:
Q. And you would say -- you would understand, though, that the taller end form of tailings would be the cell 2W, just based on what we discussed, correct?
A. Yes.
Q. And you can see to the right side, which, directionally, is east, that that lower tailings would be the cell 1E, based on your knowledge of the geometry of the sites.
A. Agree.
Q. And you can see that line, the dark blue line, and it says -- it has the words on it, "surficial groundwater." And you would agree that that term would refer to the level of water in the tailings, correct?
A. That's what it would suggest.
Q. And you understand, don't you, based on your own knowledge of the site, that the surficial groundwater does not reach to the top of cell 2W, correct?
A. That's correct.
Q. And you also understand, based on your knowledge, as well as just reflected on this image, that surficial

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groundwater does reach to the top of cell 1E, correct?
A. There is a pond in cell 1E, and surficial groundwater may reach to the top of 1E.
Q. Which would read, just from your own experience, which has also been depicted here, you'll notice in the diagram that the tailings used in cell 1E are saturated -- I'm sorry, the tailings beneath the pond on cell 1E are saturated?
A. It's a reasonable conclusion, yes.
Q. And from this drawing, if you look -- maybe you can make it a little bit larger so that the numbers on the sides are a little bit easier to read. There you go.
And I'm blowing this up just to let you see, because those are -- you can see on the right side, those are -- are you familiar enough to know that those numbers reflect mean feet above sea level?
A. The scale on the right-hand, yes.
Q. And so just looking at that scale, this makes it look like cell 1E is about 90 feet shorter than the tallest point of cell 2W.
Is that consistent with your understanding?

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A. That's reasonable.
Q. Now, if we could turn to the next page of the excerpt here, and that's also from the permit to mine, and that is, in the record, number 67113. And you can see the highlighted language, "Based on the difference in the site of flotation tailings elevation from current elevation of 1570 feet." And that 1570 feet, does that reflect, then, the starting point for the north dam that is going to be built for the flotation tailings basin?
A. I don't recall the exact elevation. It's in the ballpark.
Q. So, in other words, based on your knowledge, 1570 is the right ballpark, or the starting point. And so cell 2E right now would be about 170 feet lower than cell 2W. Just doing the math, from, you know, 1740 minus --
A. It's about right.
Q. Now, just turning to the next page of this excerpt, which is in the record as 67128, and looking at the highlighted numbers, that -- are these also consistent with your understanding that the final dam crest elevation of the flotation tailings pond would be about 1,732 feet?
A. Yes.

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Q. And there's also an emergency overflow inlet elevation of 1,729 feet, correct?
A. Yes.
Q. And is it correct that the elevation, the target elevation of the pond is lower than the dam crest to avoid going into the emergency overflow level and discharging water through that emergency overflow channel?
A. Yes.
Q. And is it correct that the beach -- so that is correct that the pond elevation target that is about 1,723 feet, correct?
A. Yes.
Q. And is it also correct that the target beach length will be 625 feet?
A. That is correct.
Q. And is that target beach length also intended to provide -- to prevent either overtopping or use of the emergency overflow?
MR. MILLS: Objection, Your Honor. We've been patient, waiting for us to get to bentonite here. I think we've got enough background. I don't know what -- overtopping is beyond the scope of this proceeding. I don't know why we're focused on all this.

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JUDGE LAFAVE: Ms. Maccabee?
MS. MACCABEE: Your Honor, there's a great deal of discussion about the need to maintain the pond. This record contains quite a bit of information, including information from Mr. Radue, about the need to pump water from the pond to avoid changing the pond edge or overtopping. And so this is just establishing the basis of what the parameters are supposed to be, and that provides some context for his own testimony about the necessity of pumping the pond in order to prevent overflow.
JUDGE LAFAVE: But how does that relate to the issues at the hearing?
MS. MACCABEE: It relates to the issues at hearing, Your Honor, because there are several witnesses who have testified in -- several experts who have testified in the record that the only way to avoid either drying out the pond or overtopping would be to have continuous pumping. And that this is one of the important questions about bentonite: Can it maintain a pond? And if so, is it going to require pumping the water both in and out?
JUDGE LAFAVE: Say that again, please.

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MS. MACCABEE: In order to understand the question of whether bentonite will be a feasible and practical alternative at closure, Mr. Radue has already testified that they're pumping water into the existing LTV ponds and pumping the water out. And so part of this is to establish what's the hydrology going to be like for the flotations ponds once the pond is in closure and has the bentonite amendment? And it's one of the issues that is really important to see whether this pond is going to be practical and workable to satisfy the Reactive Mine Waste Rule.
JUDGE LAFAVE: Explain to me why the water going in and out affects the bentonite amendment.
MS. MACCABEE: Two different things. There's one -- there's the question of the hydrology: Will the pond be maintained, and will it require water pumping into it to be maintained? And there's another question: If the bentonite is -- rather than some other kind of alternative, is keeping water at the top, does care have to be taken, in perpetuity, in order to avoid the kind of problems that result in either discharge

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or pumping?
JUDGE LAFAVE: Isn't that one step beyond the issue we're being asked to address, I'm being asked to address?
MS. MACCABEE: Your Honor, I don't believe it is one step beyond. I believe it's a part of the issues that you're being asked to address, because we're trying to figure out what is going to happen. How is this pond going to work?
JUDGE LAFAVE: We've had several discussions about admissibility of evidence and what evidence is relevant.
I have stated that, and ruled, that this -- and I've been very clear, I think, that this hearing is limited solely to the issues as set forth in the Amended Notice of Hearing.
I've allowed additional evidence in as context, which I think is important to understand the effect of the bentonite amendment and how it will work. And I find that that is helpful for me to understand context and for me to do my job.
I'm also able to determine what's relevant, what's not relevant, and what weight to give to the evidence.
That said, I will allow a little of this,

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but don't make a meal out of it.
MS. MACCABEE: Thank you, Your Honor.
BY MS. MACCABEE:
Q. So I will ask one more question, and we can move on. Is it correct that -- I think you already said that the -- talked about pond elevation. Is it correct that the target beach length will be 625 feet?
A. That is correct.
Q. And the parties have used the phrase "flotation tailings pond" in this record.
Isn't it correct that the predicted size of that flotation tailings pond is more than 900 acres?
A. My testimony, I believe it says 905 acres.
Q. Okay. And I'm going to -- this is just for demonstrative. I'm going to show you a picture from the Department of Natural Resources. I don't know, are you familiar with Bde Maka Ska, which is Minneapolis' largest lake?
A. I am.
Q. If you want to scroll down a little bit lower, the other way, according to the DNR, Lake Fond Du Lac is 419 acres. Do you see that?
A. I see that.

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Q. Assuming that's correct, would you agree that the pond enclosure would have an acreage larger than twice the size of Bde Maka Ska?
MR. MILLS: Objection. Again, we're spending time on things that aren't at issue. It's a 905-acre lake, he's testified. Comparing it to Maka Ska seems beyond the scope of this.
JUDGE LAFAVE: Ms. Maccabee?
MS. MACCABEE: Your Honor, there are experts, consultants in the record that refer to it as a lake, and I wanted to get some context. That's all. It's not a really big point. It's just one question.
JUDGE LAFAVE: The objection is sustained. Please move on.
BY MS. MACCABEE:
Q. I would like to call your attention now to Attachment 1 in PolyMet's Exhibit 30. And this contains some historic images of the tailings basin. And if you want to look at a 1972 photo.
It's correct -- looking at that photo, there are tailing ponds on most of cell 2W, and cell 2E had not been developed yet, correct?
A. That's correct.
Q. May I turn to the 1989 photo, which is still when

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LTV is in operations, correct?
A. Yes.
Q. And, again, there are ponds on cell 2W, as well as on 1E and 2E, correct?
A. Yes.
Q. I'd like to ask if we could turn to Exhibit 328, which has some additional photos of the tailings basin, historically. If you go one more page, that is the image from DNR, and that is from the year 1981 (ph). I think it shows at the top.
And at that time, there was also ponding on top of cell 2W, correct?
A. Yes.
Q. And now we turn to the next page, which is from the 2009 EIS, and everything is really well-marked. And this time, this is a picture taken for the PolyMet Draft Environmental Impact Statement, which was published in 2009.
And would you agree that there's no pond on cell 2W, but there are ponds on the two other cells, correct?
A. That's correct.
Q. And it's correct that this is about eight years after the plant shut down, correct?
A. What was the date of this photo?

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Q. If you could make it a little smaller -- it's the draft EIS, which is 2009.
A. Eight years is about right.
Q. Now, turning to the next image, which is from 2013, which is the supplemental draft EIS. And you can see there, in that situation, in that -- at that time, there was no ponding on cell 2W, and also it looks like a very small pond on cell 2E; is that correct?
A. That's correct.
Q. And you would agree that since closure in 2001, the existing LTV tailing space has not consistently maintained a pond on cell 2W, correct?
A. That is correct.
Q. And also, just from your understanding, as well as looking at these images, it's correct that the ponding on cell 1E and 2E has been variable; sometimes it's been a bigger pond, and sometimes a smaller pond, correct?
A. That's correct.
Q. Isn't it correct that since 2011, ponding has been collecting seepage from the southern part of the LTV tailings basin and pumping that seepage into cell 1E, in order to comply with the consent decree for the existing tailing space?

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A. They've collected a small amount of seepage, yes.
Q. And that seepage, when they collect it, is pumped into cell 1E; is that correct?
A. That's correct.
Q. Thank you.
And showing your testimony on page 52, I think it is lines 843 to 845. Would you agree that, in typical years, PolyMet must pump several hundred million gallons of water from basin to manage annual pond rise and pond-edge encroachments on required setbacks from dam crests?
A. That's correct.
Q. And going back again just a little bit, didn't you also testify that PolyMet does this pumping and manages water levels in cell 1E and cell 2E to maintain required pond-edge setbacks from the dam crests, and that this is in accordance with the Legacy dam safety permit?
A. That is correct.
Q. Do you know at what time of the year pumping is done to manage the pond rise and pond-edge encroachment under existing conditions?
A. Typically, not frozen conditions.
Q. Does it have seasonal variation in terms of being more in the spring than in the late summer or early

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fall?
A. I don't know the answer to that.
Q. That's just not something that you're familiar with, correct?
A. I don't have the detailed documents on that.
Q. Just if we could flip back real quickly to Exhibit 328, I have one more question. And if you look at -- make it pretty big because you have to read the words "emergency basin outflow."
If you're looking at this drawing, this illustration, which is from the final EIS, it's in Exhibit 28. It is PDF page 11. Is that blue indication on the left, the emergency basin alcove, the place from which the water is discharged when it's necessary to pump water to maintain the pond?
MR. MILLS: Objection. We're wandering outside the scope again. The emergency basin outflow isn't really an issue. I tried to be patient with this, but we haven't heard about bentonite in quite a while.
JUDGE LAFAVE: Ms. Maccabee.
MS. MACCABEE: This is the last question on that issue.
JUDGE LAFAVE: What's the relevance?
MS. MACCABEE: I'm just trying to figure

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out where the water's going. That's all. But I can move on.
JUDGE LAFAVE: The objection is sustained.
BY MS. MACCABEE:
Q. Would you agree with -- just one more slide, and this one has to with hydrology, too. And this is from Exhibit 34, the DNR's project update slide, at page 4. One more slide.
In this DNR project status update, can you see the third bullet point, "Cell 2W surface water drainage to cell 1E via outlet structure, and into groundwater water via seepage." Do you see that?
A. Yes.
Q. Is that consistent with your understanding that under existing conditions, there is also surface water drainage that is pumped from cell 2W to 1E?
MR. MILLS: Objection. We're just continuing to run outside the scope with all these questions.
MS. MACCABEE: Your Honor, this one is not outside the scope at all, because this witness has said that the bentonite may not be needed at the time the flotation tailings basin is complete

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because the existing pond may -- the existing LTV cell 1E retains the pond.
JUDGE LAFAVE: The objection is overruled.
You may proceed.
THE WITNESS: Would you repeat the question, please.
BY MS. MACCABEE
Q. Sure. Looking at the DNR project status update, the third bullet point, do you agree with DNR's statement that Cell 2W surface water drainage to cell 2E and 1E via outlet structures is also going into the ponds in 1E, as well as groundwater, via seepage?
A. The -- all the structure from cell 2W to 1E is filled with tailings. I don't know to what extent it is any longer functional. I have not personally observed drainage from cell 2W into cell 1E via the outlet structure. There may be -- there may be (mic glitch) more seepage.
Q. So you would agree that there is groundwater seepage, and you don't really have enough personal knowledge about whether there is spilled water flowing through the outlet structure; is that correct?

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A. Let me expand that. I have also not observed any seepage from the west -- excuse me, the east side of cell 2W into cells 1E and 2E. There is no surface seepage from cell 2W into 1E and 2E. And, likewise, I have not observed drainage through the drainage structure.
Q. Okay. And is it also correct that at closure, where the tailings space is all approximately the same height as cell 2W, the role of cell 2W in augmenting water flow to ponds will change?
If you don't know the answer, please -- I'm sorry, I should have asked you whether you know the answer.
A. Would you clarify? Did you say "augmenting the ponds"?
Q. Mr. Radue, do you know how the hydrology will change for the pond in cell 1E at closure, when the flotations tailing basin is approximately the same height as cell 2W?
A. Well, the hydrology will continue to have precipitation into 1E and 2E, will continue to have evaporation, and will continue to have runoff from the east. Higher ground to the east will not have runoff from cell 2W into 1E and 2E.
Q. Thank you.

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Now, if we could turn to Exhibit 284.
This is an email string, including an email that you sent to Dana Dostert, DNR senior engineer for dam safety, on June 6, 2017. Do you see that?
A. I see that.
Q. And in your role as principal engineer, were you in communications with Donald Sutton, the subcontractor to DNR's consultants, EOR, regarding the bentonite amendment, as well as regarding other stability issues that are outside the scope of this hearing?
A. This email indicates some communication with Don Sutton.
Q. Let's first look at -- this is down in the PDF. There's a lot of this that has nothing to with bentonite, so I'm skipping over.
So let's turn to PDF page 6, which is record number 266095. And if you make it a little larger -- you can see this is Mr. Sutton's highlighted language, and you can read the part, "If it is not managed, then depending on the bentonite efficacy, the pond could either periodically dry up or overfill."
Do you agree that management will be needed at the flotation tailings basin pond, depending on bentonite efficacy?

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A. Yes, the system is designed to manage water level at the pond.
Q. And that system will include necessarily pumping water in and pumping water out at different times?
A. That may be required, yes.
Q. And do you also agree Mr. Sutton says a little further that "Climate change makes precipitation predictions 100 to 200 years from now impossible, so the design needs to assume the worst case."
That's his statement. Do you agree that climate change makes predictions of future precipitation at the tailings basin, at best, uncertain?
A. I have no opinion as to what climate change may affect.
Q. Fair enough.
And Mr. Sutton also says that -- in this -- "If the water level drops lower than designed due to higher infiltration rates or lower precipitation, geochemistry assumptions will change as the tailings dry out and oxidize."
Do you agree, that without active management, if the water level drops lower, it could either -- it could change the geochemistry that was modeled?

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MR. MILLS: Objection, scope. We're not talking about bentonite.
MS. MACCABEE: That's exactly what we're talking about. Mr. Sutton is talking about depending on the bentonite's efficacy and what the effects would be on the geochemistry modeling, which is precisely what we're talking about in this case.
JUDGE LAFAVE: The objection is overruled.
You may answer.
BY MS. MACCABEE:
Q. Do you need the question to be reread again?
A. Yes, please.
Q. So you see Mr. Sutton's sentence, "If the water level drops lower than designed due to higher infiltration rates or lower precipitation, geochemistry assumptions will change as the tailings dry up and oxidize."
Do you see that statement?
A. I do.
Q. Do you agree that if the water levels are lower than designed, either due to climate change or bentonite efficacy, that it will change the geochemistry assumptions?
A. Well, the reason there was a water appropriations

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permit from Colton Lake is to avoid that very situation.
Q. And the mention of water appropriation from Colton Lake, is the intent meant to pump water from Colton Lake in order to make sure that this problem that Mr. Sutton identifies won't happen?
A. If this issue were to occur, there are accommodations to resolve it.
Q. And that accommodation is pumping water from Colton Lake to make up for -- to make the pond achieve the desired height, correct?
A. That's my understanding, yes.
Q. And do you agree that -- with Mr. Sutton, that that is -- the situation of verifying the pond height and putting water in, if necessary, is likely to be perpetual?
MR. MILLS: Objection. How the pond works, as she's -- Ms. Maccabee has identified her theme here, is not in the scope of this proceeding. We're not talking about bentonite here.
JUDGE LAFAVE: Ms. Maccabee?
MS. MACCABEE: Let me rephrase.
BY MS. MACCABEE:
Q. Do you agree that, over time, the pond bottom bentonite plan is likely to require maintenance

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either to pump water in or pump water out perpetually?
A. My understanding is there's a future point in time where passive treatment is required.
BY MS. MACCABEE:
Q. So -- I'm sorry?
A. So I don't know if that requires pumping water in or out.
Q. So maybe just to clarify. At least until passive treatment is approved, the bentonite plan for the pond would require maintenance -- "perpetual maintenance" is probably too strong a word, but would require maintenance until a passive treatment system was eventually approved?
MR. MILLS: Objection. We're outside the scope. Perpetual maintenance isn't at issue here.
JUDGE LAFAVE: Sustained.
BY MS. MACCABEE:
Q. Just one more point of clarification.
Is it correct that there's nothing in this record that has approved a specific time when passive maintenance would be provided or allowed?
MR. MILLS: Same objection, outside the scope.
JUDGE LAFAVE: Ms. Maccabee?

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MS. MACCABEE: Just getting a clarification of the witness' last statement, Your Honor.
JUDGE LAFAVE: The objection is sustained.
BY MS. MACCABEE:
Q. Now, let's turn to your rebuttal testimony, at lines 1019. We can start at 1022. That's fine. And it's in response to -- in your rebuttal testimony, you say that Dr. Benson's use of the term "potential" in evapotranspiration, in the environs of the NorthMet site, is misleading or confusing because he doesn't discuss annual precipitation. Do you recall that testimony?
MR. MILLS: Objection, misstates the testimony.
JUDGE LAFAVE: Ms. Maccabee, please rephrase your question.
BY MS. MACCABEE:
Q. In your testimony you said Dr. Benson's use of the word "potential" in front of evapotranspiration causes confusion relative to the common comparison of evapotranspiration, not potential evapotranspiration.
Do you remember that testimony?

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A. I do.
Q. And you recall -- and you recall that you explained that in the area of the NorthMet actual -- in the NorthMet project, actual annual precipitation exceeds actual evapotranspiration by 4.5 to 5.7 inches; is that correct?
A. Yes.
Q. And these numbers of actual precipitation and actual evapotranspiration are an average over the course of seasons; aren't they?
A. They are the values presented by the DNR.
Q. Do you know whether they're averaged over seasons or averaged over years, Mr. Radue?
A. What I presented here is an annual value.
Q. And then you further testified -- and let's look at your testimony in -- right at the bottom there -- that there are -- even when you're considering actual precipitation and actual evapotranspiration, there are periods of the year, including portions of the summer, when precipitation would be frequent or lacking, making it possible in summer months for the ground to dry to some depth below the surface, which will vary from year-to-year based on site-specific conditions. Do you remember that testimony?
MR. MILLS: Objection, misstates the

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testimony.
JUDGE LAFAVE: Ms. Maccabee?
MS. MACCABEE: No, it doesn't. I'm reading from the testimony.
MR. MILLS: I stand on the objection.
JUDGE LAFAVE: Please restate -- please re-ask your question.
BY MS. MACCABEE
Q. Looking at your testimony --
MS. MACCABEE: Do you want to show him the entire screen?
BY MS. MACCABEE
Q. Would you agree, even when you're talking about evapotranspiration, there are periods of the year when much of the vegetation is dormant and precipitation is in the form of snow, rather than rain, and periods of the summer when precipitation would be infrequent or lacking, when the atmosphere has a greater capacity to hold moisture than there's moisture available?
A. Yes, I'm speaking here about potential evapotranspiration.
Q. And potential evapotranspiration reflects a potential that at some times in the year, the ground may dry out; is that correct?

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A. What I'm stating here is that the atmosphere has greater capacity to hold moisture than moisture may be available.
Q. And would you agree that it is possible -- perhaps this is in the next section -- continue.
If you look at lines 1036 to 1038 -- this may be the source of confusion.
And you would agree that it is possible in summer months, even if the actual precipitation year-round is higher than evapotranspiration, that the ground will dry to some depth beneath the surface, and that will vary from year to year, correct?
A. Yes, that's correct.
Q. Do you have any knowledge about whether, if the ground dries out from year -- at different portions of the year, that would affect wet-dry cycling in bentonite?
A. I provided in my testimony the reasons that wet-dry cycling is not a concern here. I stated the information of all the characteristics of bentonite attracting water. I talked about the thick -- the cover or the bentonite-amended layer.
I believe I've spoken about the limited penetration of the plants at the site.

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Q. Well, let's take it one step at a time. Just looking at this --
MR. MILLS: Objection. She didn't let the witness finish his answer to her question. She interrupted him.
MS. MACCABEE: Your Honor, I asked a very narrow question. I'm going to get to other issues. I just asked if he said that it's possible that the ground dries to some depth, that that would affect wet-dry cycling. I didn't ask for the whole thing.
JUDGE LAFAVE: The objection is overruled.
Please do let the witness finish their answer. You may proceed with your question.
BY MS. MACCABEE:
Q. Mr. Radue, I just asked a narrower question. We'll get to some of the other issues, which are important, later.
But looking just at the question of whether you said that it is possible in the summer months for the ground to dry to some depth below the surface, would you agree that that creates a potential for wet-dry cycling of bentonite?
If you don't agree, that's fine. But this is yes or no. Do you agree or not?

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A. You know, so I guess I disagree (ph).
Q. I want to go over some of the numbers in this case, and I hate to do this, but I want to make sure I understand them all. Just looking at these numbers in row 1, do you agree that the unamended dam size and beaches in the percolation model is 7.7 inches per year in the permit to mine application?
A. It's my understanding, yes.
Q. And looking at the second row, would you agree that the inlet permeability of unamended tailings in this application -- and I think this is based on the geotechnical data report -- is 2.4 times 10 to the minus 3?
A. That's what it says.
Q. Would it help you to look at one of the pages to confirm that that's actually the correct number?
A. I'll take this --
MR. MILLS: I'm going to object to foundation. She hasn't identified and explained to the witness what she's showing him. She's just showing him numbers and asking him to agree with them.
JUDGE LAFAVE: Please restate your question.

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BY MS. MACCABEE:
Q. Mr. Radue, I'm showing you Exhibit 349, which is intended to give compilation of numbers from the water modeling data package, the Waste Characterization Data Package, the geotechnical data package, and the permit to mine application, and all of those data packages were appendices to the permit to mine application. Are you familiar with those documents?
A. Yes.
Q. And what I'm going to do is ask you, if there's any of these numbers that you're not immediately familiar with, I'm going to -- please say you're not familiar, and we can double-check and make sure with the documents from the record whether they're all correct or whether there are issues that we have to deal with.
So with that in mind, would you agree that 2.4 times 10 to the 3rd is the in-lab permeability of unamended LTV coarse tailings? And if not, we can go look at the correct page and make sure that you are comfortable with that number.
A. It sounds about right.
Q. Let's look real quickly at PDF 4, which is -- that is the permit to mine application, that's a page

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from the permit to mine application, and it is page 65611. You can see the top left -- Maybe do you want make it a little bit bigger so it's easier to read.
The conductivity in-lab permeability of LTV SMC coarse tailings is 2.4 times 10 to the 3rd; is that correct?
A. I see that, yes.
Q. And the dam size and slopes before the bentonite is amended, their conductivity would be approximately the in-lab conductivity number that we just discussed, the 2.4 times 10 to the negative 3?
A. That's correct.
Q. And then let's go back to the first page and make sure we got the rest of the numbers that we talked about. We've talked about the number of 5.56 times 10 to the negative 6 that adds the permeability not to be exceeded, according to the water model, correct?
A. That was the values in the water modeling, yes.
Q. And those are values that you came up with that you are familiar with, and you're just repeating them from what you heard. You didn't choose those numbers, correct?
A. Correct.

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Q. And, similarly, in row 2, at the far right, there's a number from the water modeling data package that the percolation rate that's modeled is 5.85 inches per year; is that correct?
A. That is correct.
Q. And then the next row, which is the bentonite-amended beaches -- and also look at the bentonite-amended ponding, ponds.
Before the bentonite amendment is put on, do you understand that in-lab permeability of flotation tables is 4 times 10 to the negative 4th, 2.0 times 10 to the negative 5th, which I believe is also the range that you included in your testimony.
A. Yes, I see that.
Q. And that for the beaches as well as the dam size, the model requires that the permeability of 5.56 times 10 to the negative six not be exceeded, correct?
MR. MILLS: Object to the form.
JUDGE LAFAVE: Overruled.
THE WITNESS: That's what the document says.
BY MS. MACCABEE:
Q. And the model also predicts that the percolation rate modeled in inches per year, once the amendment

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is placed on the beaches, will be 5.85 inches per year?
A. That's correct.
Q. Now, if the model -- we talked a little bit before about how -- other than what you did with other witnesses, that the model states that percolation to the pond bottom, once it's amended, cannot exceed 6.5 inches, correct?
A. 6.5 inches is the input value to the model.
Q. And would that be -- let's take a look at the model. Let's first look at -- catch one thing. This is going back to the conductivity of the bentonite-amended tailings on the dam size and the beaches, and is that 5.56 number we're talking about. If you move, you can see that that is derived from the highest model data research for silty clay. Do you see that?
A. I see that.
Q. And you agree that that's where the model is derived from?
A. That's what it states here, yes.
Q. Can you move over -- it says that this is a deterministic value, correct?
A. That's correct.
Q. And that means it's the -- that value can't change

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throughout the duration of the project, which is modeled out to 500 years, correct?
MR. MILLS: Object to form.
JUDGE LAFAVE: The witness can answer, if he knows.
THE WITNESS: I can't speak to the -- what modeling may show hundreds of years from now.
BY MS. MACCABEE:
Q. Are you aware that this model was run for a duration of 500 years?
A. Again, I can't say specifically to the variation.
Q. Okay. Now, let's look at PDF 9, which is another page of the model.
And that talks about the pond seepage rate, and it refers back to another model, which is Table 131, and that's on the next page of this exhibit. And if you'll look at the bottom left. So the model is actually referring to 6.5 inches per year. And you have to show the --
MS. MACCABEE: Slide up so the witness can read what it says at the top of the model.
BY MS. MACCABEE
Q. Pond seepage rate in inches per year.
Now let's go back down to the bottom.
And that table, which is incorporated

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into the model we just looked at, doesn't that say that there has to be a rate once the bentonite is amended of 65 -- 6.5 in year 30, once the bentonite is on, correct?
A. That's what it says in the table, yes.
Q. And it also has the same value of 6.5 at year 50 and at year 500, correct?
A. That's correct.
Q. And is that -- would it still comply with the model if the -- if there was less than 6.5 inches of water going through the pond bottom in a year; do you know that answer?
A. What do you mean "comply with the model"?
Q. Would the model still be valid in protecting water quality if there was less seepage to the pond bottom than 6.5 inches per year?
A. I didn't do the modeling. I don't know the answer to that.
Q. Okay. Now, let's turn back to the first page of this exhibit, which is actually PDF 2. I'm sorry. And does the number 5.233 times 10 to the negative 7th, which is the permeability cap, which is in that chart, suggested as the permeability that will lead to a result of no more than 6.5 inches of percolation to the pond bottom; is that a number

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that's familiar to you?
MR. MILLS: Object to form.
JUDGE LAFAVE: Overruled.
You can answer, if you know.
THE WITNESS: My recollection is that it's the unsaturated hydraulic conductivity of tailings below the bentonite amendment there.
BY MS. MACCABEE
Q. And so in -- just to make sure I understand. That's what you said in your testimony yesterday.
Is that different from the saturated hydraulic conductivity, if the number of that would be determining permeability if the tailings were saturated beneath the tailings basin?
A. Yes, unsaturated would vary from the saturated value.
Q. And, generally, just to make sure I understand this, does "saturated" mean wet all the way through?
A. "Saturated" means a percent saturation associated with it.
Q. So when you say "unsaturated tailings," how are you defining that?
A. Unsaturated is less than 100 percent saturation.
Q. Okay. And is there another calculation in this record of what the permeability to attain -- or the

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hydraulic conductivity to attain 6.5 inches of percolation through the tailings basin would be if the tailings were saturated?
A. There is an example computation in the record in that regard, yes.
Q. And I'm going to ask you to please show Exhibit H1, and I will -- hold on a second. I want to show where that's coming from. We want to see that. That is from the Waste Characterization Data Package, which is already in the record.
And that is -- is that exhibit -- turn to the front page, because I don't remember the exhibit numbers -- it's Exhibit Number 217, and let's turn to the highlighted page -- keep going.
And this is a statement, the waste characterization data -- actually, is this in the water management? I'm sorry, that was a saturated -- unsaturated, I'm sorry. Unsaturated is a waste characterization. Saturated is in the adaptive management plan, which is in Exhibit 221.
And this states, "The performance parameter for the bentonite-amended flotations tailings is hydraulic conductivity, otherwise known as permeability," correct?
A. That's what it says.

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Q. And so -- and this calculation is meant to be used as a performance parameter for the bentonite, correct?
A. Yes.
Q. And scrolling down a little lower, these are the computations. I'm not going to ask you to explain them because I wouldn't understand.
But this basically is making an assumption of a bentonite-amended layer thickness of 0.2 feet, correct?
Q. That's in the middle paragraph.
A. This was an example computation, and, yes, it says bentonite-amended layer thicknesses greater than 2 feet.
Q. And in this example the average pond depth is 5 feet, correct?
A. Yes.
Q. And is that the target pond depth of the pond right now or is it now eight feet?
A. Well, this is an example computation. I don't know what relation it is to the eight feet, but it's currently eight feet.
Q. And so with a five-foot average pond depth, the calculation for the average hydraulic conductivity required for the performance modeling would be 2.1

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times 10 to the negative 8 centimeters per second, correct?
A. Well, the performance modeling is based on an infiltration of 6.5 inches per year, and not based on a specific hydraulic conductivity.
Q. But what this model shows, then, is that just the percolation, but in order to create a barrier that limits percolation to that rate, that has to be achieved by -- as a result of the permeability in that period, correct?
MR. MILLS: Object to the form.
JUDGE LAFAVE: Overruled.
You may answer.
THE WITNESS: Well, this is an illustration of one permeability value that could be used to achieve the 6.5 inches. As I've previously testified, there are a number of combinations of hydraulic conductivity and layer thickness and pond depth that could be used to achieve 6.5 inches.
BY MS. MACCABEE
Q. And in order to evaluate a plan for bentonite, whether it's for the beaches or for the dams or for the pond bottom, one needs to do the calculation to figure out what level of permeability, in this case, will limit percolation to 6.5 inches, correct?

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MR. MILLS: Objection, misstates his testimony.
JUDGE LAFAVE: Please rephrase your question.
BY MS. MACCABEE:
Q. In order to evaluate how a bentonite amendment will work and whether it will achieve 6.5 inches of percolation, doesn't one need to know what the permeability is following, what you called before, Darcy's Law?
MR. MILLS: Objection, misstates his testimony.
JUDGE LAFAVE: Overruled.
The witness may answer the question.
THE WITNESS: In the input value to Darcy's Law is permeability, yes.
BY MS. MACCABEE
Q. Do you know of any other number in the record for permeability for this performance modeling, other than this number that we just talked about in the adaptive water management plan on record, page 0067041?
A. Would you repeat your question, please.
Q. Other than this number right here, 2.1 times 10 to the negative 8th, which is -- which is contained in

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the adaptive water management plan, and I gave the page as 0067041, do you know of any other hydraulic conductivity number in the application which provides a different performance modeling number for the bentonite on the pond bottom?
A. I said I'm not aware of another value. There may be, but I'm simply not aware of them.
Q. Thank you.
You wouldn't have the expertise yourself to do the calculations and provide us with another value or to challenge this one, would you, sir?
A. I'm certainly capable of using Darcy's Law, yes.
Q. And have you used Darcy's Law to make calculations of any other permeability rate that would achieve the 6.5 inches percolation rate, which is required by the model?
A. I don't recall.
Q. Sitting here today, can you say what hydraulic conductivity other than that number of 2.1 times 10 to the minus 8, the bentonite amendment of the pond bottom would have to achieve in order to achieve the 6.5 percolation rate that is contained in the model?
A. Generally, there's a wide range of hydraulic conductivities that would achieve 6.5 inches per year.

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Q. And that would depend on the thickness of the bentonite amendment, correct?
A. That is correct.
Q. And what is the thickness of the bentonite amendment that's planned for the NorthMet tailing space?
A. The current plan is 2 to 3 inches AquaBlok.
Q. And you say 2.3 inches, that's --
A. 2 to 3 inches.
Q. Is that consistent with 0.2 feet in this example here?
A. It is.
Q. So the current plan, which is consistent with this equation, is -- would be -- require a permeability rate as low as 2.1 times 10 to the minus 8, correct?
A. For use of AquaBlok, that's correct.
Q. And you would agree that this 2.1 times 10 to the negative 8th is considerably less permeable than the 3.9 times 10 to the negative 6 permeability, which is the lab value of LTV fine tailings and slimes that we've been using as representative of the existing ponds?
A. The 3.96 is the geometric mean of the fine tailings and slimes hydraulic conductivity, and that value is higher than the Sutton.
Q. Now, let's turn --

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MS. MACCABEE: Your Honor, I would -- what I would like to do, rather than ask that this exhibit be admitted, is I would like to make the changes that are necessary consistent with this witness's testimony so I don't try and put something into the record that is incomplete.
Is that an appropriate way to handle that, sir?
JUDGE LAFAVE: I'll poll the other parties. Mr. Mills?
MR. MILLS: Just so I can understand, the point is to move the admission of this demonstrative exhibit?
JUDGE LAFAVE: I believe Ms. Maccabee -- Ms. Maccabee intends to offer the exhibit. However, she wants to tweak it to reflect the testimony that was given this morning; is that fair?
MS. MACCABEE: Your Honor, what I would suggest is perhaps I should compare in Exhibit 349A, which contains what I think -- it should contain to reflect that the difference between unsaturated and saturated conductivity and all the supporting documents, rather than moving the exhibit as is currently intended or even asking counsel to speculate on something they haven't seen yet.

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JUDGE LAFAVE: Ms. Maccabee, why don't you prepare Exhibit 249A, and we can discuss its admissibility when you've completed it.
MS. MACCABEE: Your Honor, I might have misspoken, it's 349.
JUDGE LAFAVE: I'm sorry, 349A.
MS. MACCABEE: Thank you, sir.
BY MS. MACCABEE:
Q. I'd like to change gears now, make something a little simpler.
If we could turn to Mr. -- to your rebuttal testimony, and that's line 941 to 945. And in your -- in this rebuttal testimony, based on the pond area of 905 acres and the basin average depth of 8 feet, you calculated that there would be 160 million gallons a year of seepage annually lost through the pond bottom each year, correct?
A. That is correct.
Q. And you did that by multiplying, correct; you didn't go into hydraulic conductivity or anything like that, correct?
A. That's true.
Q. And to calculate how much water would percolate through the dam sides would be just -- one could just make a similar calculation using the modeled

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5.85 inches per year of percolation, correct?
A. That's correct.
Q. And basin size will cover about 380 acres. I believe you said this in your direct testimony. I don't think we need to find it. Does that sound familiar?
A. Sounds familiar.
Q. And the beach area will cover about 427 acres, correct?
A. That sounds right.
Q. And is it also correct that if the permeability of the bentonite amendment tailings on either the dam sides, slopes or beaches were to be less than or equal to 5.6 times 10 to the 6, that result would be within the bounds of the model?
A. That would be over value than what was used in the model, yes.
Q. Well, if it were less than or equal, that would be consistent with the model, correct?
A. I believe the model used a specific value, but it would be less than or equal to the model.
Q. And if the actual permeability of the bentonite-amended tailings on the dam sides, slopes or beaches were to be higher than or allowed more water than 5.56 times 10 to the minus 6 centimeters

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per second, that permeability would not be consistent with the model, correct?
A. It would be different than what was used in the model, yes.
Q. Let's turn to rebuttal testimony, 223 to 225. In your rebuttal testimony of the pages you say, "The hydraulic conductivity value shown in row 9, which is" -- can you see above --
MS. MACCABEE: Why don't you show it to him. There you go.
BY MS. MACCABEE:
Q. "5.56 times 10 to the minus 6 centimeters per second," you state, "is the value used in tailing spaces in performance modeling of future bentonite-amended basin sides, beaches and pond bottom."
Do you agree with that, that the statement contains an important error?
A. (Witness nods.)
BY MS. MACCABEE:
Q. Isn't it correct that the conductivity value 5.56 times 10 to the minus 6 centimeters per second only applies to the bentonite-amended sides and beaches and does not apply to the pond bottom?
A. In our prior discussion my understanding is the --

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that value, hydraulic conductivity, applies to the basin sides and beaches and a 6.5 inch per year percolation or seeded (ph) value was applied to the pond bottom.
Q. And based on what we just discussed, the actual conductivity value used in performance modeling for the pond bottom basin would be considerably less permeable than 5.56 times 10 to the negative 6; wouldn't it?
MR. MILLS: Object to form, misstates prior testimony.
JUDGE LAFAVE: Please read back the question.
(Record was read by Court Reporter.)
JUDGE LAFAVE: The witness can answer the question, if he knows.
THE WITNESS: Would you repeat the question, please?
BY MS. MACCABEE:
Q. Based on the discussion we just had, would you agree that the performance modeling hydraulic conductivity of the bentonite amendment of the pond bottom would be considerably lower than the 5.56 times 10 to the minus 6 value for the beaches and the dams?
MR. MILLS: Same objection.

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JUDGE LAFAVE: The objection is overruled. The witness may answer.
THE WITNESS: I stated that the performance modeling for the pond bottom was based on 6.5 inches of infiltration per year, and that can be achieved by a range of hydraulic conductivity values on various surfaces.
BY MS. MACCABEE:
Q. And you can -- and we had previously discussed about the range that would be necessary if PolyMet adopted the plan to use PondSeal on the bottom, correct?
A. If AquaBlok is used for the pond bottom and specific hydraulic conductivity is associated with AquaBlok.
Q. In your testimony --
MS. MACCABEE: And let's look at 877 to 885.
BY MS. MACCABEE:
Q. Do you recall this testimony that, "The performance of the existing tailings basin in cell 1E and 2E in maintaining a pond provides a site-specific analog for the permeability conditions capable of maintaining a pond"? Do you recall that testimony?
A. Yes, I recall it.
Q. And in this testimony you concluded that, "permeability of the bentonite-amended pond bottom

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of equal to or less than 3.9 times 10 to the 6th will maintain a permanent pond that acts as a water cover over the stored tailings."
Is that attempting to refer to the flotation tailings basin in the future?
A. It is not. I say, "demonstration of the current condition that's maintaining a pond."
Q. So if this statement were interpreted to mean that the existing -- the factors of pond on the existing tailings basin predicts that that flotation tailings basin pond will be maintained, that would not be a correct interpretation of this testimony?
A. This is a demonstration of existing conditions that maintains a pond.
Q. And this demonstration is not -- however, it's not intended to say that a pond will be maintained similarly on the flotation tailings basin?
A. This is an example of a hydraulic conductivity 3 times 10 to the minus 6 that may be capable of maintaining the pond with flotation tailings basin.
Q. Now, isn't it correct that the flotation tailings basin would be on top of flotation tailings basin -- flotation tailings rather than LTV fine tailings as slimes?
A. That's correct.

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Q. And isn't it also correct that the hydrology of the flotation tailings basin at closure at its new height would be different from that of the LTV ponds today upon cell 1E and 2E?
A. It would be different, yes.
Q. Well, one question. Isn't it correct that the proposed NorthMet bentonite amendment is not scheduled to be applied until up to 10 years after operations have ceased?
A. What area are you speaking of?
Q. I'm speaking of -- do you want to look at the direct, lines 387 to 389? And amended -- NorthMet bentonite amendment of the pond. So I'll re-ask it. That's a very good clarification.
Isn't it correct that the proposed NorthMet bentonite amendment of the pond bottom is not scheduled to be applied until up to 10 years after the operations have ceased?
A. That's my understanding.
Q. Have you calculated how many millions of gallons will seep through the bottom of the tailings pond during those 10 years before the amendment is applied to the pond?
A. I have not.
MS. MACCABEE: Your Honor, is this a good

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time for a break because I'm going to go into a different topic.
JUDGE LAFAVE: We are in recess for 15 minutes. Thank you.
(Recess taken.)
JUDGE LAFAVE: Good morning. We are back on the record. Mr. Radue, I would remind you that you are still under oath.
Ms. Maccabee.
MS. MACCABEE: Thank you, your Honor.
BY MS. MACCABEE:
Q. Mr. Radue, we're going to talk a little bit about -- change the subject and talk about some of the studies you discuss. Let's turn to your direct testimony, and that's lines 308 to 318. I think we did pull it up to make life easier for you.
Do you see that?
Maybe you can find your testimony in the Woyshner and Yanful study while we're worrying about the technical. Have you found it?
A. I have it.
Q. In your testimony you stated that the 1995 Woyshner and Yanful study showed positive results after field testing a cover system that is similar to PolyMet's bentonite amendment.

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Isn't it correct that this 1995 study, Woyshner and Yanful, used a composite cover with a 60 centimeters or approximately two foot thick layer of virus natural clay?
A. I don't recall the specifics of the barrier layer.
Q. Well, actually, if you look at your own testimony, I believe it does discuss what those specifics are.
A. What number are you looking at?
Q. 308 to 318.
A. The testimony says that the study uses a two foot thick natural clay layer.
Q. That's correct. And isn't it correct that PolyMet is not proposing to apply a composite cover with a 2 foot thick layer of natural clay to the NorthMet dam sides or the NorthMet beaches?
A. I'm not seeing it at the moment in my testimony where I use the word composite. Can you point me to that, please?
Q. Again, I wish I had access to the documents.
JUDGE LAFAVE: I'm going to see if I can get someone here to help with that. Thank you.
BY MS. MACCABEE:
Q. All right. Let's ask a few questions that don't require any documents and we'll come back to this one. You testified yesterday that the in-lab

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conductivity of the single sampling had -- was -- well, bentonite mixed with LTV tailings was 1.8 times 10 to the minus 7 centimeters per second. Do you recall that testimony?

A. Yes, I do.

Q. Is it correct that there are no specifications in PolyMet's permit to mine application to achieve a 1.9 times 10 to the minus 7 centimeters per second conductivity with the construction of either bentonite-amended dam sides or beaches?

A. The current documents focus on the basin dam sides which will be constructed first. They have specifications -- we have specifications for the thickness of the bentonite-amended clay layer. We have specifications for the percent compaction of the bentonite-amended clay layer.
We have a geometric mean hydraulic conductivity specification for that layer upon zero times 10 to the minus 6 centimeters per second, and there's some other specifications associated with that.

Q. Mr. Radue, is that 1.10 to the negative 6 centimeters per second specification contained in the permit mine application?

A. It's 1.6 times 10 to the minus -- excuse me, 1.0

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times 10 to the minus 6. It is in the permit to mine application, yes.

Q. And is there any specification contained in the permit to mine application for the hydraulic conductivity of the bentonite amendment to the beaches?

A. I believe the specifications focused on the dam sides which would be constructed first.

Q. So the answer to that is that at this point there is no specification for the bentonite amendment to the beaches?

A. I don't recall.

Q. To the best of your knowledge, is there -- isn't it correct that there's no specification yet for the starting conductivity as constructed for the bentonite amendment of beaches?

A. That's my recollection. Again, the document focuses on the basin sides, which will be constructed first, and has a specification for the hydraulic conductivity of basin sides.

Q. Okay. Let's see if we can do this: I think with the Woyshner study, let's just go back and do it really quickly without the evidence.
So would you agree that PolyMet is not proposing to apply a cover with a two foot thick

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layer of natural clay to the NorthMet dam sides?

A. Correct. We're proposing a 1.5 foot thick cover with bentonite-amended tailings.

Q. And do you know what percentage of bentonite is in the layer of two foot thick natural clay that Woyshner and Yanful used in their study?

A. If it's natural clay, it would not have any bentonite in it. Excuse me, if it's natural clay, it may not have bentonite in it.

Q. And that would depend where it's mined from, correct?

A. Correct.

Q. And if it's mined from Wyoming, it could very well have bentonite in it, correct?

A. It depends on the source of the clay.

Q. And you don't have any information on the percentage of the clay that would be in a two foot thick natural layer of clay, correct?

A. For that specific study?

Q. Yes.

A. I do not.

MS. MACCABEE: Are we still trying to get the exhibits to work?

BY MS. MACCABEE:

Q. Now, you testified earlier today that PolyMet is now

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planning to create an engineered barrier pond bottom using two to three inches of AquaBlok, correct?

A. That's correct.

Q. Is it also correct that you have no personal experience with applying AquaBlok to the bottom of a pond, correct?

A. I do not. Colleagues of mine have used AquaBlok.

Q. Has PolyMet obtained a bid calculating the cost of applying AquaBlok to the flotation tailings water column to limit permeability to 6.5 inches per year or less?

A. I do not know.

Q. And I would turn now to, I think it's your testimony in your direct, lines 603 to 605. It might be in the rebuttal, I'm sorry. I'm going to read to you once I get the right page.
I'm reading from your rebuttal testimony because you can't see it on the screen. And it's on lines 603 to 605.
In that testimony you said, "If bentonite amendment of the pond bottom is needed, products such as AquaBlok or PondSeal may be applied on the pond bottom by contractors without material defects."
Do you recall that testimony?

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A. I do.
Q. Do you have any personal knowledge of application of AquaBlok or PondSeal to a 905-acre pond without defects?
A. I do not.
Q. And isn't it correct that you're relying on Mr. Hull's testimony and examples of the use of AquaBlok or PondSeal?
A. That's correct. As I stated earlier, my colleagues have used AquaBlok.
Q. And have you gotten reports from your colleagues precisely what they used AquaBlok for?
A. I have general knowledge, yes.
Q. And have any of your colleagues reported they used AquaBlok to create an engineered barrier at the bottom of a flotation tailings pond or other tailings pond for mine wastes?
A. Yes, one of the applications was for a tailings basin for mine waste.
Q. And when did you learn about that?
A. Close in time, but I don't recall specifically.
Q. Who was overseeing the project?
A. Minntac.
Q. Minntac, Minnesota?
A. Yes.

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Q. Which pond was sealed with Minntac -- or lime?
A. AquaBlok was used. I'm not that familiar with the project.
Q. So do you know where in a Minntac project AquaBlok was used?
A. I just know it was used in the tailings basin. I'm not that familiar with the details of the project.
Q. Do you have any knowledge of any tailings pond at Minntac that is being sealed to reduce permeability or achieve a certain percolation rate in terms of inches per year?
A. Well, as I stated, AquaBlok was used to seal part of the basin at Minntac. I do not know the details of that.
Q. So you don't know whether that application was used to make a pond less permeable, correct?
A. That would be the reason for using AquaBlok is to make something less permeable.
Q. I'm saying specifically you don't know if it was used to make the Minntac tailings pond less permeable; do you?
A. I stated it was used at Minntac tailings basin.
Q. That's the extent of your knowledge, Mr. Radue?
A. It is.
Q. Thank you.

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Are you relying primarily on Mr. Hull's testimony and examples of use of AquaBlok for pond sealing?
MR. MILLS: Objection, asked and answered.
MS. MACCABEE: Was that asked and answered?
MR. MILLS: Yes.
BY MS. MACCABEE:
Q. Do you agree that --
JUDGE LAFAVE: Wait. Give me just a second. The objection is sustained. Please continue.
MS. MACCABEE: I'm just asking the court reporter. Was that asked and answered?
COURT REPORTER: I don't know.
BY MS. MACCABEE:
Q. Is it correct with the examples in Mr. Hull's testimony, broadcasting AquaBlok products to the water column primarily pertains to sediment sequestration?
A. That would be a question for Mr. Hull to answer.
MS. MACCABEE: Your Honor, at this point I don't have -- I'm going to need to be able to use the exhibits. I'm not really sure what's the next

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step.
JUDGE LAFAVE: We're in the process of trying to remedy that problem. Are there other questions you can ask?
MS. MACCABEE: I will try. I'm sorry, Your Honor, everything I've got here refers back to something that needs to be seen.
JUDGE LAFAVE: Let's go off the record for just a moment, please.
(Recess taken.)
JUDGE LAFAVE: We are now back on the record. Again, Mr. Radue, I would remind you you are still under oath.
Ms. Maccabee.
BY MS. MACCABEE:
Q. If you would turn to the Hull direct. That's at lines 348 to 354, is that where we are?
And isn't it correct that one example that Mr. Hull provided in his testimony regarding sealing of the pond was a project completed for the City of Columbus park systems?
MR. MILLS: Objection, Your Honor. She's asking him questions about John Hull's testimony. He's been on the stand for almost a full day now.

It seems like we should be moving on to other witnesses.
JUDGE LAFAVE: Ms. Maccabee.
MS. MACCABEE: I will try and make this real quick.
JUDGE LAFAVE: What's the relevance of this question?
MS. MACCABEE: The relevance of this question is whether Mr. Hull's examples informed Mr. Radue's opinion that PondSeal was an effective way to apply bentonite to a 905-acre pond without defects.
JUDGE LAFAVE: You may answer the question.
THE WITNESS: Would you repeat the question, please?
BY MS. MACCABEE:
Q. Isn't it correct that the one example that Mr. Hull provided in his testimony regarding sealing a pond was a project completed for the City of Columbus park system where he said that the material was easy to place and performed when applied to a rough surface similar to that anticipated for the NorthMet project beach area?
MR. MILLS: Objection to the extent it

misstates Mr. Hull's testimony.
JUDGE LAFAVE: You may answer based on the question as it appears on the screen -- the testimony appears on the screen.
THE WITNESS: I'm not familiar enough with Mr. Hull's testimony to provide an opinion.
BY MS. MACCABEE:
Q. Your testimony, and then this is in the rebuttal 598 to 602, refers -- you can see it up there. There it is. You can see it up there. Your testimony --
MR. MILLS: Counsel, I object. If he wants to look at the book, please refrain from requiring him to look at your screen and your highlighting. Thank you.
JUDGE LAFAVE: Mr. Mills, please direct your objections to me, but the point was well taken.
MR. MILLS: Your Honor, I apologize. I did not state that properly.
JUDGE LAFAVE: No worries.
Mr. Radue, let us know when you're ready.
THE WITNESS: Would you restate your question, please?
BY MS. MACCABEE:
Q. Your testimony refers to placement of a reactive core mat through water to remediate contaminated

sediment, correct?
A. That is correct.
Q. And you would agree that placing the reactive core mat on contaminated sediments is different from lining a pond with GCL to create a low permeability there to water percolation, correct?
A. I disagree.
Q. Has your testimony identified any -- is it correct that your testimony has identified no examples where low permeability, a liner for pond, was applied by placing a GCL from a barge to a water column?
A. I've provided photos in my testimony demonstrating that.
Q. Were those -- there's none of those photos identifying the purpose -- were any of them to provide a low permeability barrier similar to that in the NorthMet project?
A. Well, that would be the reason for using a bentonite material to provide a low permeability barrier.
Q. Is it correct that no testimony or exhibits in this contested case proceeding have identified a mine project that has applied bentonite to a water column from a barge, whether by broadcasting, injection or DCL panels?
A. Whether it's a mine project or any other project,

the process is the same.
Q. Isn't it correct that you -- that this record identifies no projects that are mine projects that have used that method of applying bentonite from a barge?
A. Well, again, the method is equally applicable, it's -- whether it's a lake or mine project or anything else.
Q. If it's a project that's not a mine project, isn't it correct that the Minnesota Reactive Mine Waste Rule would not apply?
A. That's correct.
Q. If the project is not a mine project, isn't it correct that the need to achieve a specific rate of percolation from water modeling is not applied either, correct?
A. I disagree.
Q. On what basis would you disagree?
A. There very well may be a project where modeling is required that requires a specific performance that's not a mine project.
Q. But you don't know of any specific project or specific models or --
(Reporter requests clarification.)
Q. You don't know of any projects with specific

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modeling requirements where a GCL or other application of bentonite has been used to achieve a specific rate of percolation, correct?
A. I personally do not.
Q. Turn to your rebuttal, lines 48 to 52. Do you see your testimony at lines 58 to 52?
A. Excuse me, 58 to 52?
Q. 48 to 52. Thank you.
A. I do.
Q. And in your testimony you cite the Chapuis paper, 2002 paper, to demonstrate the use of soil bentonite liners?
A. Yes.
Q. Isn't it correct that all the field testing methods for creating a pond bottom bentonite liner, discussion of Chapuis paper involved dry installation of the bentonite?
A. That's my recollections, yes.
Q. Would you agree that the standard method of creating a liner for a pond -- nevermind, strike that. I don't need that.
Yesterday Mr. Katchen asked you about the projects in the Wyo-Ben brochure, Exhibit 17, and the listing of sites where Wyo-Ben had supplied bentonite for pond and landfill liners.

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Do you recall that testimony?
A. I recall discussing it.
Q. And you told Mr. Katchen that you had no personal knowledge of any of these Wyo-Ben projects, correct?
A. Correct. I stated that I talked to Richard Brown to obtain information on such projects.
Q. If we could turn to Exhibit 17 briefly. Do you remember Mr. Katchen was talking about scale of projects, if you look at 5 through 10.
A. Yes.
Q. Do you see, I think -- I've highlighted the ones that are pond liners.
MS. MACCABEE: If you'll scroll through please, Ms. Guenther.
BY MS. MACCABEE:
Q. Do you see that most of these are just a couple of acres in size and there are a couple -- then there's -- the largest pond in terms of size is 29.5 acres?
A. I see that, yes.
Q. And is there anything on this list of ponds indicating that any of these pond liners have been created by applying bentonite to the pond column other than the more conventional way that Mr. Chapuis discussed?

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A. Would you repeat your question, please?
Q. Is there any indication in the listing of ponds that suggests that any of these ponds were lined by providing bentonite to the water column rather than on a dry application?
A. Not to my knowledge, no.
MS. MACCABEE: If you could turn back, Ms. Guenther, to PDF page 4.
BY MS. MACCABEE:
Q. And this is from the Wyo-Ben brochure and -- Exhibit 17, and doesn't that describe the standard mixed membrane method for applying bentonite? Do you see the text, sir?
A. You're looking at the right-hand column?
Q. That's correct, under "How to Apply ENVIROGEL," the right hand column, the first paragraph, and line number 1 -- item number 1.
And doesn't this appear to a conventional application on a dry surface that is visible where the soil is prepared beforehand?
A. Yes, and that's the case we have for the basin sides and basin beaches.
Q. Correct. That would be very similar to trying to work on at least the basin sides. We don't know yet about the beaches, correct?

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A. It is generally applicable to basin sides and beaches. We discussed the beaches being somewhat more challenging.
Q. All right. And if you turn back one page before that in the Wyo-Ben ENVIROGEL brochure, and does it, in fact, in the Wyo-Ben brochure say that, "In areas where water cannot be removed, ENVIROGEL is broadcast, and it's -- or poured across the surface. While not as efficient as the mixed membrane method, this technique is effective for leaks identified in areas like gravel pockets or on dam faces."
Do you see that?
A. I see that.
Q. Do you agree that using a sealing method for gravel pockets or dam faces is different from lining an entire 905-acre pond?
A. Well, the AquaBlok was proposed for the pond, which is a different product.
Q. Okay. Now, is it correct that you -- I want to turn now to Exhibit 66 and 67. We can put them up here, if you wish.
A. It's easier for me to see here.
Q. At the time when you contacted Dr. Benson in 2012, were you aware that he had spoken with geochemist

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Kim Lapakko at DNR regarding the NorthMet bentonite amendment?
A. Are you referring to a specific contact?
Q. Were you aware that Mr. Lapakko, geochemist for DNR, had sought Dr. Benson's advice on the NorthMet bentonite amendment?
A. I don't believe I was aware of that.
Q. So did you seek Dr. Benson's consultation, based on his expertise, on the subject of bentonite and covers for mine waste?
A. As I stated yesterday, he was retained by Foth to contribute to the project, and so there was a connection via that means. So I was in occasional communication with Dr. Benson.
Q. Turning to Exhibit 66 at -- it's PDF 14. Isn't it correct that at your request, Dr. Benson provided you with examples of geomembrane covers used for mine waste?
A. I don't recall specifically what was requested. He provided examples of geomembrane covers and soil bentonite covers.
Q. And to the best of your knowledge, were any of those examples of covers for mine waste applied to the water column rather than to a dry prepared surface?
A. These are dry cover systems.

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Q. And is it correct that Dr. Benson did not provide you with any examples of AquaBlok products?
A. He was unfamiliar with the AquaBlok product, to my recollection.
Q. And isn't it true that you and Dr. Benson had a brief email exchange about the AquaBlok product?
A. That's correct.
Q. And isn't it correct that after Dr. Benson wrote to you saying that the product might be the perfect product, you wrote back to him within a very brief time identifying the product you had cited as AquaBlok PondSeal and stating that no further information on this is necessary, and that's page 66.16.
MR. MILLS: Objection to the extent the question misstates what Dr. Benson wrote in his email.
JUDGE LAFAVE: Let's see what he did write in the email.
BY MS. MACCABEE:
Q. Why don't we show first the email on 66.15 so that you can see the context.
Can you see, Mr. Radue, let's go a little further, can you see, Mr. Radue, at the very top, that Craig Benson wrote an email at 9:02 a.m. on

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September 20, 2012, in response to your email about a bentonite product, and then you -- he said, "Great. This could be a perfect material." And then you wrote back. On the next page you can see your response at 9:38. "For your information," do you see that?
MR. MILLS: Objection, you're going backwards. This is misstating the order of the emails.
MS. MACCABEE: I think I put numbers on them as far as the sequence.
JUDGE LAFAVE: So continue with your question.
BY MS. MACCABEE:
Q. Is it correct that you wrote back to Benson at 9:38 saying, "The product that I've seen is called AquaBlok PondSeal. It's actually fine gravel-coated bentonite. No further searching for information on this is necessary."
A. I have to -- would you repeat the question? I need to read the string of emails.
Q. Isn't correct that at 9:38 a.m. you responded to Dr. Benson saying that the product you've, "seen is called AquaBlok PondSeal. It's actually fine gravel." And, "No further searching for information

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on this is necessary"?
A. Do I see that? I see a prior email where he indicates he had a sample in his lab apparently.
Q. Yes, and you see the prior email also where he says, "This could be the perfect material," right, that prior email?
MR. MILLS: Objection, she's calling the prior email, and that's not necessarily how email strings work.
BY MS. MACCABEE:
Q. Mr. Radue, did you put together this email string yourself, or was it put together by somebody else?
A. I believe I searched our email and located this email.
Q. If you could look at page 66.15.
A. Yes, and I see he says, "Great, this could be the perfect material."
Q. What time is that email?
MR. MILLS: Objection, she didn't ask -- objection, vague.
JUDGE LAFAVE: Please rephrase your question.
BY MS. MACCABEE:
Q. What time is indicated on the email from Craig Benson to you regarding bentonite coated sand?

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MR. MILLS: Same objection, vague as to time.
JUDGE LAFAVE: Please rephrase your question.
Wait a minute. No, that's -- you can -- the witness can answer.
THE WITNESS: His email is a little unclear to me, but it says September 20th, 2012. It appears to be 9:03 a.m.
BY MS. MACCABEE:
Q. And your email on September 12 -- September 20th, 2012, on the next page, at 9:38 a.m., says that the product that we called bentonite coated sand, it identifies the name of the product. It also says, "No further searching for information on this is necessary," correct, Mr. Radue?
A. That's what it says, yes.
Q. Is it correct that you never followed up after this from Dr. Benson to ask him to search for any information on AquaBlok or PondSeal products?
A. I don't recall if that's the case.
Q. Do you recall any instance where you followed up with Dr. Benson to find out what he thought or asked him to do any research on the AquaBlok or PondSeal?
A. I don't recall asking him to do any research on

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that, no.
Q. Thank you.
MS. MACCABEE: Ms. Guenther, let's show Mr. Radue rebuttal testimony, lines 1326 to 1330. If you could show this.
BY MS. MACCABEE:
Q. Do you see --
A. This is rebuttal testimony?
Q. That's correct.
Do you see your testimony that, "Years ago, Benson recommended a 3 percent amendment for the NorthMet project, which he estimated would have a hydraulic conductivity of 3.10 to the negative 7"?
A. I see that.
Q. If you could turn to Exhibit 67. And looking at those handwritten notes -- I think these are easier to understand than the ones in 66 -- does it say, "The Objective - Estimate hydraulic properties of tailings - bentonite and mixture"?
A. Yes.
Q. And that's not an objective to provide a recommendation on any specific content of bentonite is it? You would agree that that's not an objective to provide a recommendation on the content of bentonite, correct?

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A. That is not stated in the objective, no.
Q. And you can see below that doesn't explain what those numbers are, use efficient porosity method in Chapuis 1990, correct?
A. Yes.
Q. And can you see, then, that Dr. Benson is in these -- in this document, applying the methods in this 1990 Chapuis paper to calculate properties based on information for the pond?
A. Yes.
Q. And turn to page 4. And that page includes Dr. Benson's summary of Chapuis' method and makes a recommendation to use Chapuis' method in the model, correct?
MR. MILLS: Objection, foundation.
JUDGE LAFAVE: Overruled. The witness may answer.
THE WITNESS: His recommendation says, "Use Ks of this estimated for coarse tails and bentonite for bulk tails and bentonite."
BY MS. MACCABEE:
Q. Do you understand that is a recommendation to use the model that's -- gives that paragraph a Chapuis' model rather than to use any particular product for the project, correct?

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A. He is providing recommendations on modeling. That's not a specific product, that's correct.
Q. New topic; let's talk about vegetation.
Is it correct that the flotation tailings dam sides, slopes, beach areas and a transition zone between the beaches and the pond all have vegetation on them?
A. That is correct.
Q. In response to Dr. Benson's testimony that plant roots will penetrate the bentonite-amended layer and reduce dry cycling, did you provide a response that it is unlikely that roots would penetrate below 30 inches in the new basin sides?
A. That is correct.
Q. And did you do a brief study for PolyMet on the question of root penetration?
A. PolyMet did a study and provided a memorandum with their findings.
Q. So you didn't do the study yourself? You didn't dig the holes?
A. I did not.
Q. Are you familiar with the study that PolyMet did?
A. I am.
MS. MACCABEE: Can we turn to page Exhibit 320 -- to Exhibit 30.

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BY MS. MACCABEE:
Q. And that describes the method of digging five holes in the lift, correct?
A. That's correct.
MS. MACCABEE: And then turn to the PDF 4.
BY MS. MACCABEE:
Q. Does it appear that the process used was to dig holes and then visually inspect them with a measuring tape?
A. That's what the photos show, yes.
Q. And turning to page 10 of the exhibit. Isn't it true that all the holes tested were on the west sides of the existing dam's basin?
A. That's my general understanding, yes.
Q. And your understanding of the tailings basins on the west side -- the steeper slopes of the tailings basins as compared to the north slopes?
A. Compared to the north slopes of the existing dam and basin?
Q. Correct.
A. I don't know that to be the case.
Q. And isn't it true that the flotation tailings basin, slopes and beaches will be far less steep than the particular locations where the holes were dug for

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this study?
And I'm going to show you page 8 out of 9, if you want to take a look at the system.
A. The flotation tailings -- the slopes for the flotation tailings basin will be flatter than these slopes, yes.
Q. And do you have any experience with what's the proper procedure to take to do a study of root penetration?
A. I believe excavating holes and taking photographs and measuring depth is a reasonable approach.
Q. Have you ever done a root penetration study?
A. I have not.
Q. Let's turn real briefly to Exhibit 206.09. And that's an excerpt -- and that's an excerpt from the Williams study for the Nuclear Regulatory Commission on in-service radon barriers over Uranium tailings and their -- their degree of degradation or change over a period of 20 years.
So let's just quickly -- you're familiar with this study; aren't you, Mr. Radue?
A. Generally.
Q. In fact, didn't you cite it in your testimony referencing --
(Reporter requests clarification.)

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Q. Didn't you cite this NRC 2022 study, Exhibit 206.09 in your testimony?
A. I believe I did.
Q. So let's turn now to page 4-6 of this. This is an excerpt so we don't have to look too far.
And would you agree that this NRC study of whether earthen barriers degrade over time looked at penetration by small roots that one might not see looking down into a hole --
A. I believe it did, but that's not the only evidence from the test bits.
Q. And turn to the next page. Did the NRC study also do corings showing where the tap roots were and deliberately take locations near more woody plants?
A. That may be the case.
Q. Then turn to the next page. And didn't this NRC study design to find out the extent of root penetration cut away entire sections and excavate so they could follow the path of the root and see all the root sizes and depths?
A. Yes. In our case we have excavations on the stock plot soil adjacent to the excavations (mic glitch) is clear and considering that's at depth.
Q. And the particular five holes that PolyMet sent -- examined in their study and for which Exhibit 30

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provides the memo, however, did not include any excavation to look at the various soil profiles at depth, correct?
A. They used the test holes that are shown in the photographs provided.
Q. And didn't this NRC study conclude that medium fine and very fine roots were observed to a depth of 1,260 millimeters, coarse roots to a depth of 900 millimeters and very fine roots to a depth of the entire profile, which was more than 1,600 -- 1,650 millimeters?
A. Those are different sites in different vegetation conditions.
Q. And they're also different methodologies, correct, Mr. Radue?
A. That's correct.
Q. Now, let's just turn one more page of this study, 206.02, the -- 09, the sixth page. And this is the 2022 NRC study explaining how they evaluate the degradation of soil bentonite barriers.
And do you see that this study -- and granted there were a number of different sites and different locations -- found that plant growth is the largest contributor to soil morphological development score in the barriers, at least the

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basin. That's in the second paragraph.
A. Those are specific to the Radon barriers. Yes, I see that.
Q. Those are specific to the earthen barriers in the NRC study, correct?
A. Correct.
Q. And that others, in this study, with few exceptions, roots were observed through the depth of the observed barrier profiles, correct?
A. And some are different -- under conditions -- different vegetation conditions, that's correct.
Q. Mr. Radue, do you have any personal knowledge of the actual composition of the barriers of the vegetation in the 2022 NRC study?
A. I don't recall at the moment.
Q. You didn't participate in exhuming the barriers of that study, correct?
A. I did not.
Q. And the study also says other contributors to a high SMDS, which is a high soil morphological change development score, include insect burrowing and desiccation cracking associated with volume change induced by root water uptake.
Do you see that?
A. I see that, yes.

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Q. And would you agree that bentonite -- that plants are hydrophilic and that their roots would seek water entrapped from the bentonite?
A. It depends on the type of vegetation.
Q. Are you saying that you know of vegetation where the roots do not seek water in order to sustain the plant life, or is that outside --
A. Root depth would depend on type of vegetation.
Q. Based on your knowledge of vegetation, how deep would the roots of coarse (ph) in grasses grow, or is that outside your --
A. That's not my area of expertise.
Q. Would you agree that if the burrowing was insect burrowing rather than that of a large animal, that the entrance of that insect into the ground would not be visible by just looking for large holes?
A. It's possible.
Q. So when we talk about animal burrowing, it might be visually evident in a casual view but insect burrowing would not, correct?
A. It's possible, yes.
Q. Would you agree after just this brief review of the 2022 study done by the Nuclear Regulatory Commission to specifically evaluate what conditions change the parameters or the permeability of soil earthen

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barriers, these are different methods than the ones that PolyMet used in the study that was provided in Exhibit 30?
A. They are different methods, yes.
MS. MACCABEE: No further questions.
JUDGE LAFAVE: Mr. Mills, do you have any redirect?
MR. MILLS: I do, Your Honor. Thank you.
REDIRECT EXAMINATION
BY MR. MILLS:
Q. Good morning, Mr. Radue. I have a few questions for you. My first question is when you print an email string, isn't it standard that the last email in the string appears at the top, while the older emails appear below going on through the string?
A. That's correct, you generally read it from bottom up rather than top down.
Q. So the top email, when you print a string, is the last one in the string?
A. Yes.
Q. Showing you Exhibit 6615, which email appears at the top of this email string in Exhibit 6615?
A. It would be the last email.
Q. And is that the email from Craig Benson to you?
A. It is.

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Q. And that appears -- there's a line -- and after Craig Benson says, "Great, this could be perfect material," there's a line that says, "Sent from CHB's iPhone"; is that right?
A. Yes.
Q. Do you know where that iPhone was when this email was sent?
A. I do not.
Q. Is it possible that it was in a different time zone than you were located when you were sending your emails?
MS. MACCABEE: Objection, calls for speculation.
JUDGE LAFAVE: The witness can answer if he knows.
THE WITNESS: It's a possibility. I don't know if it was or not.
BY MR. MILLS:
Q. Sure. We don't know.
Have you encountered situations where emails appear when they are sent from different time zones to have a different hourly time stamp than the time zone you were in when you received it?
A. I have.
Q. One last question on this.

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When Craig Benson said, "Great, this could be perfect material," do you understand he was talking about AquaBlok?
MS. MACCABEE: Objection.
JUDGE LAFAVE: Grounds?
MS. MACCABEE: It's not clear what he was talking about, and Mr. Radue has already said he doesn't remember the context of the conversation.
MR. MILLS: I asked him for his understanding of the conversation.
JUDGE LAFAVE: The witness can answer if he knows.
THE WITNESS: The prior emails were with relation to AquaBlok or PondSeal so it's what was being discussed.
BY MR. MILLS:
Q. So just to be clear, Craig Benson responded to a discussion of AquaBlok saying, "Great, this could be perfect material"; is that right?
A. It is.
Q. I'll show you Exhibit 15. What does this exhibit depict?
A. It shows a cross section, the left side is north, the right side is south. It's through the north side of the basin.

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Q. You have been asked a number of questions about the construction of the bentonite amendment on the sides of the future basin. Do you recall that?
A. Yes.
Q. Did any of the questioning change your opinions about whether application of the bentonite amendment on the sides of the basin is practical and workable?
MS. MACCABEE: Objection, outside the scope of anybody's cross-examination.
JUDGE LAFAVE: Overruled.
THE WITNESS: My opinion remains the same.
BY MR. MILLS:
Q. And similarly, you were asked a lot of questions about the construction of the bentonite amendment on the beaches. Do you recall that?
A. Yes.
Q. Did any of the questioning about the construction of the bentonite amendment on the beaches change your opinion on whether it's practical and workable to construct a bentonite amendment on the beaches?
A. My opinion is that it is practical and workable.
Q. I'm going to show you Exhibit 38. You were asked some questions about this article on cross-examination. I want to turn page 7 of

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Exhibit 38. I think you were asked a number of questions about the last paragraph. Are you on page 7, Mr. Radue?
A. I am.
Q. I want to draw your attention to the last paragraph there. There's a sentence that refers to rototillers. Do you see that there?
A. I do.
Q. Can you just read that sentence, please.
A. "The only way to obtain truly effective in situ mixing is through the use of rototillers."
Q. And are rototillers part of what you would anticipate may be used to construct the bentonite amendment at the NorthMet basin?
A. Yes, and early in the evaluation of bentonite -- bentonite amendment evaluation we identified it, a rototiller type device. I believe it was called rotogator (ph) rather than rototiller.
Q. And let's turn to your rebuttal testimony transcript, please, at page 26, line 492.
A. I see that.
Q. And in that line, you're referring to rototill; is that the rototiller?
A. That's correct.
Q. Now, although you've been a bit challenged on

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cross-examination, do you remain confident that the bentonite amendment can be applied to the beaches?
A. Yes.
Q. I want to show you Exhibit 19. What was the purpose of your providing the information in Exhibit 19 as it relates to the construction on the beaches?
A. The purpose was to provide examples of typical construction equipment that would be used for bentonite application.
Q. And let's turn to Exhibit 68, please. Mr. Radue, what was the purpose of providing this information in Exhibit 68 as it relates to the beaches?
MS. COHEN: Excuse me, Mr. Mills, can we see Exhibit 68? We can only see the cover page.
THE WITNESS: The example, there -- it's showing a dual axis mixer in -- operating in challenging conditions. It was showing that even when conditions are challenging, there is a solution to executing a project.
JUDGE LAFAVE: Excuse me, sir, which page of Exhibit 68 were you referring to?
THE WITNESS: All of 68 in general.
JUDGE LAFAVE: Okay. Thank you for that.

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MR. MILLS: I'm trying to paint a big picture and be efficient.
JUDGE LAFAVE: Thank you.
BY MR. MILLS:
Q. So this coal ash example, the point was to show the capability of the contractors to operate in challenging conditions?
A. Yes, I've showed a number of exhibits in that regard.
Q. So it wasn't intended to show coal ash is the same as the tailings mixture with bentonite?
A. No. It was intended to show, again, the operations in challenging conditions. In this specific case, a specific piece of equipment that can be used for the bentonite application as well.
Q. And please describe that potential piece of equipment.
A. Well, it's a -- coal, a modified backhoe, and it's called a dual axis mixer. It's got a mixer head on the bottom that rotates in one direction to mix the material. I don't know if the backhoe rotates in 180-degree opposite direction.
And material is injected through the mixing head to mix with the, in this case, with the coal ash. This can be applied to tailings as well.

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Q. So in your experience as an engineer, you've seen contractors operate in conditions at least as challenging or more challenging than what they would encounter on the beaches of the NorthMet basin?
A. In more challenging conditions, yes.
MR. MILLS: Do we want to break for lunch or should I go into another topic?
JUDGE LAFAVE: So let's -- how much more do you have?
MR. MILLS: I'm not sure. More than five minutes.
JUDGE LAFAVE: Why don't we break -- let's break for lunch, but I want to have a discussion with counsel, though, about where we are and what we need to get done.
We're off the record.
(Recess taken.)
JUDGE LAFAVE: Good afternoon. We are back on the record. You're probably going to guess what I say next. I'd like to remind you that you're still under oath.
Mr. Mills?
MR. MILLS: Thank you, Your Honor.
BY MR. MILLS:
Q. Good afternoon again, Mr. Radue. I want to talk

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about Exhibit 293.28. It's the work plan document. You were asked some questions about this yesterday. This work plan identified objectives of pilot and field scale testing; is that right?
A. Yes.
Q. Please explain the primary objectives of that pilot, field scale testing.
A. I believe I summarized it yesterday saying something to the effect that the pilot testing and field scale testing are to confirm the percent bentonite to be used because we do anticipate some variability in the gradation of the materials that bentonite will be mixed with, so we want to confirm that we have adequate percent of bentonite.
And then secondly, to confirm that we have an effective and efficient means of mixing bentonite.
Q. In addition to those primary objectives, there was some additional objectives listed on the next page; is that right?
A. Yes.
Q. We're now on 293.9, and you were asked some questions. I just wanted to clarify that one of the objectives does relate to the pond water chemistry effects on bentonite hydration. Do you see that in

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the fifth bullet point?
A. Yes.
Q. And you agree that is one of the other objectives of the testing, correct?
A. When pond water is available, yes.
Q. And turning to -- just to be clear, turning to 293.14, this page also confirms that part of the testing process does relate to the pond water chemistry?
A. Yes.
Q. And finally on this document, let's turn to page 12. It's 293.12. You were asked some questions about testing yesterday on cross-examination, and I just wanted to point you to the final sentence of that paragraph under 3.2.3. If you could please read that sentence.
A. Are you speaking about the last sentence on -- excuse me. Are you speaking about the last sentence on the bottom of the page?
Q. The last sentence of the first paragraph under 3.2.3, it begins, "If additional experimentation is warranted."
A. Yes. "If additional experimentation is warranted or would be informative, then additional testing will be performed at the discretion of PolyMet's

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geotechnical engineer."
Q. So it's not necessarily only if DNR orders additional testing. It's also possible that PolyMet's geotechnical engineer would determine additional testing is warranted; is that right?
A. That's correct.
Q. I want to turn your attention to Exhibit 200.24. This is the Song and Yanful study. I believe you were asked a number of questions about this --
A. Yes.
Q. -- on cross.
Despite all those questions, do you still consider this study to be informative?
A. I do.
Q. And why is that?
A. They executed a field program and they identified some challenges with that program. I believe I spoke yesterday about the geometry of the configuration, we're not able to color the backside of the stock pond (ph), the air infiltration into the covered material. They acknowledge that they hadn't adequately mixed the bentonite with the cover layer.
But despite that, they also indicated they had significant improvement in water quality as

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a result of that cover system, and they had even -- even had the 65 percent -- I believe it was roughly 65 percent degree of saturation. They still had adequate -- they still had improved water quality. So I view that as being informative, despite the issues they encountered.
Q. Now I want to move to Exhibit 261, please. I want to turn to the first page of the exhibit. If we could zoom in on the first paragraph, I want to draw your attention to the last sentence in that paragraph. I don't think that was covered yesterday. I just wanted you to read that last sentence of the first paragraph.
A. "My understanding is that bentonite is used widely to create layers that retain water and reduce hydraulic conductivity, so I assume that it will work in this role, provided that it is installed correctly."
Q. And for the NorthMet project, do you believe the bentonite amendments can be installed correctly?
A. I do.
Q. And who was it that sent you this message?
A. It indicates it's from Houston Kempton, and I believe he was -- I don't recall exactly. I believe he was consulting to the DNR at the time of the EIS

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work, it looks like.
Q. I'd like to move to Exhibit 253, and we'll go to the first page of that exhibit. I think there was some confusion yesterday in the cross-examination questioning over -- if we could zoom in on the application of bentonite paragraph. It's the last paragraph on the bottom of the page.
I want to focus in on the meaning of the word "application" in this paragraph because I think there was some confusion in the questioning yesterday.
Does the first sentence indicate that the word "application" is used to refer to the application of the bentonite to the pond bottom?
A. The first sentence refers to application to the pond bottom, yes.
Q. And in the third sentence, the beginning of the third sentence refers to the specific application method. Does that still refer to the application of the bentonite?
MS. COHEN: Objection. This was asked and answered yesterday.
JUDGE LAFAVE: Overruled.
MR. MILLS: And I'm bringing clarity to the problems that were --

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JUDGE LAFAVE: The objection is overruled.
MR. MILLS: Thank you.
THE WITNESS: It's speaking about the application of bentonite to the pond bottom.
BY MR. MILLS:
Q. So the third sentence, the beginning says the specific application method. That word "application" is referring to application of the bentonite, right?
A. That's correct.
Q. Okay. And that sentence continues, "when we further evaluated in the years preceding its application." "Its application" is continuing to refer to the application of the bentonite, correct?
MS. COHEN: Objection, calls for speculation.
JUDGE LAFAVE: Overruled. The witness may answer.
THE WITNESS: It is speaking to application of the bentonite.
BY MR. MILLS:
Q. So it's not talking about the permit application, correct?
A. That's correct.

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Q. Okay. Mr. Radue, you were asked a number of questions about the pond cell 2W of the existing LTV basin earlier. Do you recall that?
A. Yes.
Q. And currently the LTV basin cell 2W does not have a pond on it; is that right?
A. That is correct.
Q. Please explain what happened with respect to cell 2W at the existing LTV tailings basin?
A. Well, my understanding is that cell 2W was drained after cessation of operations, so that's part of the reason it doesn't have a pond system.
Q. And when you say it was drained, is that -- that was intentionally drained, to your understanding?
A. There was a discharge structure from cell 2W to cell 1E.
Q. Turn, please, to Exhibit 16.
Do you recall answering questions on cross-examination about this Exhibit 16?
A. I do.
Q. Was -- and these were the test results of the 3 percent bentonite amendment?
A. This particular page is the gradation of the coarse tailings that was -- was not tested with 3 percent bentonite.

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MS. COHEN: Objection, misstates the prior testimony. His prior testimony was this gradation did not include bentonite.
(Court reporter requested clarification.)
THE WITNESS: That's what I just stated. This is the gradation of the LTV coarse tailings. Excuse me.
JUDGE LAFAVE: Thank you. Please proceed.
BY MR. MILLS:
Q. So let's step back to the whole test document that's reflected in Exhibit 16. The testing was done by an independent lab; is that right?
A. That's correct.
Q. Do you consider this test report to be reliable?
A. I do.
Q. And why is that?
A. Soil Engineering Testing is a reputable lab that's been in business for decades. We have used them for decades. They follow ASTM specifications. They are -- I don't know if the right word is accredited -- I'll use that -- by the Army Corps of Engineers. Or certified is a better word. Certified by the Army Corps of Engineers. So we have a very high degree of

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confidence in their work.
Q. And do you consider this test to be informative about the performance of the bentonite amendment on the sides of the basin?
A. I do.
Q. And do you consider this test to be informative about the performance of the bentonite amendment on the beaches of the NorthMet basin?
A. I do.
Q. And why is that?
A. This test was on the LTV coarse tailings, and as I stated previously, the coarse tailings were modified with 3 percent bentonite and received a low hydraulic conductivity, and it's fundamental to soils. As the particle size decreases or gets smaller, the hydraulic conductivity gets smaller. So if we mix 3 percent bentonite with the finer flotation tailings, it follows that it will have a low hydraulic conductivity as well.
Q. I'd like to turn to Exhibit 17, the next one. Mr. Radue, could you please explain what Exhibit 17 reflects?
A. Exhibit 17 has several parts. One is a data sheet on a bentonite product called Envirogel. There's another part which is, I'll say, marketing

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information about the Envirogel and its uses. And the third part is examples of projects where soil is amended with bentonite.
Q. Do you consider the examples where soil was amended with bentonite to be informative about the bentonite amendment at the NorthMet basin?
A. I do.
Q. And why is that?
A. For cover or liner -- liner or cover systems. As I stated previously in my testimony, there are standard construction -- there's construction equipment used, standard procedures, and those procedures can be applied to a wide variety of projects.
They've got over a hundred examples here and I just find it informative. It's a clear demonstration that the bentonite amendment soils have been used many times in the past.
Q. I want to talk to you about the hydraulic conductivity. You've answered a lot of questions about that. I want to talk about the 6.5 inches per year coming out of the pond bottom. In order to achieve that goal of the 6.5 inches per year, are there different hydraulic conductivity rates that can be used to achieve that?

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A. There are.
Q. And what is the variable in play that would affect the differences in the hydraulic conductivity rates for the pond bottom?
A. I've spoken about in Darcy's law there are, in addition to the hydraulic conductivity, the other two variables are the thickness of the bentonite-amended layer and then the depth of the water above that layer.
Q. So if you were to have a higher hydraulic conductivity rate, for example, the 3.9 times 10 to the negative 6, would you need a thicker layer to achieve that?
A. Yes, that's correct.
Q. And do you have an estimated number of how thick the layer would have to be to achieve the 3.9 times 10 to the negative 6?
A. I do not.
Q. You were asked a number of questions about seepage. I want to cover that topic a bit.
MR. MILLS: Please bring up Exhibit 216 at record number 741193, please.
BY MR. MILLS:
Q. Mr. Radue, do you recognize this figure?
A. I do.

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Q. And what does it depict?
A. It depicts the overall water balance for the flotation tailings basin during long-term closure.
Q. And what is the seepage rate expressed in gallons per minute from the basin pond?
A. It's 304 gallons per minute.
Q. I believe there was testimony earlier about there would also be seepage from beaches and dams, correct?
A. Yes.
Q. I want to show you a demonstrative exhibit showing the first row. Is that the 304 gallons per minute from the pond?
A. It is.
Q. And then the second column, first row, that expresses it in million of gallons per year?
A. That's correct.
Q. And what is the million gallons per year for pond?
A. It's 160 million gallons per year.
Q. And then there's an infiltration number tied to the basin beaches in the second row; is that right?
A. That's correct.
Q. And what is the infiltration for the beaches?
A. 139 gallons per minute.
Q. And then for the beaches, what is the millions of gallons per year?
A. 73 million gallons per year.
Q. And then with the dams, what is the infiltration in gallons per minute?
A. 123 gallons per minute.
Q. And how many million gallons per year?
A. 65 million gallons per year.
Q. And then there's a line for cell 2W and other. What is the infiltration from cell 2W and others?
A. 1072 gallons per minute.
Q. And how many million gallons per year?
A. 563 million gallons per year.
MS. COHEN: Excuse me, Your Honor. May I ask a question about the demonstrative exhibit?
JUDGE LAFAVE: What's your question, Ms. Cohen?
MS. COHEN: Is this a per-acre figure, or is this the entirety of the 900- to 1,000-acre pond?
THE WITNESS: These are --
MS. COHEN: For the pond. And similar questions for the beaches and dams.
THE WITNESS: These are totals for the entirety of the acreage.
JUDGE LAFAVE: Thank you. Please proceed.

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MR. MILLS: I intended this as a demonstrative, but if it would be helpful to put it in the record, I would be happy to do that. Otherwise not.
JUDGE LAFAVE: Unless someone has a burning desire to have it in the record, I think the testimony is sufficient.
MR. MILLS: Thank you, Your Honor.
BY MR. MILLS:
Q. So let's put this -- these infiltrations, then, into context. Let's go to the next demonstrative. So, Mr. Radue, what is the stored water volume in millions of gallons per year in pond water?
A. It's 2,170,000.
Q. I believe you may have misspoke.
A. I did misspeak, excuse me. 2 billion. Those are million gallons per year, so 2,170,000,000.
Q. So to be clear, when there's 2, comma, 170, that's expressing it in billions, correct?
A. Yes.
Q. And then what is the stored water volume in the basin below the pond?
A. 32,180,000,000.
Q. And then what is the stored water volume in the zone

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in the beaches?
A. 1,510,000,000.
Q. And what is the stored water volume of the -- under -- in the zone under the dams?
A. 520 million.
Q. And then there's also a stored water volume related to the LTV cell 2W. What is that number?
A. 19,560,000,000.
Q. And then there's also a water volume in LTV cells 1E and 2E. What is that volume?
A. 15,300,000,000.
MS. COHEN: Excuse me again, Your Honor. You know, this morning Mr. Mills had certain complaints about Ms. Maccabee's direct examination, that it wasn't clearly related to bentonite and its background, and I guess I'm going to hold up a mirror to this particular examination. I'm not sure how it is relating to bentonite. I'm not sure how it is relating to redirect testimony related to what the witness has testified to to this point.
JUDGE LAFAVE: Mr. Mills?
MR. MILLS: He was asked a lot of questions about seepage and infiltration. In order to understand the context of

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seepage and infiltration, you have to understand how much water is in the basin because when you talk about 160 million gallons of infiltration per year, you have to look at the denominator to figure out, well, what's the context of the overall water in the basin.
MS. MACCABEE: And, Your Honor, in that case, I'm going to raise an objection because the issue is compliance with the reactive mine waste pool, not how much water is in the wetlands or in the legacy tailing basin. So that's the context in which the 160 million is relevant is the provisions of the reactive mine waste.
JUDGE LAFAVE: I'll give you a chance to respond before I rule. Go ahead.
MR. MILLS: Sure. They're making a lot out of how much seepage is coming out of this pond. And in order to understand the materiality, if you will, of the seepage, you need to understand how much water there is that's not coming out of the basin.
JUDGE LAFAVE: I understand the objections, and I -- and in fairness to Mr. Mills, I will allow him a chance to -- this topic was -- there was a lot of questions on this topic on

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direct -- or on cross.
I will allow Mr. Mills to get his information in.
But again, I would encourage everyone to focus on the issues we're here to address because we are running into a time crunch.
MS. COHEN: Your Honor, can I ask one more clarifying question?
JUDGE LAFAVE: Yes.
MS. COHEN: Is this bentonite amendment figure, or is it -- the figures being provided, are they previous -- you know, the pond before the bentonite amendment and the beaches before the bentonite amendment being applied?
JUDGE LAFAVE: You may answer the question.
THE WITNESS: This is after the bentonite amendment.
MR. MILLS: And, I mean, in the interest of time, I'll just say -- I'll propose to mark this as Exhibit 81 and have it in the record, and I can --
THE COURT: Ms. Maccabee, I would ask that you, if you'd be kind enough to eFile Exhibits 349 and 350. And then, Mr. Mills, if you'd

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be kind enough to eFile Exhibit 81.
MR. MILLS: We were, and I have no further questions at this time.
JUDGE LAFAVE: Ms. Maccabee.
MS. MACCABEE: Your Honor, when you say eFile, did you say file 349 and 349A?
JUDGE LAFAVE: Yes, please.
MS. MACCABEE: Thank you.
MR. MILLS: And so with Exhibit 81, I'll try to move things on.
JUDGE LAFAVE: Thank you very much. Mr. Katchen, based on Mr. Mills' questions, do you have any recross?
MR. KATCHEN: No, Your Honor.
JUDGE LAFAVE: Ms. Cohen?
MS. COHEN: Your Honor, I'll pass, in the interest of time.
JUDGE LAFAVE: Ms. Maccabee.
MS. MACCABEE: Your Honor, in the interest of time, no questions.
JUDGE LAFAVE: Thank you. Mr. Holleman?
MR. HOLLEMAN: No questions.
JUDGE LAFAVE: Thank you all. I appreciate that.
Mr. Mills, you may call your next

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witness. And, Mr. Radue, thank you very much for your time and testimony. You may step down.
MS. MACCABEE: Your Honor, off the record, please.
JUDGE LAFAVE: We're back on the record. Mr. Mills?
MR. MILLS: Thank you, Your Honor. PolyMet calls John Hull to the stand.
JUDGE LAFAVE: Good afternoon.
THE WITNESS: Good afternoon, Your Honor.
JUDGE LAFAVE: Please raise your right hand.
JOHN HULL,
called as a witness herein, having been first duly sworn to speak the whole truth and nothing but the truth, was examined and testified as follows:
JUDGE LAFAVE: Please state and spell your name.
THE WITNESS: John Hull. J-O-H-N, H-U-L-L.
JUDGE LAFAVE: Thank you. Mr. Mills.
MR. MILLS: Thank you, Your Honor. May I approach the witness?
JUDGE LAFAVE: You may.

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DIRECT EXAMINATION
BY MR. MILLS:
Q. Mr. Hull, good afternoon. I have provided you a copy of your -- the transcripts of your direct testimony, and your prefiled rebuttal testimony. Do you see that in front of you?
A. I do.
Q. And can you please confirm that this is your testimony, both the prefiled direct testimony and the prefiled rebuttal testimony, this is truthful and accurate?
A. It appears to be.
Q. And you adopt the -- these transcripts as your testimony in this hearing?
A. I do.
MR. MILLS: With that, I don't have further questions at this time.
JUDGE LAFAVE: Thank you. Mr. Katchen -- Mr. Smith.
JUDGE LAFAVE: Mr. Smith.
MR. SMITH: Thank you, Your Honor.
CROSS-EXAMINATION
BY MR. SMITH:
Q. Good afternoon, Mr. Hull.
A. Good afternoon.

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Q. My name is Bryson Smith. I'm an attorney on behalf the DNR. I'll be asking you a few questions. Do you mind just -- I know it's in your testimony, but to give everybody here some background, just what your position is and what your relationship to the NorthMet project is.
A. My current position is as a senior consultant with Verdantas LLC, which is an environmental engineering firm. That is my day job. My night job, if you will, is I am also the president and technical director of another company, AquaBlok, Limited.
Q. And prior to this proceeding, had you had any involvement with the NorthMet project?
A. No.
Q. You provided several real-world examples in your prefiled testimony regarding subaqueous underwater applications of bentonite. Do you recall that testimony generally?
A. I do.
Q. And some of those examples included the Machado Lake in California, correct?
A. Yes.
Q. As well as the east branch of the Grand Calumet River in Indiana, the Ottawa River in Ohio, the

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Grass River in New York, and the CERCLA site in Illinois. Do you recall those examples?
A. I do.
Q. And in your view, these examples lend support to the conclusion that bentonite can be successfully applied to the NorthMet project pond bottom; is that correct?
A. It is.
Q. Could you summarize why you think that's the case?
A. Several of the projects were similar in terms of water depth. They're all freshwater applications that I provided as examples. They entail the type of logistical constraints that one would encounter at NorthMet, and they were successfully performed.
Q. And when you say they entailed similar logistical constraints, what are you referring to there?
A. Water depth primarily. Side slopes, beaches, inclined areas.
Q. I'd like to call your attention to page 4, line 50, of your direct testimony, please. And starting on line 50, it's highlighted on the big screen here. You say, "I have personally incorporated bentonite and bentonite-based products in waste containment and water control projects. I have designed since at least the mid-1980s. In all

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instances the designs performed as intended."
My first question is, is the examples you're giving here, are these the same examples we just discussed including Machado Lake, or are these different examples?
A. Different examples, generally use of bentonite as a geotechnical amendment.
Q. And could you elaborate a little bit just on the examples you're referring to here, what kinds of projects and applications you're referring to?
A. Designed and permitted and overseen the construction of numerous landfills for municipal solid waste, residual industrial waste, coal combustion byproducts, those sorts of things.
And in some cases I incorporated bentonite materials to either improve the natural soil conditions or to augment a liner system and critical components such as under -- in a leaching collection sump where I wanted to have belt and suspenders, if you will, to provide extra protection.
Q. Okay. And when you say in all instances, the designs performed as intended, were there quantifiable metrics that were being targeted there, or is that -- it might vary by case.

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And so, tell me, was it the general intent to reduce water infiltration or were there quantifiable metrics intended?
A. Both. In some cases, tests were performed to ascertain relative permeability post installation, pushing Shelby tubes and running lab tests on those tubes.
Other cases, the long-term efficacy of the overall system designs was provided by extensive monitoring.
Q. And so in the cases where there were quantifiable metrics being targeted, based on your statement that in all instances the designs performed as intended, is it fair to say that those metrics were met in all cases?
A. Yes.
Q. And then jumping back to the examples we talked about initially, Machado Lake, those lines of examples, do you know if there were quantifiable metrics for hydraulic conductivity, for example, in those cases?
A. Yes.
Q. And do you know if those metrics were achieved?
A. Yes, they were achieved.
Q. In all the examples provided?

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A. Yes.
Q. What about long-term performance? So, you know, some of these you say in your testimony the bentonite was applied successfully.
Are you aware of monitoring protocols at these sites to determine if the hydraulic conductivity is being maintained at a certain level over the long run?
A. The monitoring at the sites are probably different, and in some cases that I have personal knowledge of, they are. They are different. They're site specific.
I am familiar with applications of bentonite amendments where the finished product has been -- product being the project -- has been monitored for years with evidence of continued success of typically providing a containment function.
Q. And in these various projects, was there some degradation of the bentonite application over time?
A. I don't recall any indication of any measurable degradation over time.
Q. And do you know if any field tests were conducted at these various example sites prior to the installation of the bentonite application?

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A. They're typically --
JUDGE LAFAVE: Mr. Hull, why don't you -- I think these run on battery packs.
THE WITNESS: Okay.
JUDGE LAFAVE: So I think we're about at the time to switch you out, so if you'd just exchange that microphone with the one to your right, that should solve our problems for right now.
THE WITNESS: Thank you. Could you repeat that question, please?
BY MR. SMITH:
Q. Sure. Are you aware of any field tests being performed at these example sites prior to the actual installation of the bentonite amendment?
A. Most of sites have had some field work to characterize existing conditions in terms of permeability or grain size distribution of the native materials or the layer that would be capped.
Q. And I know we're talking about multiple sites, so we're kind of generalizing a little bit, but how long do these field tests tend to go on prior to the application?
JUDGE LAFAVE: Keep going, see if that last -- I think you were on --
THE WITNESS: See if it works? Okay.

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Most of the tests are fairly short-lived. It doesn't take too long to determine the conditions in the field relative to permeability.

BY MR. SMITH:

Q. And we talked about, you know, these subaqueous applications. You think that supports the conclusion that bentonite could be applied to the pond bottom in this case. Do you think the examples you've given also support the conclusion that bentonite can be successfully applied to the beaches and the dam sides at the flotations facility?

A. Yes.

Q. And why is that?

A. Several of the projects, examples provided included areas that were side slopes similar to the beaches, and several of those areas, the opportunity for preparation of the surfaces was rather limited, but that could be overcome by application methods and the types of materials that you put on.

Q. And so for some of these examples, how were those obstacles overcome?

A. Some cases used -- sorry.

Q. It's not just you. We were having issues yesterday as well.

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A. Some cases involve the use of mats to provide a proximity for general construction equipment to reach the areas. We worked off of pontoons or barges offshore to reach onshore in some areas. Material could be applied remotely by telescoping conveyors that can reach out as much as 200 feet to reach an area. In my experience, materials applied by such means can be applied fairly accurately and uniformly over the surface.

Q. Are you aware of any real-world examples where bentonite has been mixed with tailings?

A. Yes.

Q. What are those examples?

A. The project that Mr. Radue referenced earlier today here in Minnesota, the Minorca mine.

Q. Sorry. What was that?

A. The Minorca mine.

Q. Did you have any personal involvement in that facility?

A. I did not have any involvement in the design. AquaBlok provided materials for that application, and I have seen photographs and some reports of the placement of that material.

Q. Do you know if the AquaBlok -- first of all, when was that applied to that facility; do you know?

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A. First there was a field pilot test several years ago, and then last year there was an application. Or the previous year. I'm losing track of time.

Q. And do you know how large that tailings facility was?

A. A very large facility. This was just a portion of it. I'm not privy to how they determined where to put it or why. I just saw the extent of it and the amount of material that was provided.

Q. And do you have a ballpark in terms of acreage for how big a portion AquaBlok was applied to?

A. I don't.

Q. And where is this facility located?

A. In Minnesota. I have not been there. I don't know exactly. It's a Cleveland-Cliffs property.

Q. Is that, generally speaking, northern Minnesota?

A. Yes.

Q. Are you aware of any real-world examples where bentonite has been mixed in-situ with tailings as opposed to being applied on top of the tailings?

A. Just some of the literature that I reviewed.

Q. And what were some of those sites; do you know off the top of your head?

A. The Whistle Mine report.

Q. Any others?

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A. Not in depth.

Q. And going back to the prior application where it's just on top of the tailings, you gave the Minorca -- am I saying that right?

A. Yes.

Q. That mine. Are there any other examples you're aware of to bentonite being applied on top of tailings?

A. Not tailings per se, but quarry waste materials.

Q. And do you know where those projects were?

A. Illinois, several in Ohio.

Q. And we've heard some testimony about the beaches of this facility being relatively moist, having a high moisture content. Are you aware of any instances where bentonite has been successfully applied to surfaces based on the moisture content that's expected for the beaches here?

A. Yes.

Q. What are some of those examples?

A. One of the examples I provided was the park rehabilitation in Columbus, Ohio. A larger facility was a CERCLA Superfund site in Alabama where the AquaBlok material was used to cap a number of acres of a contaminated marsh area.

Q. Is it fair to say that the examples you provided

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where bentonite's been applied subaqueously tend to be much smaller applications than what's being proposed for the 900-acre pond bottom in this case?
A. To date, that's correct.
Q. And do you think there are challenges regarding scalability, you know, going from the Machado Lake, for example, which I believe is approximately 45 acres, going to a 900-acre application here, are there any challenges that you foresee?
A. No. Actually, there are opportunities by going larger.
Q. And what do you mean by that?
A. Economies of scale come into play very quickly. The materials can be manufactured on-site, which results in significant cost savings. The contractors will typically learn a lot and refine their operations, and end up with a much more uniform and efficient process.
Q. Okay. So generally, if you're talking economies of scale, you mean the bigger the application, the more efficient things become on a per-unit basis in terms of both labor and materials?
A. Yes, both.
Q. Do you think there's any potential for things like wave action in a larger body of water to have

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impacts that could adversely impact the bentonite amendment?
A. The wave action that may occur on the proposed tailing basins is probably going to be fairly minimal. That's a fairly small fetch, which is the distance the wind blows over the water to create the waves.
And the water depth would allow for dissipation of significant wave energy before the bottom were to be impacted.
Some of the beach areas could be perhaps affected by wave action, but that to me would be more of a maintenance activity to make sure that didn't become detrimental to the overall project.
Q. And when you say a maintenance issue, what does that maintenance process entail?
A. The current project, as I recall, does anticipate some armoring of some of the beach areas with riprap, and that is intended to protect the underlying containment layers.
Q. Do you think variability in terms of depth is an issue that can have a differential impact on the bentonite application, you know, whether you're applying it to a body that's a foot deep versus eight feet deep?

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A. Not really. Actually, after you get several feet deep, the material seems to go on smoother through most application methods.
Q. And what's the greatest depth of application you're aware of for bentonite being applied subaqueously?
A. Five hundred feet.
Q. Where was that?
A. That was in a well where it was applied through a drilling fluid to address a crack in the bedrock that was causing the well drilling operation to lose fluids too fast. And so they needed to address that and plug that, seal that before they could continue with the drilling.
Q. And was it applied successfully in that case?
A. It was.
Q. Based on the exhibits you submitted along with your prefiled testimony, it looks like you had several patents for various bentonite products; is that correct?
A. That's correct.
Q. Including patents regarding the use of a product you mentioned earlier, AquaBlok, right?
A. That's correct.
Q. And are you involved in the marketing operations of AquaBlok?

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A. Not directly. I'm more involved with the technical direction.
Q. In your opinion, does the type of bentonite used, whether it's powdered, granulated, pelletized, or AquaBlok specifically versus some other brand, does that matter in terms of the effectiveness of the application?
A. It does matter. Typically, thought is given to the type of application, and the materials that are selected for a particular performance is given consideration.
Q. So if you had an example where AquaBlok was successfully applied to sufficiently restrict the infiltration of water, do you think that lends support to the idea that a non-AquaBlok product can similarly be successful in restricting water infiltration?
A. The AquaBlok product is challenging to deliver high-value, fine-grain particles through water to a water surface to perform a variety of functions. Bentonite is one of the materials that we use in various product configurations, and bentonite was chosen initially because we're very familiar and comfortable with its relative performance under a variety of conditions.

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Q. Okay. But more specifically, when bentonite works in a specific application, do you think that lends support to the use of bentonite more generically beyond AquaBlok being used to limit water infiltration?
A. Oh, yes.
Q. Why is that?
A. It has a very long record of being used in a lot of different product applications for sealing, from trench dams to grout slurry walls, manage soils for building dams and liners.
There are other commercial products that include bentonite components in them to provide water sealing for basement walls or for incorporation into liner systems that have different types of layers and functions.
Q. And do you know if PolyMet intends to use AquaBlok in regard to its flotation tailings basin?
A. I'm sorry. Could you state that again?
Q. Sure. Do you know if PolyMet intendeds to use AquaBlok in its bentonite application to the NorthMet facility?
A. I believe that the application is appropriate for the flotation tailings basin.
Q. Right, but to your knowledge, do you know if PolyMet

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intends to use AquaBlok?
A. They have included in their design an AquaBlok product name as an option.
Q. But you don't know if they intend to use that definitively, correct?
A. No.
Q. And what is that AquaBlok-named product?
A. PondSeal.
Q. And everything you've testified about so far regarding the application of bentonite, would those statements be consistent as applied to the PondSeal product?
A. Yes.
Q. I'd like to refer you to page 11 of your rebuttal testimony, starting at line 206.
A. I see it.
Q. Okay, great. You're talking about the adaptive water management plan, and at the end of that paragraph you say, "I understand that the purpose of the bentonite-amended layer for the pond bottom is to maintain a positive pond water balance.
To achieve this objective, a target permeability of approximately 3.9 times 10 to the negative 6 centimeters per second is identified based on the performance of the existing pond's

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permeability and existing tailings at the pond bottom surface."
And then you cite to Mr. Radue's testimony. And you continue, "Nonetheless, I do believe the pond bottom could be amended with bentonite to achieve a pond bottom hydraulic conductivity of less than 2 times 10 to the negative 8 centimeters per second if it were necessary."
Do you see that?
A. I do.
Q. And I'm not going to get into the nitty-gritty of the hydraulic conductivity; I think your testimony speaks for itself as to why you think these numbers are attainable.
But I do want to address this idea that you say a lower hydraulic conductivity could be achieved if it were necessary.
And my question is, once you apply the bentonite, is it a static hydraulic conductivity, or is there a way to modulate the hydraulic conductivity in order to achieve a lesser or greater hydraulic conductivity?
A. We have actually had, at AquaBlok, customers select a permeability, and we've provided materials, different blends to achieve the permeability that

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they wanted for a particular application. So there's quite a range that could be provided.
Q. And what goes into that process of choosing the select -- the targeted hydraulic conductivity?
A. The types of clay minerals that are applied can be one factor. The particle sizes can be a second factor. And then the -- probably the major factor is the amount of bentonite by weight relative to the finished product.
Q. And when you come up with a different product for a different project, is that a different material every time or does it all fall under the same AquaBlok brand, it's just a modification of the same product?
A. Modification of the same product.
Q. If you could turn to page 21 of your rebuttal testimony, line 408.
A. I see it.
Q. Okay. And you say, "The bentonite amendment would not degrade rapidly, and while the system might increase in overall permeability over time, I believe the overall system mechanics anticipate and compensate for such an eventuality."
Do you see that?

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A. I do.
Q. And so do you acknowledge that the bentonite amendment may degrade over time?
A. Certain aspects of its performance may degrade over time, but that is highly unlikely in this particular scenario, in my opinion.
Q. Why is that?
A. The material that will be reaching the amended barrier layer will be primarily rainwater. It may pick up some cations as it goes through the overlying layers, but that will be relatively dilute, and my experience with the basic bentonite materials that we use and production of our products is that that would have a negligible impact on its performance from that aspect.
Q. Okay. But you do acknowledge there could be some degradation of the bentonite amendment over time?
A. Bentonite is a geologic material, so the basic material is not going to degrade over time as a function of any biological process. It keeps its properties basically forever.
Q. In regard to potential cation exchange, which you mentioned, do you acknowledge there could be some increase in the hydraulic conductivity over time due

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to some marginal diminishment of the performance?
A. In this particular application, on the side slopes, et cetera, I think it would be negligible.
Q. And do you consider yourself an expert on cation exchange?
A. I know the basics.
Q. Okay. Would Dr. Diedrich be a better person to ask about the more specifics of cation exchange?
A. She would. And I have had in my employ a PhD clay mineralogy expert helping with the development of the products and I've learned a lot from him.
Q. In this quote here you say, "I believe the overall system mechanics anticipate and compensate for such an eventuality."
What are you referring to when you say the overall system mechanics?
A. My understanding is that there's a seepage control system --
MS. COHEN: Your Honor, we're going to object to this.
You beat me to it, Paula. Go ahead.
MS. MACCABEE: Objection. This one -- this issue is very squarely in the area where you asked that there be no discussion at all.
MR. SMITH: Your Honor, I'm not trying to

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get into the specifics. I was just curious what the reference was to just to give us context on this quote.
JUDGE LAFAVE: The seepage control containment systems are not at issue in this trial but you can answer the question. And if you need to mention it for context, that's fine, but don't go into the specifics of the seepage control.
THE WITNESS: Understood. I'll keep my comments to bentonite.
JUDGE LAFAVE: Thank you.
THE WITNESS: Based on measurements of the overall system performance, one could augment any previous placement of materials with additional bentonite materials, particularly in the pond bottom or on the beach areas, without too much trouble. And that might help your system perform better.
BY MR. SMITH:
Q. Mr. Hull, have you reviewed the rebuttal testimony from petitioners' and DNR's expert?
A. I have.
Q. And after reviewing all that testimony, did any of that change any of your opinions given in your prefiled testimony?
A. Not that I can recall.

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Q. I appreciate your time. I think that's all I have for now.
A. Thank you.
JUDGE LAFAVE: Thank you.
Ms. Cohen.
CROSS-EXAMINATION
BY MS. COHEN:
Q. Mr. Hull, I usually have the very same mic problems you do so I'm going for the record on the number of mics that fail on me. And you're coming close, so I don't like that.
Mr. Hull, my name is Ann Cohen. I am the attorney who represents the group of environmental organizations which we call the conservation organizations.
So first I'd like to note that I apparently awarded you an honorary PhD in our rebuttal testimony and I assume you were not offended.
A. No.
Q. So you are a licensed engineer, correct?
A. I am.
Q. And you've been working with various waste containment and water projects for a very long time, 40 years, correct?

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A. Over 45.
Q. And a lot of those involved your patented product which is called AquaBlok, or a related product called PondSeal, correct?
A. No, most of my experience has been with conventional containment liner systems.
Q. Okay. Is it liner systems mostly or cover systems?
A. It's the same thing depending on where you place it and what you're trying to accomplish.
Q. Okay. So you focus on cover systems such as what is being proposed here, correct?
A. I have designed cap systems for waste containment facilities.
Q. And those involved, as you say, conventional bentonite?
A. They have largely involved native soils. They have included, in some instances, other products, including bentonite and liner systems, to achieve the design effect.
Q. Okay. So it's fair to say that some of these systems that you have described involve what we'll call, for lack of a better term, classic bentonite, not your patented products, just some of the systems involved bentonite.
Others were other kinds of soil systems,

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maybe including natural clays, magnesium clays, calcium clays, clays that were just being compacted and used for cover systems, correct?
A. By and large my experience is in native soil cover systems.
Q. Okay. By "native soil" you mean what?
A. What is available.
Q. What is available?
A. Near the construction project.
Q. Okay. So the engineers would set up a hydraulic conductivity standard and you would look for a source of that material that would be nearby and it could be placed and compacted and would meet that standard, correct?
A. Generally, yes.
Q. Okay. So today, for the first time during Mr. Radue's testimony, I heard that PolyMet would use AquaBlok for the pond bottom. Are you aware of that?
MR. MILLS: Objection to the extent it misstates Mr. Radue's testimony.
JUDGE LAFAVE: Noted. You may proceed.
THE WITNESS: It's been my understanding that it is one option that they have considered and looked into.

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BY MS. COHEN:
Q. But to your knowledge, they have not agreed to a proposal or signed a contract with your company, what you call your night business, which is the AquaBlok company?
A. I believe on the drawings it says PondSeal or equivalent. That could be any number of things. But, no, there's been no discussion of a purchase order or really costs.
Q. Okay. But nevertheless, you seem to have -- at this point, you know, Mr. Radue apparently thinks that there's some kind of an arrangement, correct?
MR. MILLS: Objection to the extent it misstates Mr. Radue's testimony.
JUDGE LAFAVE: Sustained.
THE WITNESS: I've had no discussions with Mr. Radue about any business applications here.
BY MS. COHEN:
Q. Okay. And so at the -- your testimony, you said PolyMet didn't contact you about this product until this hearing, correct?
A. That's correct.
Q. And so can you please tell me what permit support documents you reviewed for your testimony beside the 2019 testimony?

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A. I've looked at a lot of information. I can't recall the name of every document. I've seen some of the plan drawings.
Q. Okay.
A. Some of the supporting documents.
Q. I've asked you this question because I think, like Mr. Smith, I was struck by the fact that you referred to the targeted permeability of the pond bottom as 3.9 times 10 to the negative 6 centimeters per second, but your citation for that was actually Mr. Radue's testimony.
A. I don't understand the question.
Q. Well, I guess the question was, are you getting your information from Mr. Radue or are you getting your information from the actual application documents that have been submitted?
A. I believe I received most of the information from the -- my review of the documents.
Q. Okay. So -- but you don't recall which documents specifically you reviewed?
A. No.
Q. Okay. Are you familiar with the modeling on this project?
A. No.
Q. Okay.

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A. I don't exist.
Q. You don't exist, but that is not one of the documents that you've reviewed, correct?
A. Reviewed is a relative term. I have been provided with several feet of documents, and the amount of time I've spent looking over individual documents has been variable.
Q. So I don't want to put you on the spot here, Mr. Hull, but if this figure that you're using in your testimony, the 3.9 times 10 to the negative 6, was different from the modeling used, you would agree that it would make a difference in a couple of things, including the amount of water flowing through the bottom of the tailings pond and into the groundwater, correct?
A. It could.
Q. And it would also probably make a difference in terms of how much AquaBlok would be necessary, correct?
A. No, not necessarily.
Q. And just to be clear, Mr. Hull, when I say AquaBlok, I'm talking about the AquaBlok family. It could include other products as well.
All right. So I'd like to talk to you a little bit about your definition of "practical

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workable." And this was in your testimony. I hope you've reviewed your testimony so we can talk quickly about this.
But I'll read to you from your rebuttal testimony what your definition was. It's, "Practical and workable is that it considers the materials and methods, e.g. equipment, skill sets, et cetera, necessary to accomplish a goal are available, are relatively cost effective, can be completed safely, and do not rely on challenges or performances that are not regularly achievable at full-scale applications."
Does that sound familiar?
A. It sounds familiar. Could you give me the reference, please?
Q. Sure. It's your rebuttal testimony, page 4, lines 67 through 70. And I think we have it on the screen for you, if you'd like to look there.
A. Okay.
Q. And Mr. Hull, I understand you might have looked also at Petitioners' expert's testimony and that's not too far off from what our expert said. Do you agree?
MR. MILLS: Object to form and foundation.

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JUDGE LAFAVE: Are you referring to the next line in -- the next question in the testimony?
MS. COHEN: Actually, no, I'm not.
JUDGE LAFAVE: Then if the witness understands the definition referred to, you may answer. If you need more clarification, please ask.
MS. COHEN: Well, I'll rephrase the question.
BY MS. COHEN:
Q. Do you feel like you have a dispute with petitioners' experts, any dispute over what practical and workable means?
A. I have one major dispute.
Q. And what's that?
A. My reading of their definition seems to hinge on the circumstance that if it hasn't been done before at a certain scale or exactly as is proposed, that it has not been demonstrated as being practicable or workable. And I took exception with that qualification.
Q. Okay. I mean, we'll talk about that a little bit then.
So I just wanted to ask you, you talked about the Minorca mine, correct?
A. Yes.

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Q. And you're not deeply familiar with it but you knew that a pilot test was conducted, for example?
A. I am aware of that.
Q. And so would you -- and when I was reading your testimony, it seems like most of the projects that you worked on involve some form of field testing or pilot testing before you went live, so to speak, and built the project?
MR. MILLS: Object to form, foundation.
JUDGE LAFAVE: Overruled.
THE WITNESS: It's not uncommon to complete pilot tests or field tests to determine the best means and methods to accomplish a design goal.
BY MS. COHEN:
Q. And if a project is considered a complex one or a large one, would it be your recommendation that a pilot testing and the fairly -- you know, pilot testing be done? We can just leave it at that, pilot testing.
A. Actually, a large project of some duration and size lends itself to actually fine-tuning the means and methods while you're in the process of project completion.
Q. But you would agree, Mr. Hull, on a project that involves environmental impacts more in the nature

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almost of a remediation project, you can't really take your time to implement the cover system on the pond because all while you are adjusting and trying to make it work, the thing that you're trying to control is not being controlled? You would agree with that?

A. On a remediation project, say a spill response project, then containing the issue, minimizing potential impacts, so time is of the essence, absolutely.

On an existing facility that is being run and operated and maintained, I don't think that is critical.

Q. But you would agree, Mr. Hull, we've -- we have here a situation where we have reactive mine waste, which if it isn't properly contained in closure, could be having an environmental impact?

A. Any facility that isn't operated or contained in closure properly could have an impact.

Q. Right, and you wouldn't want to rely on having to adapt the application at closure when you have an opportunity first to figure out whether it worked through pilot testing or field testing, correct?

A. I would not propose a remedy that I didn't think would work in the first place.

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Q. I have --

A. That's the engineer's job, is to identify alternatives and do preliminary evaluations and select something.

Q. I agree with you, Mr. Hull, that's the engineer's job. So you would want the engineer to do that job to the best of their ability before the project actually starts, correct?

A. The best of the ability oftentimes is when the project starts where you have a particular contractor on board, you have the best knowledge of the existing conditions at that time, as opposed to a projection of what the conditions will be, you know, way down the road.

It's very common in construction of large containment projects to have some design components selected, and then prior, just prior to the construction, completing field testing to verify your design approaches.

Q. Mr. Hull, I don't disagree with you, but you would also agree that you don't start a mine without knowing, having some idea of how you're going to do the closure, right? That wouldn't be responsible engineering?

A. I presume not.

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Q. And so at the time when you get to closure, you might engage in some further testing to confirm that your original design is still valid, correct?

A. That's not unreasonable.

Q. And you would further agree that if your design has to change significantly, you might find out that, for example, the permittee is not satisfied and wanting to pay for it?

MR. MILLS: Object to form and to scope.

JUDGE LAFAVE: The objection is overruled. You may answer.

MR. MILLS: Can I clarify?

JUDGE LAFAVE: Sure.

MR. MILLS: DNR specifically excluded financial assurances from this proceeding, and I think the reserves question --

JUDGE LAFAVE: I didn't take that as a financial reserve question. You may -- if you can remember what the question was, repeat it. Please re-ask the question.

BY MS. COHEN:

Q. So I will ask the question again, Mr. Hull. So you would not want to get to the point of having to close a facility only to discover that what you assumed was going to work isn't going to work and

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you have to do something more expensive because the permittee may not have anticipated that cost, correct?

A. You're asking a question of me as -- in what role, what capacity?

Q. I'm putting you in the role of the engineer who's designing the closure plan for the purpose of submitting a permit application to the DNR to get this thing permitted, to get the mine permitted. And you're -- that is your role in this question.

A. I have designed and permitted many, many waste containment facilities, and I have provided cost estimates to the clients, and the discussions between them and the state agencies on financial assurances is above my pay grade.

Q. I agree. And that's not what we're talking about here today. But you agree as a responsible engineer, it is part of your job to advise your client before they move forward with the project of what the cost will likely be when it comes to the point of having to actually execute a plan?

A. Typically, the engineer's job is to design something that will work, that is cost efficient. That's one of our charges. And we have that conversation with

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the client and we relay that information to the best of our ability.
Q. Right, and that's consistent with your definition of practical and workable, it has to be cost effective, correct?
A. Yes.
Q. And that means the client has to know what the costs are and be ready to pay for them at that time?
A. There are typically contingents provided for in any estimates.
Q. Sure. So, for example, if you -- if there was a possibility, as a prudent engineer, that more bentonite or more PondSeal might be needed, you would want your client to understand what the cost of that might be?
A. Yes.
Q. And this segues very nicely into some questions I'd like to ask you about testing.
JUDGE LAFAVE: Is this a good time for a break, Ms. Cohen?
MS. COHEN: No, it's fine.
JUDGE LAFAVE: Let's -- we need to give -- make sure our court reporter gets a break.
MS. COHEN: Yes, we do.
JUDGE LAFAVE: We're in recess for 15

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minutes.
(Recess taken.)
JUDGE LAFAVE: Good afternoon. We are back on the record. Mr. Hull, I remind you that you are still under oath.
THE WITNESS: I understand.
JUDGE LAFAVE: Ms. Cohen.
BY MS. COHEN:
Q. Mr. Hull, I believe where we left off is I had just finished asking you some questions about whether it would be advisable to know what the cost of a closure plant is going to be at the time you start a mine or that kind of facility.
So I'd like to now move on to some questions about testing. And first I'd like to just note your testimony, which was that "laboratory conditions can almost never perform exactly as large-scale field implementation."
Do you recall that testimony?
A. Can you give me the citation?
Q. Sure can. Again, this is your rebuttal testimony. I think it is. Maybe Ms. Guenther here can pull it up. I have it as page 2, lines 35 to 36, but I'm a little worried that I'm off just a little bit, but we'll see.

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Oh, no, that's it. "Laboratory conditions can almost never perform exactly as large-scale field implementations."
THE WITNESS: Your Honor, could I correct that?
JUDGE LAFAVE: What would you --
MS. COHEN: Your Honor, I'm perfectly willing, if Mr. Hull wants to correct his testimony, that's just fine with me. We want a good record here.
JUDGE LAFAVE: Thank you.
Mr. Hull.
THE WITNESS: That was a little poorly worded. Laboratory conditions and field conditions rarely are exactly the same. It doesn't mean one performs better than the other.
JUDGE LAFAVE: Thank you.
Ms. Cohen.
BY MS. COHEN:
Q. Yes, but you also said that a practiced engineer never relies solely on laboratory outputs, correct?
A. Correct.
Q. Then laboratory outputs are just a place to start, correct?
A. When you say rely, that context makes that question

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difficult for me to answer.
Q. Those are your words so hopefully you can explain them better. I'm not getting the gist of them.
But you said, "A practiced engineer," this is your line 32, "never relies solely on laboratory outputs."
A. Through the execution of a project, while we may rely on the laboratory results or modeling to design something, during the execution of the project, construction activities typically require quality control, quality assurance activities that are done at the time the activity is being complete.
Q. Absolutely, and the purpose of that quality assurance and quality control is to be sure that the design is actually being met in the construction phase, correct?
A. Yes. They're done to assure that the objectives of the design are going to be met.
Q. Correct. And so if your quality control, quality assurance parameters were exceeded, you would be upset with your contractor, correct?
A. Not necessarily. Exceeded could imply bad performance.
Q. Oh, I didn't mean that. I meant if they were underperforming, then you would discover that

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through your confirmation testing and you would require your contractor to make it right, correct?
A. Correct.
Q. But when you're designing a project, you wouldn't want to rely solely on your lab testing, correct? You'd want to pilot that project or field test that project, particularly if it was one that could be affected by field conditions?
A. Not necessarily. An experienced engineer is going to rely primarily on their experience of using the proposed design parameters and probable means and methods, which would be fine-tuned in the field. There are different ways to skin a cat and you have to consider the project objectives and sometimes priorities of project objectives, other constraints, the time of the year construction is going to go under. There are many variables that you don't want to pin things down too tight in a engineering design plan that is not reflective of the conditions under which you're going to construct the project.
Q. Correct, and you would agree that most large-scale environmental engineering designs are very site-specific, correct?
A. They are all site-specific.

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Q. And so while components of means and methods might be similar to other projects that have been successful in field scale, the appropriate combination of materials, configurations, and implementation are frequently unique. And I am reading your own words.
A. I recognize them.
Q. So it seems -- and let me mention one other thing. You stated that you would assume an order of magnitude increase in the permeability of fill relative to lab testing, and you described that issue "rule of thumb."
A. With regards to permeability of many native soils where you will have the current variability on an aerial extent over site, you can't count on a specific lab number being achieved by the same set of other parameters, like compaction criteria, density, moisture content, et cetera. So we do multiple tests prior to construction to provide bookends, if you will, of the acceptable tolerances for the field testing that is conducted as the materials we placed and compacted. It's prudent to understand that you may have some variation, so we don't really pick an exact number, although the regulations might say that you shall have a liner of three feet thickness, 1 times 10 to the minus 7 centimeters per second. We'll evaluate the native soils, for instance, and based upon our understanding of the compactive effort necessary to achieve a certain permeability, we may design a field protocol that is more rigorous than the laboratory protocol, because part of quality assurance sometimes is going out and taking a sample as the material has been placed and then sending that off to a laboratory. And we want to make sure that that passes the tests appropriately.
Q. So, Mr. Hull, you would agree if some of that material were available today, you would recommend to the DNR that the permit applicant go out and do some tests of that material to discover, for example, its variability?
A. The variability that is likely to occur, I believe, has been addressed by the work plan that has been included as part of the application that notes that there may be a range of bentonite amendments to achieve the desired permeability for the constructed improvements.
Q. But, Mr. Hull, you would agree that it would be best

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in designing a cover system, if you have the material available, before you actually propose a design, you would go out and test that material. You would test it in lab, and, if appropriate, you would do field testing of that material?
A. My understanding of the project is that much of it is going to be built as the -- like the dams and sides slopes, as the facility is constructed, they'll be going through construction every year.
Q. Well, Mr. Hull, let me -- I think we're missing each other here. So I'm pointing out to you that on this particular facility, we have some of the tailings already deposited that will be used, for example, to build the dams.
And in that situation, your recommendation as -- you know, in the place of a design engineer would be to test that material with the bentonite, for example, that you would be using, the various types of it and amounts, so that you could have a better design going into the permitting process?
MR. MILLS: Object to form, and to the extent it misstates his prior testimony.
THE WITNESS: I --
JUDGE LAFAVE: Wait for just a second,

sir.
It was kind of a compound question. If you'd be kind enough to rephrase, please.
MS. COHEN: Sure. So I'll just go back to the beginning.
BY MS. COHEN
Q. So you understand that there is material available today that is going to be used to build the dams?
A. That's my understanding.
Q. And you would agree that today that material could be tested against various dosages and types of bentonite to see what the results would be in terms of permeability or oxygen saturation or what-have-you?
A. It could be.
Q. And you would agree that before you make a design, because you're a prudent engineer, you would complete that testing and perhaps apply the rule of thumb, which is to increase in order of magnitude your design specifications based on that testing?
A. Not necessarily. It -- depending on my level of comfort with an understanding of the material at hand, that would determine whether or not I would -- were going to do additional testing during the design stage.

Q. But if you were a prudent engineer and you were following your own advice, you would do that testing; would you not?
MR. MILLS: Object to form, and asked and answered.
JUDGE LAFAVE: I'll allow it. You may answer the question.
THE WITNESS: The question again, please.
BY MS. COHEN:
Q. If you had -- following your own advice, Mr. Hull, as stated in your testimony, you would test the material that you have available and then you would increase it by an order of magnitude under your own rule of thumb for your design?
MR. MILLS: Object to form, and to the extent it misstates his prior testimony.
JUDGE LAFAVE: Overruled. You may answer the question.
THE WITNESS: Not necessarily. Depending upon my level of comfort and understanding of the materials at hand, I would not necessarily feel obliged as a professional to conduct additional testing.
If I know through experience that a bentonite amendment will achieve the particular goal

and I'm comfortable with a range of that material and are anticipating that, I don't see any reason to do a lot of extra testing before I go out and start construction.
BY MS. COHEN
Q. Even if this was a unique, environmentally complicated scene?
A. They're all unique.
Q. All right. Not a pond bottom for a park?
A. I'm sorry?
Q. Not a pond bottom for a park, but instead a thousand-acre mining tailings facility.
MR. MILLS: Object to form, argumentative.
JUDGE LAFAVE: Sustained.
MS. COHEN: All right. I guess I should move on then.
BY MS. COHEN:
Q. So if AquaBlok was going to be used for a project like this, would you want to design for that use? Plan for that use?
MS. COHEN: Can I have Exhibit -- PolyMet's Exhibit 9, please.
BY MS. COHEN:
Q. So, Mr. Hull, this is PolyMet's Exhibit 9. It's a

picture that Mr. Radue offered in his testimony. Have you seen this picture before?
A. I don't recall.
Q. So Mr. Radue testified that this shows the conditions under which contractors can work.
MR. MILLS: Object to form, foundation.
JUDGE LAFAVE: Please rephrase your question.
BY MS. COHEN:
Q. Mr. Hull, you agree that this shows earth works on a site that's very wet, and it appears that splitter dams are being used to separate smaller ponded areas, correct?
MR. MILLS: Object to the form and foundation.
JUDGE LAFAVE: Overruled.
THE WITNESS: It could be a depiction of that.
BY MS. COHEN
Q. And so if you were going to do a project that would benefit from having smaller areas to work in, so you could work, for example, from land to deposit the AquaBlok product, splitter dams might be something that you would want to have built into the design, correct?

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MR. MILLS: Object to form, calls for speculation.
THE COURT: Where are we going with this testimony?
MS. COHEN: Your Honor, what I want to establish is that if you are going to use a particular product, it's important that the design that's being approved reflect the use of the particular product.
In this case, AquaBlok -- you know, the examples that have been given all involve smaller areas. And so it may be that if you're going to use AquaBlok, you would design the tailings facility to include smaller areas, as we see here in this exhibit.
MR. MILLS: Your Honor, the design of the tailings facility is not at issue in this hearing.
JUDGE LAFAVE: I was going to -- I mean, I'm not following where -- I mean, I understand that there's -- you're questioning the scale; that there's a big difference, in your view, from a 40-acre pond or a 20-acre pond to a 940-acre pond. That I understand.
Does this get you there?
MS. COHEN: The object of the question is

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to establish that as a prudent engineer, designing a closure system for a mine, if you -- you need to take into account at the design stage what the closure is going to look like, and if you need to have smaller areas in which to work, you would want that to be incorporated in the design. Otherwise, it's not a reasonable -- it's not a prudent and workable solution.
MR. MILLS: Your Honor, if I may?
JUDGE LAFAVE: Yeah.
MR. MILLS: The design of the tailings basin is not at issue here.
JUDGE LAFAVE: No, I get that. I get that there's -- I don't think there's a dispute about the design -- no one's disputing that the design of the tailing basin is not at issue. The question Ms. Cohen is raising, as I understand it, is that this is going to the workable, practical and the size and scope.
You can certainly proceed on that line. I'm not sure your line of questioning as to the compartmentalizing was getting you closer to where -- your goal, but I'll allow -- I'll, you know, give -- you can keep exploring this, the concept.

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MS. COHEN: Your Honor, hopefully I can move on shortly. I mean, to me, it seems very simple, and if you have a practical and workable closure plan, you have to plan for the materials that you're going to use, you have to test the materials that you're going to use and design accordingly.
That's all -- that's the point I'm trying to get the witness to either agree or disagree with.
BY MS. COHEN:
Q. So do you agree that if you're going to use a particular project, it makes sense to test -- product, it makes sense to test that particular product and design for that particular product and not do that on the fly when you finally get to closure?
A. You only do testing of those aspects of the product as they pertain to the project at hand where there is some question as to the ability to apply the product in the manner prescribed.
Q. I think we'll just move on.
So I'd like to explore some of your testimony that you offered with regard to the bentonite amendment plan. All right?
So what you've indicated -- again, this

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is in your rebuttal, page 5, lines 90 to 94 -- you were in support of this plan because you said, "The material is readily available. Its performance under a variety of geochemical exposures is sufficiently well-known. It is relatively cost effective, and the means to incorporate the bentonite under various scenarios exists using specific special equipment. And in some cases, rather common construction equipment and techniques."
Do you remember testimony?
A. Yes.
Q. So is it fair to say that you are not testifying that this type of cover proposal is well-known; is that correct?
MR. MILLS: Object to form, and to the extent it misstates his testimony.
JUDGE LAFAVE: Overruled. You can answer the question.
THE WITNESS: I'll need the question again.
BY MS. COHEN:
Q. Well, again, you've used a lot of words like "sufficiently" and "relatively" and the "material is readily available" and things like that, but you

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seemed rather hesitant in your endorsement of the proposal. You have these words in there that indicates some equivocation about it; is that fair?
MR. MILLS: Object to form.
JUDGE LAFAVE: Overruled.
THE WITNESS: No.
BY MS. COHEN:
Q. So in some cases, you say common construction equipment and techniques work, correct?
A. Yes.
Q. But that means in other times they don't, correct?
A. It may be very advantageous to use specialized equipment, especially on a project of this scale.
Q. Right, because this is a difficult project with a complicating factor of permanent pond, for example, that might interfere with placing bentonite on the beaches?
MR. MILLS: Object to form.
JUDGE LAFAVE: Overruled.
THE WITNESS: I think I testified earlier that there could be some advantages from applying materials on the beaches from the water. I don't see that as a particular challenge in this area.
BY MS. COHEN
Q. You have 625 feet of beaches.

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A. Yes.
Q. So you're going to apply -- you're going to float a barge on the water and apply the material and somehow mix it, because it has to be uniformly mixed on 625 acres of beaches?
MR. MILLS: Object to form.
JUDGE LAFAVE: Overruled.
THE WITNESS: I'm sorry, I still don't understand the question.
BY MS. COHEN:
Q. The question is whether or not you agree that you could use common construction equipment on this site.
A. Portions of the site can be capped or bentonite amendments placed using common equipment.
Q. And portions might be more complicated?
A. And portions will require other equipment.
Q. And you're saying that equipment might have to be custom made?
A. No, I believe I said that the opportunity of having some custom equipment may reduce costs and provide efficiencies.
Q. And would you agree that when you're getting into construction of this kind of layer, there are some challenges, correct?

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A. Every construction project has some challenges.
Q. And you would agree -- you had mentioned the Song and Yanful Whistle Mine studies. You would agree that the contractor there who was making the test plot encountered some challenges in mixing the material?
A. I wasn't there. I didn't see it. I didn't read enough detail of what those challenges particularly were.
When you're amending a product, you have a lot of options of doing a better job of straining and mixing materials that you're going to be using, applying different amounts of bentonite, applying different amounts of compaction. You have a lot of variables to make it work.
Q. Absolutely a lot of variables. And isn't this why on most of your projects you do some pilot testing and field testing before you decide on the design?
MR. MILLS: Object to form.
THE WITNESS: No.
MR. MILLS: And to the extent it misstates his prior testimony. I feel like we're going over or around in circles and time is sort of getting short.
JUDGE LAFAVE: You've kind of explored

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his -- you've explored his opinions on testing. I think you can move on.
MS. COHEN: All right. Thank you, your Honor. I'll do that.
BY MS. COHEN:
Q. So let's just briefly talk about -- well, we've already touched on the Whistle Mine, I guess, even though -- you said the closest was the Whistle Mine in your testimony, and I'm trying to get you to agree that there were problems there, but you are reluctant to do that.
So would you also agree that industry guidance documents -- maybe I should ask you. Are you familiar with mining industry guidance documents that address this type of a cover system, the soil cover system --
MR. MILLS: Object to --
BY MS. COHEN
Q. -- with bentonite? Are you familiar with those?
MR. MILLS: Apologies. I think the question has ended.
Object to form, compound. And strike all the commentary about what -- you know, we don't need commentary here, Your Honor.
JUDGE LAFAVE: Please rephrase your

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question.
MS. COHEN: I will.
BY MS. COHEN:
Q. So are you familiar with industry guidance documents with regard to covers systems for reactive tailings? And I'll name them. There's amend guidance, the "GARD Guide," all these -- they're various industry publications. Are you familiar with them?
A. I am familiar they are there. I have looked over some of them briefly. They are not documents that I use on a regular basis.
Q. So are you familiar with what they recommend with regard to soil-based cover systems?
A. No.
Q. All right. And you indicated you've done research yourself on this subject of soil cover systems?
A. I have.
Q. And this is unpublished research, correct?
A. Some of the research was used to obtain a patent.
Q. And you agree that this unpublished research that you speak of has never been -- you agree this research is not peer-reviewed, correct?
A. That's correct.
Q. And you agree the main reasons academics, researchers publish in journals is to get the

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approval of peers, correct?
A. Academics seem to like to have approval of their peers.
Q. And you would agree that it would be difficult to introduce these manuscripts today, right, as part of your testimony, your research?
A. No.
Q. And you would agree, and without disrespect, that it would be difficult for the DNR to rely on your unpublished studies, right, because they have not been peer-reviewed?
A. That's correct.
Q. And you would want a regulator to rely on written evidence when making an important permitting decision?
A. I'm not a regulator. I don't know the rules of their reviews.
Q. All right. I'd like to get back to your testimony on the efficacy of the 3 percent bentonite blend that's proposed here.
Do you have an opinion about whether it's going to work or not, 3 percent?
A. I do.
Q. Do you know enough at this point to say what your opinion is?

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A. I believe it has a chance of being successful at 3 percent. When you are doing a blended material, the amount of clay minerals or bentonite that may be present is only one factor. The gradation of the material, the amount of fines and the size of those fines is a very important factor.
I've achieved recompacted natural soil liners using basically sand materials that were very uniformly well-distributed over the sand/silt range with as low as 2 percent clay, and by providing appropriate compaction and construction techniques, I have achieved 10 to the minus 9 centimeters per second permeability.
Q. All right. I won't beat the dead horse here, but wouldn't you want to test that blend against those particular soils before you made a design based on that?
A. It's my understanding that they did do a test.
Q. So would you want a regulatory agency to make a regulating -- an important regulatory decision based on one test?
MR. MILLS: Object to form, foundation.
JUDGE LAFAVE: Sustained.
THE WITNESS: Most regulatory reviewers that I work with -- I beg your pardon.

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JUDGE LAFAVE: Don't answer.
MS. COHEN: He sustained the objection.
JUDGE LAFAVE: I sustained the objection so you don't need to answer the question.
THE WITNESS: Okay.
BY MS. COHEN:
Q. Right. So your testimony is your understanding is there was one test, correct?
A. Yes.
Q. And the objection was to my question as to whether you think it is appropriate to make a regulatory decision based on one test?
MR. MILLS: Object to form and foundation.
JUDGE LAFAVE: That objection was sustained.
MS. COHEN: Okay. That's sustained, okay.
BY MS. COHEN:
Q. So I'd like to ask you just a couple of questions. You thought the -- you know, given the moisture problem that might be present in the beach areas at closure and due to the permanent pond, that you could build the bentonite amendments in winter; is that your testimony, frozen ground?

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A. You can apply it in winter.
Q. But you can't in-situ mix it in winter, correct? Because the soils would be frozen.
A. You're assuming the soils are frozen?
Q. I am. Otherwise, they wouldn't be very firm to go on.
A. You could mix it in winter.
Q. Can you moisture condition it in winter?
A. Yes.
Q. Have you been in Minnesota during a winter?
A. Yes.
Q. So -- okay. Can you discharge bentonite pellets through a frozen pond?
A. No.
Q. Okay. And in any case, it would be more expensive and slow the work, too, to have to work in the winter, correct?
A. Depends on what work you were doing in the winter.
Q. All right. We're almost at the end here. So your testimony was that we don't have to worry about desiccation with regard to the beach and the dam bentonite amendments because "they would be ceded in the pond and can benefit from capillary action." Is that your testimony?

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A. Yes.
Q. And when you say capillary action, you mean that the pond water will infiltrate into the beaches, correct?
A. Soil particles, soil particles that are completely dry will pull water up when they're in contact with the water, and they coat the soil particle. It's a surface tension phenomenon.
Q. Correct. And your testimony -- I'm sorry. Go ahead.
MR. MILLS: Objection.
JUDGE LAFAVE: Please let the witness finish his answer.
THE WITNESS: The bentonite is hydrophilic. It loves water. It has, if you will, a super surface tension phenomena and it will wick up water if there is bentonite in contact with water like the pond bottom and with other bentonite particles. So it can literally be pulled up a slope out of the pond quite a ways.
BY MS. COHEN:
Q. Right. Are you aware that Dr. Diedrich testified to the opposite, the pond water will not infiltrate or affect the beaches?
MR. MILLS: Objection to the extent it

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misstates prior testimony.
JUDGE LAFAVE: Let's assume for the sake of this question that the representation as to the -- Dr. Diedrich's testimony was correct; you may proceed.
BY MS. COHEN:
Q. So she had that wrong?
A. Say the question again, please.
Q. So Dr. Diedrich said we didn't have to worry about the chemical composition of the pond water affecting the bentonite that would be incorporated into the beaches because the pond water will not affect beaches. And I take your testimony to be the opposite?
MR. MILLS: Objection to the extent it misstates both testimonies.
JUDGE LAFAVE: You can clarify the -- your answer, or you can respond to that question.
THE WITNESS: I think that the other statement that Dr. Diedrich made was in relation to the quality of the pond water.
BY MS. COHEN:
Q. Correct.
A. That's not what I'm speaking to.
Q. What are you speaking to?

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A. The presence of the pond water.
Q. So you agree that the pond water will be present in the beaches?
A. The potential for pond water to replace or replenish the moisture content of the bentonite-amended layer over the beach area is what I'm referring to. So if there is excess desiccation, one would expect the pond water to help replenish what is lost through evapotranspiration and keep that more plastic.
Q. I understand. So I'm going to ask you a last question here. You attached to your testimony a dissertation that was prepared by now Dr. Roberts. And I gather you were involved in the work that he did to prepare that paper; is that correct?
A. I helped to provide materials and some guidance to Dr. Roberts. He was sponsored by a Japanese company that we had a relationship with.
Q. And it would be correct to say that the dissertation covered two basic areas, the compaction of the AquaBlok, the gravel-coated bentonite and what effect that would have on it, and then the other area was the effect of leachates on the bentonite-coated product, correct?
A. Those were two areas that he investigated.

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Q. Right, and so it's fair to say that his compaction research showed that if you overcompact the AquaBlok, it can become more permeable because of cracks occurring in the gravel matrix, correct?
A. He did achieve a, I would say a ridiculous level of effort to compact material wherein he did create some aggregate and described an increased permeability to that factor.
But he achieved overall really low permeabilities by using compaction, moisture content, almost approaching the permeability of a plastic membrane layer, which is considered impervious.
Q. Okay. And, but what I would like to draw your attention to is really the leachates. And you would agree that he tested the product against some artificial leachates that contained various combinations of dissolved solids, cations, et cetera.
And it's fair to say that these did impact the swell of the bentonite product, correct?
A. His testing was, I believe, limited to a relative swell --
Q. Correct.
A. -- and not permeability.

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Q. Correct, but it did affect the swell, correct?
A. It did affect the swell.
Q. And would you agree that Dr. Roberts' conclusion was it's extremely important to conduct leachate -- it is extremely important to conduct leachate compatibility tests on bentonite-coated gravel prior to its usage in a landfill site. That was his conclusion?
A. His work was predominantly targeting municipal solid waste landfills. The leachate that you get from an MSW landfill can be very complex and very strong. It can have a lot of different things in there that could impact a bentonite-type material.
Q. Right, and you -- go ahead.
And so you would agree his conclusion was test?
A. His conclusion was to anticipate that there could be some impact, and depending upon the relative importance of that impact in your liner system, test.
MS. COHEN: I have no further questions.
JUDGE LAFAVE: Thank you.
Ms. Maccabee.
MS. MACCABEE: Your Honor.

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CROSS-EXAMINATION
BY MS. MACCABEE:
Q. Mr. Hull, my name is Paula Maccabee and I represent WaterLegacy and I have just a few clarifications of some of the matters that Mr. Smith talked about.
You've mentioned the Minorca Project and he asked you how much -- how big it was in acres and you said you didn't know.
Do you have a sense for how much AquaBlok material was used for that project?
A. Yes, I have a rough recollection. I think it was 3- to 4,000 tons, because that is an outward basin economically viable to manufacture on-site and that material was being manufactured off-site.
Q. And it's your understanding this was part of a larger project? Or was that just the only project was the AquaBlok? I couldn't understand that in your testimony.
A. I was not a party to the project design. And it -- I understand that it may have been a particular area of a sidewall that they wanted to improve and minimize leaching or seepage through that sidewall for a slope stability issue. And so sort of a patch, if you will, was placed over a specific portion of the area.

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Q. And as I understand the way you've described it, this was not a subaqueous application, correct?
A. It was a partial subaqueous.
Q. And when you say partial, what do you mean?
A. If I recall correctly, they had a long section of the sidewall of a certain sloped length, and that some portion of that slope length was under water.
Q. And is that similar to how you described the project in the Columbus Park, Franklin Park project where it was partially -- there were some areas where there was standing water?
A. No, that was more of a -- the Columbus project was more of just very moist soils and it's kind of a regular surface.
Q. And when you say a regular project, do you mean that was not a -- no part of that was --
(Court reporter requested clarification.)
Q. When you said it was a normal project, am I understanding correctly that you're saying it's a moist soil rather than a subaqueous project?
A. Again, I don't recall using the phrase "normal project." But that project, most of the area that they capped were moist soils.
Q. Now, I think with Mr. Smith you also talked about

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your experience that many of the soil covers that you put on were compacted natural soil covers; is that correct?
A. Yes.
Q. And you also talked about meeting performance objectives.
How did you measure the median -- the performance measures at the time of construction?
A. At the time of construction, very common to have the contractor build a test pad using the actual equipment he's going to use at the appropriate thickness, and using predetermined field quality control compaction and moisture testing ranges. And then you have field technicians testing the soil using a nuclear densitometer or some equipment that's similar to determine the moisture content compaction, establish the number of passes of the particular equipment as needed to construct a lift to the appropriate target compaction.
Q. And have you ever exhumed any of those covers 10 or 20 years later and tested their conductivity in the laboratory to determine what characteristics have prevailed?
A. I cannot think of a situation where I have taken

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field tests of a cap that I have constructed or under my design. I have taken field samples of caps that have been existing when we came onto a project, maybe an old closed landfill or a fly ash facility, something like that, and we've assessed the existing cap for its relative performance.
Q. And that's -- so you just described the situations where you came in to fix a problem and that those -- and you would evaluate the problem before you tried to fix it, correct? Is that a fair assessment?
A. Not necessarily a problem, but to assess -- generally assess the condition of a site.
Q. And you were talking about permeability measures in your work. Have you ever used lysimeters to try and determine how much percolation you're actually getting through the barriers?
A. Yes.
Q. And in which projects have you used lysimeters?
A. I can't recall.
Q. Is that something that you customarily do to evaluate or was that kind of a special project?
A. We've used lysimeters on consolidated disposal -- or confined disposal facilities for trash material to assess its regular -- its progress and consolidation. One of those is the Port of

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Cleveland CTF, just came to my mind. We've used lysimeters to evaluate the potential for slope failures at completed landfills.
Q. I'm sorry. My question must have been too vague. Have you used lysimeters to measure the permeability of cover and liners that you've installed?
A. I have not used lysimeters to measure the permeability.
Q. One other question I'm trying to -- sorry, this may be something that was really obvious and I just missed it.
Do you still -- do you still have a financial interest in the AquaBlok, Limited, company?
A. I do.
Q. And what's the nature of that interest? Just in general terms. I don't need to know dollars.
MR. MILLS: Objection, relevance and beyond the scope.
JUDGE LAFAVE: Overruled.
THE WITNESS: I have an equity interest.
MS. MACCABEE: I've cut a lot of this so excuse me a second.
BY MS. MACCABEE
Q. You also mentioned that -- let's take a look at the

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City of Columbus Park example that you provided, and that is -- I think it's in the direct, 347 to 351.
A. What pages?
Q. About 347 to 351. I think it's where he was -- yes, that's right in the area. It's page 21, sir.
Do you need more time before I ask a question? You've got it?
A. I have it right here, yeah.
Q. Okay. And so this is the pond project you were talking about, I believe, with Mr. Smith, and it was a project where you had to work with a rough surface and moisture in the soil, but it was not a subaqueous project, correct?
A. That's correct.
Q. I hope I read your testimony correctly, but I didn't find any other examples in your testimony specifically of creating liners for ponds. Did I miss one?
A. You did not find any examples of creating a liner for a pond?
Q. Correct.
A. Lake Machado.
Q. So you're saying that Lake Machado is a pond liner?
A. Essentially, it was a capping of the sediments in a pond to sequester the materials underneath, yep.

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Q. I'm going to make a distinction between a pond liner and a sequestration of contaminated materials, and I don't want to be confusing about that. But I think they're two different kind of projects.
Would you agree that the purpose of the Lake Machado project was to cap some contaminated samples and that that's what the objective of that project was?
A. It was a primary objective.
Q. And in this -- let's turn quickly to Exhibit 345, which is a Stormwater Solutions document.
Is the Franklin Park revitalization the specific project that you were talking about when you referred to the City of Columbus?
A. Yes.
Q. And if you'd just like to turn to page -- the PDF page 6 of this project. I think I've highlighted it. And in this project, just -- the improvement included demucking and excavation of the upper basin, correct?
A. I'm looking for this.
Q. Oh, I'm sorry.
A. Is there an exhibit?
Q. It's an exhibit. I might not have it. I'm sorry. It's 345 and you might not have it. That would be

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page 6 of the PDF. I think it says six out of nine up there. I'm not quite sure.
A. Okay.
Q. And do you see in the last paragraph, that's what I was reading from, "The improvement project included demucking and excavation of the entire upper basin to provide more capacity," et cetera. Do you see that?
A. I'm looking for it in here. I'm sorry.
Q. Oh, I'm sorry.
MR. HOLLEMAN: Can I -- since we gave Ms. Maccabee that exhibit, it doesn't have the same highlighting as what's on the screen. So if you look to the highlighting, you won't be able to find it. But the text should be the same.
THE WITNESS: I'm looking for the text.
MS. COHEN: Page 6 of 9.
THE WITNESS: Page 6 of 9. Okay. I have page 6 of 9.
BY MS. MACCABEE:
Q. Do you need me to ask the question again?
A. Yes, please.
Q. And in this project, the Franklin Park project, you would agree that the improvement project included demucking and excavation of the entire upper basin

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to provide more capacity, and that it also included some areas along the banks of connecting waterways that were excavated with minimal subgrade preparation?
A. Yes, I see that.
Q. And looking -- you can look at the end of this first paragraph, that this project was done based on the good experience of the Goodale project in Columbus, correct?
A. Yes.
Q. And I'm afraid this one I don't have a copy of, so I'm going to ask you to look at the screen if it's convenient.
And this is -- I'll mark it as a new Exhibit 350 and it's just about ponds.
And is that --
MS. MACCABEE: Show the top so he can see that.
BY MS. MACCABEE
Q. Are you familiar with AquaBlok installation summaries even though you're not the marketing person?
A. I'm familiar with some of them. I don't see them all.
Q. Well, I will represent that I've downloaded all the

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ones I could find on the current website. But this installation project for Columbus, Ohio, this is for the Goodale project.
MS. MACCABEE: Can you pull it up so that Mr. Hull can see the rest.
BY MS. MACCABEE
Q. And is this correct, that this was an example again of a project that was dewatered before --
JUDGE LAFAVE: Mr. Hull, we're getting you a hard copy.
THE WITNESS: Thank you.
MS. MACCABEE: Oh, thank you.
BY MS. MACCABEE:
Q. And, Mr. Hull, can you verify that this is also a project that entailed dewatering the basin before the conseal (ph) product was applied?
A. As I recall, the basin leaked and dewatered itself.
Q. Okay. And this was a .9-acre basin I've highlighted. It's in the first project objective on the page there.
A. I see that.
Q. Okay. And for the benefit of everybody else, we're going to turn to the actual pages and move on to the next page of the next PDF, which has some images. And that's what the pond looked like before you

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filled it.
And is it correct that you -- the application -- now, is this PondSeal that you applied to this project?
A. I believe it was.
Q. And is there any difference between the common AquaBlok, was it 2080 that is the normal freshwater formulation and PondSeal, are they the same or are they different?
A. They're essentially the same thing.
Q. So if I'm using PondSeal, it's just the AquaBlok -- is it 2080 is the correct number?
A. That's one common variation.
Q. Okay. And this -- before you apply the AquaBlok, this document says that water losses were up to a maximum of 12 vertical inches per 24 hours and then they were reduced to an average loss of approximately one-half inch per 24-hour period; is that correct?
A. That's what it says.
Q. And do you have any memory that it performed differently than that?
A. I have -- I had very little to do with this. The company has stocking distributors and the company that did these two projects was Meredith Brothers

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out of Clovis, Ohio. And they -- and their contractors worked out how much and where, so --
Q. So from your perspective, because you're sort of at the top of the heap, these would only be -- images like this, installations, spotlight reports, would only be useful as sort of summaries of how AquaBlok produced a project, but it wasn't necessarily something that you were involved with hands-on as an engineer?
A. That's correct.
Q. Okay. Thank you for that clarification. Now, I'm going to move forward. On the next few pages there's some other examples of ponds that were actually sealed with AquaBlok. There's -- that's still the Goodale project, but keep going. Are you familiar with -- are you familiar with these projects as well, the Rarey residential pond or the Jones Road farm pond?
A. No, I'm not.
Q. From what you're looking at, would you say that they're representative of what AquaBlok products are capable of doing based on the fact that this is what the AquaBlok marketing staff that you have produced?
A. These are depictions of some applications that have been accomplished.

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Q. And in terms of the scale of these applications here, would you say that this is sort of the customary scale that you're familiar with in terms of actual pond sealing as opposed to -- and I'm setting aside sediments sequestration. But just focusing on pond sealing, is this about the scale that you're -- is adequately represented?
A. Those pictures don't show the scale, but the installation spotlights again are usually prepared in conjunction with a sale from a stocking distributor, and most of those are fairly small projects.
Q. Okay, and then I'm just going to show you one more of these projects then. And some of these projects are done subaqueously and some are also done on a dry surface, correct?
A. Correct.
Q. I'm going to just look at page 8, which is the Marble Cliff Crossing Pond Repair.
MS. MACCABEE: And pull that up a little bit further because I need to see the highlighted section.
BY MS. MACCABEE
Q. And is this copy here something that's written by

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AquaBlok rather than you individually, correct?
A. Correct.
Q. And I'm going to ask you to look at this sentence, and I'm not attributing it to you, but it says, "Although excavated within abundantly placed soils, small instances of sand and gravel can become exposed along the pond bottoms and substantial water can be lost to infiltration in a very short period. Such was the case in the summer of 2020 in the north pond."
And then it goes on to say that "bedrock brought water levels down to a minimum, relegating the once picturesque water body to a muddy mess." Do you see that language?
A. I do.
Q. And would you agree that if there are areas in a pond where the permeable sand area, a small land -- small area, those relatively small areas can result in substantial water loss due to infiltration?
A. Exfiltration.
Q. Okay. That is -- is exfiltration the correct term? Well, infiltration through the pond bottom or exfiltration from the pond, yes, sir?
A. Yes.
Q. Okay. And can you -- can you identify any examples

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of pond sealing at a landfill scale or another industrial scale that you know that were done with a subaqueous deposition?
A. Lake Machado is the best example.
Q. And can you think of any others? Because I know Mr. Holleman is going to talk about that one.
A. There was another pond. I can't remember the name of it, in the San Diego or LA area. It was a city pond that was losing a lot of water. The contractor provided a similar seal over there. I'm sorry, I can't remember how many acres it was.
Q. And for either of these ponds, to your knowledge -- for either of -- any of these ponds, to your knowledge, was there a lysimeter measurement of what the degree of percolation to the pond was either before or after?
A. In the Lake Machado, I believe they are relying on chemical testing of the water quality to ascertain performance, which is not unusual.
The other pond that I cannot remember the municipality's name, sorry, they took water measurements and staff gauges, and using climatological data made an assessment of the relative performance.
Q. But you would agree that this question of lysimeters

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and measuring the actual percolation from the pond, that data was not collected? I'm not saying that no data was collected, but lysimeter data, percolation through the bottom of the pond was not collected, correct?
A. Not to my knowledge.
Q. And isn't it correct that none of your examples here involve sealing the mine tailings pond?
A. That's correct.
Q. And actually, none of the examples -- let me see where you cover that.
There is one more topic. I'll start it.
I might not finish it. There's a place in your testimony where you explain that you had successfully installed bentonite for sequestration projects under the control or the direction of the U.S. EPA, the Department of Defense, and other regulatory agencies. That's all I'm going to ask you is just to make sure that I've got that correct?
A. Yes, that's correct.
Q. And I'm going to show you -- once again, I don't have a copy of this document, but your counsel -- counsel for PolyMet may have a copy.
Exhibit 203.01. And this is a copy of -- this -- this document is a U.S. Army and Corps of Engineers

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document from 2020 that you were the co-author of that document if I remember correctly?
A. Yes.
Q. And so you're familiar with that?
A. Yes.
Q. And let's just turn to page 4, which is PDF 14. I don't know if you have that.
A. I would like to -- I don't know if I have it in here.
Q. I'm going to ask you to -- since I don't have paper copies, if you wouldn't mind looking at this. We won't rush you, but it's the tool we have.
A. Okay. I'll try to accommodate you.
Q. Thank you.
And this page is -- talks about the formulation of products used, and that there were actually three different variations tested: AB-1585, AB-2080, and AB-37, correct?
A. Yes.
Q. And do those numbers then correspond to how much clay they have in them, so that a 2085 has 15 percent, 2080 has 20 percent; is that how that works?
A. By weight. The first number is the clay mineral. Second number is the aggregate.

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Q. Okay. And as a general matter, is the cost of the aggregate dependent on the percentage of clay that it has?
A. I'm sorry, could you say that again?
Q. As a general matter, is the cost of the product, the AquaBlok product, dependent on the amount of clay that it has?
A. It can have an impact.
Q. And I'm going to ask you now to turn to what's page 41 of this article. And I want to state preliminarily -- I'll give you all the time in the world. I'm so sorry I don't have copies.
And do you see the highlighted language, what is generally a relatively favorable report, the Army Corps points out concerns about AquaBlok's service integrity after wet and dry periods post capping. Do you recall that being a concern?
A. I see that.
Q. And are you -- it also says that this may -- the extreme swelling --
(Court reporter requested clarification.)
Q. This part of the report also says that the swelling nature of the bentonite may exacerbate dessication, cracking, and erosion by rip -- is that rip-up clast or riprap clast?

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A. I think I need to explain a little bit the genesis of this report.
Q. I'm going to ask you just to help me understand this part. And I was reading it and trying to understand what rip-up clasts are and if they're the same as riprap?
A. They are not.
Q. Okay.
A. This doesn't pertain at all to capping sediments or lining a pond.
Q. Okay. So this is something that only would take place in the form -- on the format of laboratory testing; is that what you're suggesting?
A. No.
Q. Okay, go ahead.
A. Following Hurricane Katrina and the disastrous loss of property and lives, the Army Corps of Engineers looked at an accelerated program to upgrade their levies and -- levies run by the local wards down in the Gulf Coast area, and they were doing a study of what types of materials they could use to efficiently and quickly build on top of existing levies out in the air.
They were concerned about wave action overtopping levies and scouring the back sides of

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the levies, creating a failure where the levy would burst and flooding occurs.
Then they asked if we would be interested in having AquaBlok evaluated for that application, and I've done a lot of work with the folks at the Army Corps of Engineers' experimental station down in Vicksburg, have a good relationship with them. We said, as always, we're happy to accommodate them.
Many years before, they tested AquaBlok for a strength parameter known as shear stress in a sediment-capping application.
And as a result of that earlier test, they could not put a number on the strength because the equipment they had wouldn't stress it enough.
Q. Thank you, Mr. Hull. I'm going to tell you, this is brilliant, and I'd love to hear --
MR. MILLS: Objection. He was in the middle of explaining it.
MS. MACCABEE: But I think he had already explained -- excuse me.
JUDGE LAFAVE: No, Ms. Maccabee, you need to -- you really do need to let him answer the question.
MS. MACCABEE: But the question -- you know, he got to the point saying that this is not

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applicable about -- several minutes ago, and I -- that was what he had -- and that's my question. The only question I had is, is riprap the same as rip-up, sir.
JUDGE LAFAVE: All right.
MR. MILLS: No, that's not --
JUDGE LAFAVE: I will respectfully -- I didn't recall your question being that narrow. But you -- if you're -- well, what would you like to say to finish?
THE WITNESS: I'm almost done.
JUDGE LAFAVE: Okay.
THE WITNESS: In the intervening years, they had -- the Corps had built a larger device called a SEDflume testing device that could exert much higher shear stresses on soil samples, and they wanted to test the AquaBlok material in that new device.
The previous test with the older device, they couldn't get it to fail, okay. So they tested it, got it to fail with some other materials, and that's the subject of the study here.
Going into the study, I didn't think it was an applicable use that I would propose as an engineer, the AquaBlok material, to be particularly

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good at, but they want to look at it.
BY MS. MACCABEE:
Q. Thank you very much. I really appreciate it, even though I realize we were complete -- this was a different use and I appreciate your clarification. Do we want to continue? I have about -- I don't know -- maybe ten minutes more at most.
JUDGE LAFAVE: If you can keep it to ten, but then we truly have a -- like I will cut you off midsentence.
MS. MACCABEE: Or do you want us to start and do ten minutes tomorrow morning?
JUDGE LAFAVE: I mean, again, I want to try to get as much done as we can. What can you accomplish in five to ten minutes?
MS. MACCABEE: I'll try my best.
JUDGE LAFAVE: All right. I will cut people off when I deem necessary.
Mr. Mills, concern?
MR. MILLS: No concern about continuing to go. I do have serious concerns about how much time they've spent on this relative to the time we're going to get, so we're going back to the chess clock.
JUDGE LAFAVE: Yeah. No, I appreciate

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your concern.
MR. MILLS: Thank you.
JUDGE LAFAVE: Thank you.
Ms. Maccabee, please proceed.
BY MS. MACCABEE:
Q. If we could just turn to Exhibit 331. Are you familiar with this report, Mr. Hull, which is from the Department of Defense which is evaluating the use of AquaBlok at a -- as a sediment-capping tool?
A. I probably have reviewed this report.
Q. And on this report, let's turn quickly to page 3, which is PDF 21, just to identify what kind of AquaBlok product were -- they were using.
And this was a product that had a nominal 5 percent PAC, which is powdered-activated carbon, and a 10 percent clay, sodium bentonite, correct?
A. Correct.
Q. And then let's turn quickly to page 38, which is on PDF 56. And looking at the top of the page is the general estimate of costs that are common for capping, and they range from about 300 -- at least in this 2017 report, they range from 350- to $700,000 an acre.
Is that consistent with what you know about the cost of sediment capping?

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A. The cost of sediment capping is highly dependent upon the location, the size of the project, the placement aspects of the project. The smaller the project, the more expensive per square foot.
Q. And in this case, this project, if you want to scroll down a little bit lower, this was -- in this case, this demonstration placement was $11.21 per square foot?
A. May have been.
Q. Okay. And have you done any work to estimate the cost of the application of PondSeal to the 900 to whatever thousand-acre pond that is, the NorthMet tailings basin?
MR. MILLS: Object that it misstates the record.
THE WITNESS: I have --
JUDGE LAFAVE: Sustained.
BY MS. MACCABEE:
Q. Well, we have documents in the record that make the size of the pond a little indefinite, but this is to say it's a 905-acre pond.
Have you done any -- made any estimates of what it would cost to seal that pond for the NorthMet tailing space?
A. In the first place, the cost of the materials is

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very important in an overall cost. That particular project was a treatment amendment and the cost of that material per ton versus a sealing material is a couple of multiples. So that's a very big number, according to what I would expect.
Second, it's my understanding that no material, no bentonite amendment for the pond basin may be needed.
Third, if some is needed, there is -- there is nothing that says you have to cap the whole area. So you might achieve the equivalent six-and-a-half-inch percolation control by identifying some areas within the 900 acres that appear to be more problematic. They may be quite small.
You cap those, and you see what the response is. So estimating how much you need to achieve the control of the situation is an exercise. Lastly, the size of the scale here is something that I'm not familiar with. They have rail at the site. Railing and raw materials would significantly reduce the costs. The economies of scale of application would significantly reduce the costs. I could make a guess and be off by, you

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know, a multiple. And it's 20, 30 years down the road.
Q. So I think that's really important information. And at this point, as I understand your testimony, you haven't made that estimate, and you wouldn't -- you wouldn't be able to do that because you don't know the scope of the project; is that correct?
MR. MILLS: Objection to the extent it misstates his testimony.
JUDGE LAFAVE: The objection is noted. You can answer, if you can.
THE WITNESS: No one has asked me what it would cost, and no one has said that they're going to need it. Or if they do need it, how much they need exactly. And those are key inputs to preparing a cost estimate.
BY MS. MACCABEE:
Q. I have two quick questions left. You mentioned in your testimony a study that you did with, and it's in Exhibit 64, testing the permeability of AquaBlok freshwater when exposed to highly fracked water. And is it correct that that experiment was conducted for 15 days?
A. That is my recollection, but I'd like to see it, if I may.

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Q. That one should be in your book.
A. Okay.
Q. And we can also put up your --
MS. MACCABEE: Why don't we put up Mr. Hull's rebuttal testimony, pages -- lines 655 to 659, so if he wants to quickly see what he testified to.
THE WITNESS: Could you give me the page number of the rebuttal?
BY MS. MACCABEE
Q. Of the rebuttal, yes, it's 655 to 659. Oh, page number 38.
A. Thank you.
Q. Does that refresh your recollection about the length of the study?
A. Yes.
Q. And, of course, an application, often the PondSeal project has served its purpose for decades or even centuries, correct? Just that question. I know you want to say more, but I'm trying to --
A. I'll have to hear the question again, sorry.
Q. In an application, the PondSeal or the AquaBlok project has to last a great deal longer than 15 days, correct?
A. Yes.

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Q. And in your testimony, and this is in your rebuttal at lines 473 to 490, you also talked about a lab study you did on establishing a planned community on alkaline lime waste?
A. Yes.
Q. And do you recall that -- and I'm sorry. I'm hurrying because I want to get this done and respect the judge's request, so I apologize for talking so fast.
But I just want to clarify that this -- you're aware that the question of whether roots would go through or avoid alkaline lime waste is not really applicable to the NorthMet tailings basin?
A. It is similar in that roots seek something to their benefit, to benefit the plant, and if there are no nutrients in the mine tailings, that is a deterrent for their -- spreading that deep (ph).
Q. And is it correct that this study was about alkaline, high pH lime mining waste, correct?
A. The study was to demonstrate that with a specific species of grasses that were being proposed for the site, that they could achieve a good cover with a shallow root zone.
Q. And that specific chemistry and specific time frame and specific grasses are not necessarily applicable

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to the NorthMet pond site, correct?
A. That's correct.
MS. MACCABEE: No further questions.
JUDGE LAFAVE: Very good. Thank you very much for your testimony this afternoon. We are in recess until 9:00 a.m. tomorrow morning. We're off the record.
(Proceedings were adjourned.)

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STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

REPORTER'S CERTIFICATE

I, Lisa A. Blanks, do hereby certify that the above and foregoing transcript, consisting of the preceding 215 pages is a correct transcript of my stenographic notes, and is a full, true and complete transcript of the proceedings to the best of my ability.

Dated: April 7, 2023

/s/ Lisa A. Blanks

LISA A. BLANKS
Registered Professional Reporter

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