

STATE OF MICHIGAN

STATE OFFICE OF ADMINISTRATIVE HEARINGS AND RULES

In the matter of: File Nos.: GW1810162 and  
MP 01 2007

The Petitions of the Keweenaw  
Bay Indian Community, Huron Part: 31, Groundwater  
Mountain Club, National Discharge  
Wildlife Federation, and 632, Nonferrous  
Yellow Dog Watershed Metallic  
Environmental Preserve, Inc., Mineral Mining  
on permits issued to Kennecott  
Eagle Minerals Company. Agency: Department of  
Environmental  
Quality

Case Type: Water Bureau  
and Office of  
Geological  
Survey

D R A F T T R A N S C R I P T

HEARING - VOLUME NO. XXI (21)

BEFORE RICHARD A. PATTERSON, ADMINISTRATIVE LAW JUDGE

Constitution Hall, 525 West Allegan, Lansing, Michigan

Thursday, May 29, 2008, 8:30 a.m.

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(Comparison of Predicted and Actual Water  
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Calculation for Nickel)

NOTE: Page numbers may change on final transcript.  
Full exhibit list for today will be included in the final  
transcript.

1                   Lansing, Michigan

2                   Thursday, May 29, 2008 - 8:36 a.m.

3                   JUDGE PATTERSON: Mr. Lewis.

4                   MR. LEWIS: Yes. Thank you.

5                                   DIRECT EXAMINATION

6           BY MR. LEWIS: (continued)

7           Q     Dr. Miller, I think we got past the swearing in yesterday  
8                   but did not get to the next step which is to please state  
9                   your name and spell it for the record.

10          A     My name is Stuart Donald Miller. And I apologize that you  
11                   have to suffer another Australian accent. It's S-t-u-a-r-t,  
12                   Donald, D-o-n-a-l-d, Miller, M-i-l-l-e-r.

13                   MR. HAYNES: Your Honor, before the witness  
14                   continues and we have to listen with pleasure to his  
15                   Australian accent, we want to renew our objection stated  
16                   yesterday. Because the two hours that you gave us plus  
17                   additional time last night preparing for the witness was not  
18                   quite enough for what we believe to be the complexity of  
19                   this witness' expected testimony. I also note that, having  
20                   spent what time we could last night to prepare, we were  
21                   handed this morning a revised set of slides that the witness  
22                   is probably going to testify based upon. And they've been  
23                   renumbered and some of them have been taken out. So I've  
24                   just spent the time before the hearing this morning trying  
25                   to renumber my slides so that I could put them in the order

1 that I prepared. So once again we're at a slight -- at a  
2 disadvantage because of the inability to prepare for this  
3 witness' testimony. So we renew our objection based upon  
4 the reasons stated yesterday to this witness testifying.

5 JUDGE PATTERSON: Okay. Well, I'm going to allow  
6 him to testify over objection.

7 Q Dr. Miller, you're a geochemist; is that right?

8 A That's correct.

9 Q And I've asked you to prepare to testify and testify about  
10 the geochemical testing program done by Mark Logsdon and  
11 Geochimica in this case and also to review and discuss some  
12 of the comments made by the Petitioners' experts about that  
13 program; is that right?

14 A That's right.

15 Q Could you please review your academic qualifications for us,  
16 Dr. Miller?

17 A Yes. I have a bachelor of science in agriculture from the  
18 University of Sydney in 1972 and then a master of applied  
19 science through the School of Chemical Engineering at the  
20 University of New South Wales in '74. I then did a master  
21 of philosophy and a Ph.D. at Yale University. I got my  
22 Ph.D. in 1979. And the title of my thesis was "Chemistry of  
23 Pyritic Strip Mine Spoils," which deals with the oxidation  
24 of pyrite and acid generation.

25 Q What's the subject matter of your Ph.D. degree?

1 A It is to do with pyrite oxidation, acid generation and the  
2 cycling of sulfur and hydrogen ions within an oxidizing  
3 pyritic waste.

4 Q And your master of philosophy, what subject matter was that?

5 A That was more of course work, master's.

6 Q What kind of courses?

7 A Courses in geology, geochemistry, land management, soil  
8 science.

9 Q And have you had academic appointments, Dr. Miller?

10 A Yes. I'm an adjunct professor at the University of British  
11 Columbia in Canada.

12 Q Are you currently doing that?

13 A I'm currently doing that. I'm currently supervising a Ph.D.  
14 student who is researching acid generation mechanisms within  
15 land waste rock dumps.

16 Q And where do you live?

17 A I live in Sydney, Australia.

18 Q With your family there?

19 A I do.

20 Q And what do you do when you have free time in Sydney,  
21 Australia?

22 A Opportunities to go sailing, I go.

23 Q I'd like to review now, Dr. Miller, some of the pertinent  
24 qualifications and experience that you have relating to the  
25 subject matter that you're here to talk about today. Could

1           you review some of that experience for the court, please?

2           A     Well, my work experience has basically been, before doing my  
3           post-graduate degrees, I worked with the government.  And  
4           following post-graduate degrees, I worked for a consulting  
5           company before establishing my own business in 1983.  And  
6           that business is called -- the company is called  
7           Environmental Geochemistry International.  And most of the  
8           work that we do is associated with mine waste geochemistry  
9           and in particular acid rock drainage.

10                         Over the time, I've worked on more than 250 mining  
11           projects throughout the world with a lot of that focused in  
12           the Asia Pacific region.  I'm active in research -- research  
13           through the Mining Industry Research Association in  
14           collaboration with universities again focused on pyrite  
15           oxidation and ARD control mechanisms.

16           Q     And have you -- I think you have on the slide here that you  
17           developed some ARD technologies; is that right?

18           A     Yes; yes.  Net acid generation test is particularly one that  
19           we have developed.  I think initially we developed that in  
20           the early 90's.  But it has evolved through time, and it is  
21           now fairly generally accepted worldwide as a test.  It is  
22           one of the tools in the testing of ARD materials.  Also the  
23           column leach protocols which tend to be used particularly in  
24           the Asia Pacific region are protocols that we've developed.

25           Q     And those are -- the NAG test and the column leach testing

1 are topics that Mr. Logsdon talked to us about yesterday?

2 A Yes.

3 Q Next I'd like to review what you've done, what you've  
4 reviewed in order to prepare for your testimony. And would  
5 you summarize that for us, please, Dr. Miller?

6 A I've reviewed a number of the Intervenor reports -- exhibits  
7 particularly focusing on the mine permit application  
8 appendices, the appendices which Mr. Logsdon prepared, the  
9 D1 through to D5. I've also looked at the Intervenor  
10 exhibits relating to responses to the DEQ's comments. I've  
11 looked and evaluated some of the geochemical data that's  
12 provided in 309 and 310 and also the kinetic leach test data  
13 in Exhibit 595.

14 Q Are some of the opinions you're going to talk about and the  
15 figures that we have in here derived from the data in those  
16 Intervenor Exhibits 309, 310 and 595?

17 A Yes.

18 MR. LEWIS: Just for the court's reference, those  
19 were admitted through Andrew Ware when he testified earlier.

20 Q Did you also review Mr. Eary's report?

21 A I did.

22 Q And Mr. Eary is also a geochemist who reviewed and commented  
23 on the Geochimica work; is that right?

24 A That's correct.

25 Q On behalf of the DEQ?

1 A Yes.

2 Q And have you reviewed various of the Petitioners' reports  
3 and exhibits in this matter?

4 A Yes, I have.

5 Q And I think you have those listed here. You've reviewed  
6 reports of Ann Maest and Mr. Coleman.

7 MR. HAYNES: Your Honor, just for the record, it's  
8 Dr. Coleman.

9 MR. LEWIS: I'm sorry. Actually it's Dr. Maest  
10 and -- it's Dr. Maest and Dr. Coleman.

11 MR. HAYNES: They're both doctors. Right.

12 Q Okay. At any rate, you've reviewed those reports?

13 A I have.

14 Q And have you also reviewed the testimony or at least  
15 portions of their testimony in this proceeding?

16 A Yes, I have.

17 Q Is this a summary of the topics that you're going to discuss  
18 as we go through these slides?

19 A Yes.

20 Q And could you just go through them quickly for us?

21 A As shown on that slide, the areas or the topics that I'm  
22 going to address is dealing with sample selection. That is  
23 looking at how representative the samples that were included  
24 in the geochemical program area. Looking at the acid  
25 generating potential of the mine rocks, that's in relation

1 to the acid base accounting work and the other static test  
2 work. The ARD evolution kinetics and metal leaching, that  
3 is looking and reviewing the kinetic test work results, the  
4 column leach test results. The fourth item there,  
5 geochemical predictions for the mine and development waste  
6 stockpile, that's dealing with the water quality predictions  
7 and also predicting the nature and behavior of the materials  
8 when they are mined. And then the last item is addressing  
9 some of the -- or looking at some of the geochemical control  
10 strategies which I proposed.

11 Q And could you tell us -- I think the next slide describes  
12 the general approach for this analysis.

13 A Well, this is the general approach for the -- looking at the  
14 sample selection component or item. And that involved  
15 reviewing the geological reports and the geochemical reports  
16 and the lithology and geological databases. And also I did  
17 some analysis of the data that were provided.

18 Q And what were your -- what did you find as to the  
19 representativeness of the sample selection by Geochimica?

20 A I found that the representativeness of the samples was very  
21 good as far as covering the different lithologies and having  
22 sufficient samples to give an indication of variations  
23 within each of the lithologies of the rock types to be mined  
24 and exposed.

25 Q And did you specifically look at the sampling and testing as

1 to the sulfur distribution?

2 A I did.

3 Q Is that what this slide represents?

4 A Yes. And Mr. Logsdon also showed this slide yesterday.

5 It's worth just spending a little time on it because it's

6 quite an important slide. Just to run through again what it

7 shows, on the horizontal axis here is the sample numbers

8 which indicates that there are 6,348 samples included in the

9 geological database with sulfur assays. And these are

10 essentially ranked from lowest and highest and then

11 plotted -- lowest to the highest sulfa value and then

12 plotted as a distribution. And just to reinforce what we

13 said yesterday is that these inflection points indicate a

14 change of rock type, a quite clear change, a distinctive

15 change that would be observed within the exposures. And

16 from this point down what we're dealing is what's called the

17 development waste. Then through this area here is the

18 semi-massive and disseminated sulfide ore. And at the top

19 here is the massive sulfide ore and a distinct jump in

20 sulfur content from the semi-massive sulfide to the massive

21 sulfide. What was important with this is that these 6,348

22 samples with sulfur assays are really part of the

23 geochemical database, not just the 108 acid base account

24 samples which were included in the geochemical reports.

25 Q Okay. What's the importance of that, Dr. Miller?

1 A It's a very good, very extensive sample database for  
2 characterizing the orebody and the waste units.

3 Q And did you also review the sampling as to the various rock  
4 types, Dr. Miller?

5 A Yes. Sorry. Yes, I did. That's incorporated within the  
6 whole database, the geological database, the lithology  
7 database and looking through the rock types as described by  
8 the geologists. And there is -- I can see no reason for any  
9 change in rock type -- any change in the rock type  
10 descriptions. They're all well defined and well  
11 characterized.

12 Q And I think you've -- on the next slide, you've got some  
13 discussion about the sulfur grade of the development rock  
14 versus the ore. Can you tell us what that is about, please?

15 A Okay. This shows that the development rock, which will be  
16 temporarily stockpiled and then returned underground, has a  
17 sulfur grade ranging from less than .1 percent to  
18 approximately 3 percent and an average sulfur grade of 1  
19 percent. The ore -- there are three different ore types in  
20 a way; the massive sulfide unit, the semi-massive sulfide  
21 unit with much higher sulfur contents and the disseminated  
22 sulfide ore as well within the intrusive rocks.

23 Q And what does that tell us about the potential for acid --  
24 development of acid condition?

25 A Within the ore, the ore is very high sulfide rock. And, of

1 course, that ore will be actually mined and removed from the  
2 site. What would be remaining essentially will be rocks  
3 represented by the development rock with small amounts of  
4 these left in the underground mine. But they will  
5 subsequently be inundated with water and then -- and  
6 oxidation would be -- will shut down. With the development  
7 rock, a lot of these materials do have potential to generate  
8 acid without mitigation.

9 Q And did you summarize, then, your conclusions as to this  
10 first topic, the sample selection, your review of the  
11 representativeness of the sample selection, Dr. Miller?

12 A Yes. I feel that the Geochimica selected samples were  
13 representative of all the lithologies and the rock types.  
14 There's a very high number of samples for the small scale of  
15 this operation.

16 Q Why do you say this a small scale operation?

17 A With development waste being less than a million tons and  
18 the ore production four-and-a-half million tons or  
19 thereabouts, it's quite a small operation.

20 Q Can you give us some reference to other operations you've  
21 been involved with reference in terms of the scale of other  
22 operations versus this operation?

23 A Well, with respect to the development waste stockpile as far  
24 as looking at non-ore materials that have never been exposed  
25 to atmospheric conditions, there are many operations around

1 the world which would move that amount of material in one  
2 day.

3 Q Meaning the entire 600,000-some tons we're talking about?

4 A Yes; yeah.

5 Q What's your next conclusion here, Dr. Miller?

6 A That the focus of the sampling -- sample selection on the  
7 country rock and the intrusive, the materials that will  
8 comprise the development waste and also would be the bulk of  
9 the final exposures, is an appropriate way to focus your  
10 sampling. But the other lithologies, the sulfide ores, are  
11 included so that some valuation of the impact of those  
12 during the operation can be assessed, so they're included in  
13 the program. And it does comply with what would be  
14 considered acceptable practice.

15 Q And the next topic in the list we looked at earlier is the  
16 acid generating potential of the mine rocks. And could you  
17 describe what you did to -- for this part of your review?

18 A Well, again for this part of the review, it was reviewing  
19 Geochimica reports and mineralogical reports, which were  
20 included with the Geochimica reports, and also some  
21 interpretation of the data that's contained in the Exhibits  
22 109, 110 and 595.

23 Q Is that 309, 310?

24 A Sorry. 309.

25 Q And 595?

1 A Yes; yes.

2 Q Okay. And as to the acid generating potential, what did you  
3 conclude?

4 A There was a high proportion of the material which has the  
5 potential to generate acid. If we just run through a little  
6 bit on -- just to refresh our understanding of the acronyms  
7 and the units that are used, essentially all the ore grade  
8 rock really has quite a high potential for generating acid.  
9 And I think that's well understood.

10 There are two ways of assessing the acid  
11 potential. One is looking at the ratio of the neutralizing  
12 potential to the acid potential. That is essentially  
13 providing you with what is the factor of safety. If the  
14 neutralizing potential exceeds the acid potential, then the  
15 ratio is greater than 1, which means there's a credit as far  
16 as neutralizing potential over acid potential. And if the  
17 ratio is less than 1, then there is a deficit. If the ratio  
18 is less than 1, there is a likelihood that that material  
19 will generate acid. If it's greater than 1, then it's  
20 likely that -- so if it is greater than 1, it's unlikely to  
21 generate acid. If it's less than 1, it is likely to  
22 generate acid.

23 The neutralizing potential is essentially another  
24 way of looking at that balance. But it's giving you a  
25 quantitative measure of the amount of deficit or the amount

1 of credit you might have in your neutralizing capacity in  
2 your material. But with the way Geochimica has evaluated  
3 the data, they've used a ratio of 3, a very conservative  
4 factor of safety. And because of using this conservative  
5 factor of safety, the prediction is that at least 75 percent  
6 of the development waste is expected to be potentially acid  
7 forming. So that's quite a conservative conclusion.

8 Q And I believe in the next slide, if you would, you also  
9 looked at the other testing of the potential for acidity,  
10 that being the net acid generation test?

11 A Yes.

12 Q That was done by Geochimica?

13 A Yes.

14 Q And what did you conclude there?

15 A Well, Geochimica analyzed 60 samples through the Phase II  
16 program for the net acid generation during the NAG test.  
17 Now, as Mr. Logsdon mentioned yesterday, the NAG test is  
18 quite different to the acid base account. It's a direct  
19 oxidation using hydrogen peroxide to react the sample and  
20 allow the sample to -- the acid generated from the sulfur to  
21 react with the inherent neutralizing minerals and other gang  
22 minerals to come up with a net result. Using the two  
23 together is a --

24 MR. EGGAN: Your Honor, if I could interpose an  
25 objection at this point. This witness is now testifying

1 about net acid generation testing, which was not at all on  
2 the expected testimony -- the recitation of what his  
3 expected testimony was to be. And so again my concern would  
4 be that we confine the witness, as we all understood would  
5 be the case, to what the recitation would be. And in this  
6 instance, what we have is the witness not confining and  
7 essentially expanding what he said he would be testifying  
8 about in what we already contend is a very, very minimal  
9 recitation of what his testimony was expected to be. So I'm  
10 going to object to that.

11 MR. LEWIS: Same discussion we had yesterday. I  
12 don't think I need to repeat what I said.

13 JUDGE PATTERSON: I'm going to overrule the  
14 objection.

15 Q Would you continue, Dr. Stuart (sic)?

16 A Yes. So as I was saying, that using the two independent  
17 tests reduces the uncertainty and gives you a lot more  
18 confidence about your prediction of whether a sample is  
19 likely to be acid generating or not.

20 Q Now, that NAG test again, is that the test that you  
21 developed?

22 A Yes.

23 Q And is it widely used in the industry now?

24 A It is widely used in the industry.

25 Q And if we could look at the next slide, we've reviewed some

1 of these terms again, the various ways of looking at the  
2 potential for acid generation of these type of materials.  
3 And I believe you've summarized some of these results on  
4 this slide; is that right?

5 A Yes. This is -- this plot here is showing the results for  
6 the 60 samples that were assayed for NAG as well as the acid  
7 base account. Plotted here is the ratio of the neutralizing  
8 potential to the acid potential. And putting the results of  
9 the NAG test on the vertical axis and the results of the  
10 acid base account on the horizontal axis divides the  
11 results into four domains, one being the non-acid forming  
12 domain where the ratio is greater than 1 and the NAG test  
13 result also confirms that it's not acid forming. So you've  
14 got two independent tests suggesting that the sample is  
15 non-acid forming, which gives you a greater confidence that  
16 that sample is non-acid forming.

17 Q That's the NAF on that?

18 A NAF is non-acid forming. In this quadrant here  
19 (indicating), which is the potential acid forming, samples  
20 that fall in here are classified as potentially acid  
21 forming. And they have a ratio less than 1 and a NAG pH  
22 less than 4.5. And we can be very confident that samples  
23 that fall in this quadrant are potentially acid forming.  
24 You also -- doing it this way, you also identify, too,  
25 uncertain quadrants where, if you have conflicting results,

1           you have an uncertain classification.

2                       So if -- when we plot all the Eagle samples, we  
3           can see here that the ratio used for classifying samples as  
4           potentially acid forming is a ratio of 3, which is this line  
5           here (indicating). And we can see there are a lot of  
6           samples less than 3, in fact, down to about .7, which are  
7           actually more likely to be non-acid forming than acid  
8           forming. And I think the reason for this is just to again  
9           show that there's a -- it's a high factor of safety and a  
10          very conservative approach has been taken to classifying the  
11          number or the percentage of the rock that's likely to be  
12          acid forming.

13       Q     And you're referring to that classification done by Mark  
14              Logsdon in his reporting?

15       A     Yes; yes.

16       Q     And then could you summarize your conclusions as to your  
17              review of the acid generating potential of the mine  
18              material?

19       A     Well, I think the results certainly -- my review of the  
20              results certainly concur with Geochimica's conclusions that  
21              there's a high likelihood of ARD and metal leaching from  
22              both the development waste and, of course, the exposed ore  
23              materials.

24       Q     And you say "unmitigated" there. Why do you conclude that?

25       A     Well, I think with mitigation such as limestone addition,

1           then you would be reducing that potential. And we also  
2           concur with recommendations that active management would  
3           definitely be required for ARD control.

4       Q     And the final one?

5       A     And the final one just reiterates the point that  
6           Geochimica's predictions or estimates that at least 75  
7           percent of the development waste materials is likely to be  
8           acid generating is a conservative estimate.

9       Q     Now, if we could turn to the next slide, the next topic you  
10          have listed in the introductory slide is a review of the ARD  
11          kinetics and metal leaching. And could you explain what you  
12          looked at for that analysis?

13      A     Yes. Again reviewing the Geochimica reports on both the --  
14          on the static test results, reviewing and evaluating the  
15          kinetic leach test results, which were contained in Exhibit  
16          595 and include results up to week -- 190 weeks and also  
17          comparing those results with published literature and also  
18          my experience with doing -- with looking at maybe hundreds  
19          of kinetic test results every year and thousands of static  
20          test results every year.

21      Q     Does your company, EGI, do column testing in a laboratory at  
22          your facility?

23      A     We do.

24      Q     And are you personally involved with that?

25      A     Yes.

1 Q And then if we go to the next slide, could you describe what  
2 this shows as to the acid base characteristics based on this  
3 testing?

4 A Yes. This is the results of the 108 static test samples  
5 that were conducted by Mark Logsdon.

6 Q And again are these the shorter term testing?

7 A These are the shorter term tests. These are the static  
8 tests.

9 Q 24-hour tests?

10 A No. These are the static tests. These are the acid base  
11 account, the sulfur assay and the neutralizing potential  
12 assays. And what's plotted here is the sulfur content and  
13 the neutralizing potential that was for each sample. What  
14 it shows here is these here are the massive sulfide samples  
15 with more than 30 percent sulfur. And it shows that, within  
16 the static test database, there were four or five samples  
17 included. And the red dots indicate the samples selected  
18 for the column leach tests, the kinetic tests. Again we've  
19 got samples here from the semi-massive sulfide, and again  
20 there were five or six samples included in the static test  
21 program. And, of course, these are supported by the  
22 extensive 6,000-plus samples in the geological database.

23 And then in the less than 5 -- or less than 5  
24 percent is where most of the samples are included, because  
25 this includes the country rock and the intrusive rock, which

1 is part of the development waste. This chart here is an  
2 expanded scale from zero to 3 percent sulfur. So it takes  
3 these samples from zero to 3 percent sulfur and up to 60  
4 percent neutralizing potential and just expands that out to  
5 show the distribution around this line, which is the balance  
6 where acid potential equals neutralizing potential. And the  
7 samples selected for column leach tests are all again  
8 indicated by the red circles. And so what this shows to me  
9 is that the samples selected for kinetic tests are a good  
10 representation of the distributions identified in the static  
11 program.

12 Q And then did you also examine from the data in Exhibit 595  
13 the column leach test results -- did you prepare some  
14 summaries of what that data shows as well, Dr. Miller?

15 A Yes.

16 Q And could you explain this graph for us, please?

17 A This graph here is a trend plot through time showing a pH of  
18 the leachates from all the columns which represent the  
19 country rock. And what it demonstrates is that some  
20 materials have a very -- have a short lag time and drop in  
21 pH rather quickly within 25, 26 weeks; pH is down to below 5  
22 and below 4 by one year. Other samples have longer lags  
23 before they drop in pH. And other samples maintain  
24 circumneutral or close to neutral pH's into the long term.  
25 And these results tend to confirm the acid base account

1 results, the static test results. The predictions have been  
2 potentially acid forming or non-acid forming. This is all  
3 again unmitigated. This was without addition of limestone.  
4 It is the samples as we've saved.

5 Q And did you do a similar summary for the so-called intrusive  
6 rock?

7 A Yes.

8 Q And could you explain what this shows, please?

9 A The intrusive rocks again, this is showing the time trend of  
10 pH. It shows that the pH in most of these samples does not  
11 drop much below around pH 7. So they're much slower  
12 reacting than even some of the country rock samples  
13 indicating a longer lag time. One of the samples does  
14 plunge to a pH of 4 for a very short period of time but  
15 recovers back to 5 and up towards 6. And that's the highest  
16 sulfur sample to underscore 5, which is that 2.44 percent  
17 sulfur.

18 Q We've been talking a lot about pH's in the last few days.  
19 For a point of reference, can you tell us generally what's  
20 the range of pH for rainwater?

21 A Well, pure rainwater in equilibrium with atmospheric carbon  
22 dioxide has a pH of about 5.4.

23 Q Now, we just looked at the charts for the country rock and  
24 the intrusives. Are those the primary materials that would  
25 be expected to be put in the development rock storage area?

1 A Yes.

2 Q And then you also -- the next chart, I believe, you looked  
3 at the semi-massive and massive sulfur units. Could you  
4 show what this -- explain what this shows, please?

5 A This plot is of the same plot of time trends of pH for the  
6 massive sulfide, which is the red plot. This demonstrates  
7 that the pH in the massive sulfide drops almost immediately.  
8 So you can certainly expect acid generation from the massive  
9 sulfide materials very early after exposure within the mine.  
10 The semi-massive sulfide does have some lag but also would  
11 be expected during mining to produce acid within the mine.

12 Q And again does this confirm what the static testing had  
13 shown?

14 A Yes.

15 Q And I believe the next point was your discussion about  
16 the -- the comparison of the release rates for these  
17 materials to examples in other waste samples?

18 A Yes. This is a very noisy slide. I apologize for that.  
19 But what I was trying to demonstrate here is to put the  
20 Eagle materials in the context of other sites and rank as  
21 far as how reactive they might be. What I've shown here,  
22 again this is the weeks through the leach column tests. And  
23 on the vertical axis we have what we call the sulfide  
24 release rate in units or the milligrams of sulfide released  
25 per kilogram of rock per week. And you can see it ranges at

1 four orders of magnitude. With the release rate less than  
2 10, that's really a negligible release rate. It would have  
3 no impact at all on further water chemistries. With release  
4 rates up to about 10 -- of up to about -- sorry -- up to  
5 1 -- from 1 to 10, we would be looking at a low reactivity.  
6 From 10 to 100, we're looking at moderate reactivity. And  
7 greater than 100, we're looking at a high reactivity.

8 Interestingly enough, even though these massive  
9 sulfides contain very high sulfur content, they are not that  
10 reactive compared to many other sites. This is not uncommon  
11 with massive sulfide, because it is a fairly well  
12 crystalline unit. And the access of oxygen to these units  
13 is not as -- tends not to be as readily available as in  
14 materials which have got less well formed pyrite. So these  
15 results are not unexpected. But I think it's important to  
16 put it in the context of the fact that, even though the high  
17 pyrite or high sulfide, that they're not really highly  
18 reactive.

19 Q Have you also got -- is it only the ore and the semi-massive  
20 sulfides represented on this grid?

21 A No. I'm sorry. The green plot -- the green traces are for  
22 country rock, the blue are for the intrusive rock, and the  
23 red is the massive sulfide, semi-massive sulfide samples.

24 Q And I believe earlier -- you misspoke, I believe, on the  
25 range of SRR for the negligible category. That's 0.- --

1 A Yes. 0.1.

2 Q To 1?

3 A To 1, yes.

4 Q And then could you please summarize your conclusions as to  
5 the ARD kinetics for these rocks?

6 A Yes. I think that the long-term column tests certainly do  
7 confirm the static results. They identify -- they confirm  
8 samples that are classified as potentially acid forming as  
9 being potentially acid forming. They also confirm those  
10 that are classified non-acid forming as being non-acid  
11 forming. They also provide information on the lag period  
12 that you would expect before onset of acid conditions once  
13 those materials are exposed. It indicates that country  
14 rocks have a variable lag, probably from 20 weeks to three  
15 years. That again is without any mitigation. Intrusive  
16 rocks have a longer lag and are slower to react. Whereas  
17 the ore samples certainly would be expected to generate low  
18 pH conditions during the mining operation.

19 The other summary and conclusion was that those  
20 samples classified non-acid forming are confirmed as being  
21 non-acid forming and are likely to maintain circumneutral pH  
22 into the long term. The generation rates -- the acid and  
23 sulfide generation rates are really ranked low to moderate  
24 when compared to many other sites. The column leach tests  
25 were carried out and are consistent with standard practice

1 and procedures. And I certainly did not identify any major  
2 geochemical -- any gaps in the geochemical program. It was  
3 complete and thorough.

4 Q And I'd like to turn next, then, Dr. Miller, to your review  
5 of the mine water quality predictions by Geochimica. And  
6 first of all, what did you review for that analysis?

7 A I reviewed the Intervenor exhibits that are listed, the DEQ  
8 exhibits again -- this was Mr. Eary's report.

9 Q Yes. On the Intervenor exhibits, could you describe just by  
10 topic what those are, Dr. Miller?

11 A Intervenor reports -- these relate to the mine permit  
12 application.

13 Q They include the Geochimica report?

14 A They include the Geochimica reports from appendices D1  
15 through D5. They include the geochemical, geological,  
16 lithology and the kinetic leach test results.

17 Q And once again you have reviewed Dr. Maest's and Dr.  
18 Coleman's reports and testimony?

19 A Yes.

20 Q Okay. And how would you characterize then the program used  
21 by Geochimica to do this characterization?

22 A I would describe that as the standard approach you would  
23 take to provide an initial evaluation of the impact of  
24 mining operation on water quality and what the implications  
25 may be for the mining operation.

1 Q And this has been referred to earlier as a mass balance  
2 calculation; is that right?

3 A Yes; yes.

4 Q And on the slide here, you say, "Mass balance to calculate  
5 total concentrations of constituents coupled with a  
6 geochemical speciation model." What do you mean by a  
7 "geochemical speciation model"?

8 A Well, the mass balance predicts the total mass that might be  
9 released from each of the rock types and then summed into a  
10 total amount and a total concentration. Because you cannot  
11 continue to add solutes to a solution because you meet some  
12 solubility constraints as the concentrations increase, and  
13 hence there is a ceiling on what the concentrations can be  
14 under certain conditions. And pH is a very major control on  
15 this condition. If the pH is near neutral, then most of the  
16 metals will be at low concentrations, because they have a pH  
17 dependence for their solubility.

18 The other thing if you're looking at a  
19 particular -- an acid ARD situation where you have sulfate  
20 and you have calcium where you are near neutral pH, then you  
21 have a limit on your sulfate concentration as well due to  
22 precipitation of certain minerals such as gypsum.

23 Q So when you refer to the speciation modeling, is that the  
24 same topic that Mr. Logsdon talked about yesterday when he  
25 referred to solubility control?

1 A Yes.

2 Q And did you, I think, characterize your findings of your  
3 review of this part of the Geochimica analysis, Dr. Miller?

4 A Yes. My review of Geochimica's analysis really is that it  
5 does reflect a well managed, modern mining operation.

6 Q And why do you say that or what do you mean by that?

7 A Well, what I mean by that is the way the selective mining  
8 where the ore has been well characterized to ore and waste  
9 control -- waste grade controls so that there is good  
10 demarcation of the different rock types within the mine and  
11 hence mining is carried out quite precisely as far as  
12 excavation and segregation of the units.

13 Q And what else did you conclude, Dr. Miller?

14 A Well, as I just said, with the selective mining is really  
15 industry establish best practice these days. And  
16 particularly over the last five to ten years, particularly  
17 five years, the waste grade control has become commonplace.  
18 It goes hand in hand with ore grade control. And the  
19 controls that have previously been restricted mainly to ore  
20 and waste being considered just waste and hence problems  
21 with that approach, we now have the industry treating waste  
22 like ore and getting very good controls on segregation,  
23 selective placement for ARD metal leaching controls.

24 But Geochimica, of course, even though, as I said,  
25 the assumptions used really reflect a well managed, modern

1 mining operation, they still did identify a need for active  
2 management and provided Kennecott Eagle Mining Company with  
3 a clear direction that mitigation would be required.

4 Q And we turn next, I think, Dr. Miller, to your review of  
5 some of the opinions offered by Dr. Maest and Dr. Coleman.  
6 And I think -- and does this slide summarize the differences  
7 that you found in the recalculations done by those persons  
8 as opposed to the Geochimica calculation?

9 A Yes.

10 Q Could you explain what those are?

11 A There were five areas where I noticed that there was  
12 significant differences or differences in the input  
13 parameters and approaches used. The first one relates to  
14 the kinetic data used for modeling, which is the column  
15 leach test results, the actual samples -- the actual  
16 leachate chemistries that were selected for modeling. The  
17 second one was the distribution and proportion of the  
18 different rock types that are within the development waste  
19 stockpile and also within the mine. There were differences  
20 in the mine inflow volumes. There were also differences in  
21 the massive development waste that was used as backfill.  
22 And there was also a difference in the effective surface  
23 area of rock, the calculated effective surface area that was  
24 calculated for the development rock stockpile.

25 Q Are those the primary assumptions that were different

1           between Geochimica and Maest and Coleman modeling?

2       A     Yes; yes.

3       Q     And if you turn, then, to the first one of that list, the

4           difference in kinetic data used in the modeling -- and I

5           think you talk about that here on the next slide -- could

6           you explain that difference, please?

7       A     Yes. Just flashing back to the slides where I showed the

8           time trends of pH and the sulfide release rates, we could

9           observe there's a wide variation in leaching characteristics

10          of the samples. And, of course, they change through time up

11          to a point before they become relatively stable. And

12          Stratus and Geochimica selected -- when you look at the

13          data, they selected the same kinetic test samples and fairly

14          similar chemistries for the massive sulfide unit, the

15          semi-massive sulfide unit and the country rock within the

16          same orders of magnitude. However there was a significant

17          difference in the samples selected for the intrusive rock.

18          Whereas Geochimica used a low and a high sulfur peridotite

19          at an early stage of leaching, because that's what was

20          available at the time of the analysis, whereas Stratus used

21          a high sulfur peridotite and at a later stage of leaching.

22       Q     And I think you're prepared a figure here that demonstrates

23           the effect of the selection of the high peridotite sample by

24           Dr. Maest. Could you explain this, please?

25       A     Okay. This again is a slide showing the time trend of

1 nickel concentrations in leachates from all the 15 kinetic  
2 test columns. You can see the concentration ranges over six  
3 orders of magnitude. It also shows -- the green traces are  
4 for the country rock, the blue for the intrusive rock and  
5 the red is for the ore grade massive sulfide units.

6 If we look at what was selected and what I've sort  
7 of indicated, not that easy to see -- I must apologize --  
8 but the Status samples in this symbol, the Geochimica  
9 samples in that symbol, with respect to what was selected  
10 for the massive sulfide and semi-massive sulfide units, we  
11 are within the same order or magnitude. For the country  
12 rock again we're in the same order of magnitude. Whereas  
13 with the intrusive rock, Geochimica selected samples early  
14 in the leaching phase, even though it was the same sample --  
15 but early in the leaching phase compared to Stratus  
16 selecting a chemistry two orders of magnitude higher.

17 Now, there's no -- if you were doing the analysis  
18 now, you might select some different numbers. So selecting  
19 the numbers for the reason you are selecting them is really  
20 the -- is up to whoever is doing the work and the purpose  
21 for doing the evaluation.

22 Q How many peridotite samples are represented there, Dr.  
23 Miller?

24 A Five.

25 Q And in terms of the degree of reactivity shown in the

1 testing on those five samples, which one did Ann Maest pick  
2 to use in her recalculation?

3 A The higher reacting sample.

4 Q The highest one?

5 A The highest one.

6 Q And then Mr. Logsdon instead used an average value?

7 A He did select the higher sample but at an earlier stage of  
8 the leaching phase. And he also selected a lower sulfur  
9 peridotite sample. So you can see from these plots, it  
10 is -- to select just one sample is not that representative  
11 of what's likely to happen in a mixed waste or development  
12 rock stockpile. The development rock stockpile is going to  
13 be mixed of those materials. So there's quite a range that  
14 you could select from. And again it depends on the purpose  
15 of which you are doing your evaluation.

16 Q And could you go to the next slide, please? Could you tell  
17 us what you've indicated here on this slide, Dr. Miller?

18 A What I'm looking at here is the proportions and the  
19 distribution of the different rock types in the development  
20 stockpile. As I said before, the standard operating  
21 procedures for ore and waste grade control at modern  
22 operations is specifically addressed -- they specifically  
23 are monitoring waste on a routine basis. And when I'm  
24 talking routine basis, I'm meaning on a daily basis. So  
25 that the units, the blocks, can be marked out and segregated

1 as needed. And contingencies will be incorporated within  
2 those standard operating procedures so, if something is  
3 inadvertently placed in the wrong location, it would be  
4 picked up and removed and moved. And my feeling would be  
5 that the implementation of modern grade control procedures  
6 at Eagle would certainly minimize the likelihood of --

7 MR. HAYNES: Your Honor, I'm going to have to  
8 object at this point. The witness is qualified in  
9 geochemistry. He has gone through in some detail the slides  
10 and the sampling and the geochemistry issues. But for him  
11 to opine now on control procedures at the proposed mine is  
12 outside his area of expertise. So his testimony lacks  
13 foundation.

14 MR. LEWIS: Let me ask Dr. Miller a few questions  
15 if I may, your Honor.

16 Q Dr. Miller, I believe you testified earlier that you had  
17 experience in something like 250 mines in your career?

18 A Yes.

19 Q And if we refer to your CV, which by the way, has been  
20 stipulated to be admitted and marked as Intervenor Number  
21 209, you list in your CV I think what you represent as  
22 typical projects and in there I believe under the  
23 "experience" section you say, "Experience with more than 250  
24 mining projects within Australia and world wide," and then  
25 under "Australia" you list by my count some 30 different

1 mining projects?

2 A Yes.

3 Q As typical?

4 A Yes.

5 Q And "international" you've got listed as some of the typical  
6 projects some 42 mining projects?

7 A Yes.

8 Q In your experience at these various mining projects -- I  
9 mean, do you in fact go to those projects and spend time at  
10 those projects?

11 A Many of them; most of them.

12 Q And as part of what you do with these geochemical testing  
13 characterization and consulting for mine operations, is it  
14 also an important part of what you do to know what the ore  
15 handling, waste handling methodologies will be at those mine  
16 projects?

17 A Yes.

18 Q Is that important in terms of the characterization of the  
19 potential for acid rock drainage at those projects?

20 A Yes.

21 Q And do you have the knowledge then of the general standards  
22 that are used for the kinds of things you're talking about  
23 here, the separation of ore from waste and so forth based on  
24 that experience of yours in this industry?

25 A Yes.

1 Q Now, based on your understanding of the practices used in  
2 the industry, do you believe that these kinds of practices  
3 will in fact be followed for this project?

4 MR. HAYNES: Objection; lack of foundation,  
5 speculation.

6 MR. LEWIS: I believe there's sufficient  
7 foundation, your Honor.

8 MR. HAYNES: Well, but now he's speculating as to  
9 whether or not he believes they will be followed, and that's  
10 going off into the future based -- and he's a geochemist and  
11 now he's going to be talking about whether certain practices  
12 will be followed at proposal -- at a project that isn't even  
13 operating yet.

14 MR. LEWIS: Let me ask it a different way.

15 JUDGE PATTERSON: Okay.

16 Q Is that the generally accepted standard practice in the  
17 industry based on your experience, Dr. Miller?

18 A Yes.

19 Q And by the way, in your consulting career and in some of  
20 these hundreds of mine projects that you worked, have those  
21 included some of the Rio Tinto Company mine projects?

22 A Yes.

23 Q And in your experience on those projects do they in fact use  
24 these vary same industry standard controls for separation of  
25 waste rock and ore rock?

1 A At many mining projects they do. In fact, at many of those  
2 I've actually set those programs up.

3 Q Now, if we could turn to the next slide. I believe this was  
4 the -- perhaps the third point of distinction you summarized  
5 earlier between the assumptions used by Geochimica versus  
6 Maest and Coleman for the calculations of the mine water  
7 chemistry and that related to the assumptions of mine inflow  
8 volume; is that right?

9 A (No verbal response)

10 Q And we heard Mark Logsdon testify about that yesterday and -  
11 - but that's one of the differences in the recalculation  
12 numbers that we heard about?

13 A Yes.

14 Q And also on the next slide -- I think Mr. Logsdon covered  
15 this yesterday as well -- another point of difference in  
16 your list was the massive development waste backfill used by  
17 Maest and Coleman versus Geochimica for these calculations?

18 A Yes.

19 Q And if we could turn to the next slide then I think perhaps  
20 the last point of distinction you had in your list was the  
21 difference in the assumptions used for the effected surface  
22 area of the development rock and could you explain your  
23 conclusions as to the different assumptions made there by  
24 Geochimica versus Dr. Maest and Dr. Coleman?

25 A Yes. I think this is quite an important aspect of the whole

1 evaluation. As I point out here, the purpose of estimating  
2 the particle surface area, or more correctly referred to as  
3 the specific surface of the rock within a waste dump or  
4 within a development waste stockpile or within the columns  
5 is to provide a method of scaling up from the column test  
6 works to the field, the real live dump. And one way of  
7 doing that is to use this specific surface area. Now, if we  
8 look at the results that are presented in the Geochimica  
9 reports and in Maest and -- Dr. Maest and Dr. Coleman's  
10 reports we can evaluate what the scale-up factors have been.

11 Now, if we look at the particle size distribution  
12 for the column samples that Geochimica provided in their  
13 report is that the calculated specific surface areas for the  
14 columns -- now, there's the sample crushed to less than ten  
15 millimeter size, less than one centimeter size. The  
16 calculated surface area averages around about .9 square  
17 meters per kilogram of sample. And for the development  
18 waste stockpile Geochimica assumed a mean particle diameter  
19 of 100 millimeters in centimeters, whereas Dr. Maest assumed  
20 90 percent at the hundred -- 100 millimeters and ten percent  
21 at ten millimeters. And if you calculate out what that  
22 means as far as specific surface area, for Geochimica the  
23 number is 0.22 square meters per kilogram, and for Dr. Maest  
24 it's 0.042 square meters per kilogram.

25 So we have an estimate of the surface area in the

1 columns based on a particle size distribution, but  
2 importantly, that particle size distribution only goes down  
3 to the finest fraction being one millimeter. And then so we  
4 then look at what is the ratio with a scale-up factor, the  
5 ratio between what the surface area in the column is  
6 compared to the run of mine development waste stockpile.  
7 And the ratios are actually .035 for Geochimica and .042 for  
8 Dr. Maest; not that different, only a factor of two.

9 If we move to the next slide. Now, what I'm  
10 saying here is that the estimates of the specific surface  
11 area for both the column test samples and the development  
12 waste are very low. And they really are not true surface  
13 area measurements. To do a true surface measure -- surface  
14 area measurement you have to take your particle size  
15 distributions down to micron size, not millimeter size. And  
16 it's the very fine fractions which provide the bulk of the  
17 surface area. So as far as comparing surface areas, they're  
18 not real measurements of surface areas. They're estimates  
19 to provide some method of scaling the columns to the test  
20 pads. So as I said, those factors are .025 for Geochimica,  
21 .047 for Dr. Maest, not that much difference; in a  
22 geochemistry world that's not bad as far as comparison. And  
23 the values -- and those scale-up factors are a reasonable  
24 estimate compared to what is generally applied.

25 Q Both Geochimica and Dr. Maest?

1 A Yes.

2 Q And what about Dr. Coleman's scale-up factor?

3 A Okay. So what Dr. Coleman did, he assumed for -- he assumed  
4 the particle surface area in the development waste 100 times  
5 what Mr. Logsdon used. What this means is that his scale-up  
6 factor when you calculate it through is a factor of 2.2 and  
7 we compare that to a factor of .02 and .04 for Mr. Logsdon  
8 and Dr. Maest, Dr. Coleman's number implies that there is a  
9 greater surface area per unit -- massive per unit volume in  
10 the development waste stockpile than in the column. And we  
11 know that the column is crushed to a very fine size and the  
12 development waste is, of course, a greater material and that  
13 is an unrealistic conclusion. The problem here is I think  
14 that -- the problem here is that one side of the scale-up  
15 factor was adjusted without examining the basis of the  
16 calculation.

17 Q Which is the size of the particles in the column --

18 A In the column, yes.

19 Q Okay. And what affect does that -- what you call  
20 "unrealistic assumption" have on Dr. Coleman's estimations  
21 or calculations of the various water quality parameters?

22 A Well, further mass balance calculation, because you're  
23 actually multiplying the loading so significantly you're  
24 getting very, very high mass balance concentrations,  
25 unrealistically high. And in some cases conflicting

1 chemistries.

2 Q Okay. I wanted to show you, Dr. Stuart (sic), a table that  
3 I looked at with Dr. Coleman when he was here. This was  
4 what was titled, "Corrected Table 2 of Appendix D-5" in Dr.  
5 Coleman's report titled, "Recalculation of Kennecott's  
6 Prediction of Post Mining in Mine Water Quality,"  
7 Petitioner's Exhibit 157. If we could -- I believe I asked  
8 Dr. Coleman about this when he was here and what he  
9 represented here I believe he has various parameters like pH  
10 alkalinity and so forth and then this chart actually  
11 continues on the next page and near the bottom of this page  
12 and continuing he has various metals on here and  
13 concentrations of those various salts and metals and so  
14 forth. And in the first column he's represented what he  
15 calls the "Appendix D-5 Value," which is from the Mark  
16 Logsdon report. And then in the second column he's got his  
17 so-called corrected value. Have you seen this before, Dr.  
18 Miller?

19 A Yes.

20 Q And in terms of what you were just talking about, that as  
21 to -- the point being that Dr. Coleman's numbers are so high  
22 that we have to take into account the solubility controls;  
23 would you explain that in terms of what's shown here in this  
24 second column for Dr. Coleman's number?

25 A Because of those -- the very high mass loadings we get very

1 high concentrations. And there is some conflicting  
2 chemistries here that invalidate this data set and it starts  
3 right at the top where we have alkalinity of 903 units in  
4 milligrams of calcium carbonate per liter as specifically  
5 highlighted in the title. At that alkalinity we are talking  
6 about a very alkaline solution, much higher pH than 7, maybe  
7 8, maybe 9. It's not a natural water type alkalinity. So  
8 that would imply a neutral to alkaline pH. If we have a  
9 neutral of alkaline pH then these metal concentrations will  
10 be orders of magnitude lower than presented in this table.  
11 The sulfate concentration will be orders of magnitude lower  
12 than presented in this table. So it's a fairly -- because  
13 of that massive loading that's put in here and without  
14 solubility considerations, these values are meaningless.

15 Q I think this relates to the post mining water quality  
16 predictions done by Mr. Logsdon. And what we're talking  
17 about here is this -- we talked a little bit with Mr.  
18 Logsdon about yesterday this failure by Dr. Coleman to take  
19 into account the solubility controls. Was that also an  
20 issue with Dr. Maest's calculations as well?

21 A Yes.

22 Q I think on this slide, Dr. Miller, you've got some  
23 discussion about some of the factors that affect the actual  
24 behavior of rocks, such as in this development rock  
25 stockpile in this project and could you explain what this

1 shows, please?

2 A Within a -- again, when we're trying to scale up from the  
3 columns to the real live development waste stockpile there  
4 are many other factors besides the surface area that are  
5 important in predicting the chemistry and they affect what  
6 that scale-up factor should be. And then they're physical,  
7 they're hydrological parameters, there's geochemical  
8 processes; there's many of these reactions and physical and  
9 chemical reactions which occur that tend to reduce the rate  
10 of release of constituents from a real live development  
11 stockpile compared to a column. And those include things  
12 like preferential flow pathways. Water doesn't uniformly  
13 flow through the stockpile that has preferential flow paths,  
14 so some areas may never be flushed; some areas might be  
15 continually flushed. The differences in the hardness and  
16 fracturing due to blasting in mining results in different  
17 exposures of mineral assemblages, not necessarily the same  
18 ratio or the same proportions that you will find in a finely  
19 crushed sample. The other one is the mode of occurrence of  
20 the different minerals, how they are associated with each  
21 other within the ore -- within the samples. And that can be  
22 very different in a course, in a finely crushed sample. And  
23 the surface chemistry affects. We can have precipitation  
24 and armoring occurring within a development waste stockpile  
25 and a real stockpile, and that armoring can be armoring of

1 the sulfide. It can be armoring of the neutralizing  
2 mineral. But armoring of the sulfide results in reducing  
3 the rate of oxidation compared to what you will see in a  
4 column test where you're accelerating the process. And very  
5 importantly is the mass transfer and availability of oxygen  
6 at the sulfide mineral surfaces. So oxygen has to get into  
7 the stockpile and also get to the surface of the sulfide to  
8 affect the oxidation mechanism.

9 Q And all those factors, if we compare the results in the  
10 column leach testing and then we try to extrapolate that to  
11 the field conditions, do all these factors tend to reduce in  
12 the fact predicted leaching that's predicted by the column  
13 leach test?

14 A They do.

15 Q And if we could turn to the next slide please. I think, Dr.  
16 Miller, you've got some points here again as to the  
17 differences in the assumptions made by Dr. Coleman and Dr.  
18 Maest and Geochimica and what affect those have on the  
19 numbers?

20 A Yes, this is in a way summarizing the differences in the  
21 chemistry -- predicted chemistries. There's two components  
22 to it. There's the mass loading that's predicted from the  
23 mass balance evaluation, and then there's the prediction of  
24 the concentration which is basically adding the water to the  
25 loading that's predicted. Now, the reasons for predict --

1 the reasons the mass loading predicted by Geochimica and by  
2 Mr. Maest and Dr. Coleman -- why they differ widely is  
3 firstly due to the higher element release rates selected by  
4 Dr. Maest and Dr. Coleman, and the larger surface areas  
5 used. So those two factors result in a higher mass loading.  
6 The other factor is the -- with respect to the  
7 concentrations, the higher concentrations predicted by Dr.  
8 Maest and Dr. Coleman is due to the higher mass loadings and  
9 the lower groundwater inflows, and no chemical speciation  
10 assessment. That's quite an important reason for the higher  
11 concentrations. They haven't been validated or corrected  
12 through -- corrected as a result of speciation modeling.

13 Q Again, that's the solubility control subject that we talked  
14 about?

15 A Yes.

16 Q And we just talked about it specifically in terms of the  
17 table and Dr. Coleman's report wherein there was no pH  
18 indicated, yet there was a high alkalinity value? Is that  
19 what you're talking about?

20 A That's correct.

21 Q And then the next point I think that --

22 A The next --

23 Q Go ahead.

24 A The final point was to do with the fact that no limestone --  
25 limestone wasn't included. Now, limestone wasn't included

1 in Mr. Logsdon's evaluations either, but was dismissed from  
2 by stratus -- or by Dr. Maest because of the fact that some  
3 evaluations that Dr. -- that Mr. Logsdon did indicated very  
4 little impact as we saw yesterday, very little effects on  
5 some of the metals because the pH was high, near neutral.  
6 Where the pH is lower or considered lower, then you have to  
7 incorporate the limestone.

8 Q Meaning in the Maest and Coleman scenarios?

9 A Yes.

10 Q And I think the next slide you've got a -- some summary of  
11 your conclusions here?

12 A Yes. What I'm saying here is that Geochimica followed  
13 standard practice and validated the concentrations by using  
14 speciation solubility modeling. Now, although the input  
15 assumptions used by Geochimica result in lower mass loadings  
16 than Dr. Maest, they did identify the need for active  
17 management, which of course includes the need for limestone,  
18 affection treatment, et cetera.

19 Q And the next slide, please, I think is -- continues this  
20 summary, Dr. Miller?

21 A This is -- Dr. Maest assumed that the limestone would not  
22 affect constituent concentration based on the findings of  
23 Mr. Logsdon, but that finding is not applicable to the  
24 chemistries that Dr. Maest had predicted, because she is  
25 predicting much higher concentrations where the need for

1           solubility modeling was important in the need for limestone.  
2           The effect of limestone would be quite significant.

3       Q     I believe Mr. Logsdon in his report on the post mine water  
4           quality indicated a pH of 6.8?

5       A     Yes.

6       Q     And in the Maest recalculations did she report a pH at all?

7       A     No.

8       Q     Nor did Dr. Coleman?

9       A     No.

10      Q     But they nevertheless reported much higher concentrations of  
11           these metals; is that right?

12      A     That's correct.

13      Q     And based on your experience, if you have those kinds of  
14           concentrations that they included, is there a necessary  
15           corollary to what must be the pH in that material?

16      A     Well, the Dr. Coleman one is very confusing because of the  
17           conflicting chemistries which are extremely high alkalinity  
18           and extremely high metals.  Extremely high metals would mean  
19           low pH; extremely high alkalinity means very high pH.  Dr.  
20           Maest with the higher metal concentrations would imply low  
21           pH; and hence, addition of limestone would be very  
22           important.

23      Q     And then I think your next two slides I think we've pretty  
24           well covered, Dr. Miller.

25      A     Uh-huh (affirmative).

1 Q So let's go to the next point, which is the Limestone  
2 Addition and would you discuss for us what will be the  
3 affect -- and again, limestone addition is not factored into  
4 the Geochimica calculations either, because as Mr. Logsdon  
5 testified, his point was to identify the need for mitigation  
6 and then limestone would be one of those mitigation  
7 techniques. But let's talk a bit, if we may, about what  
8 will be the effect of the limestone addition that will be  
9 done and is required by the permit for the development rock  
10 for this project.

11 A Okay. Well, my understanding is that the plan in the mine  
12 permit application is to add 20 kilograms of limestone per  
13 ton of development waste rock as a overall application rate.  
14 This would -- on the basis of the calculated average  
15 neutralizing potential of the development waste it would  
16 increase it from the current unmitigated value of 13  
17 kilograms of calcium carbonate per ton to 33 kilograms of  
18 calcium carbonate per ton. The effect of that would be to  
19 increase the average net neutralizing potential from a  
20 deficit of ten unmitigated to a surplus or credit of plus  
21 ten as an overall -- as the mass of the development waste  
22 stockpile.

23 Q And when you say a "surplus or a credit," do you mean in  
24 terms of being able to neutralize acid to maintain neutral  
25 conditions, or what do you mean?

1       A     It mean that the -- in the average sense you would -- you'll  
2            have a -- you'll have a credit, an excess, so you will be --  
3            what would -- the implication will be is that it will extend  
4            the lag period rather than necessarily -- it's not  
5            sufficient to over -- in an overall sense to neutralize  
6            every -- the potential acidity, but it is certainly  
7            sufficient to extend the lag beyond the period of time when  
8            it's exposed to atmospheric oxygen.  Because once it's  
9            placed back underground and inundated with water, then  
10           access to oxygen is shut off in the mechanism -- the sulfur  
11           oxidation mechanism is shut off.

12       Q     We talked earlier and we talked yesterday with Mr. Logsdon  
13            about the -- I guess the predicted lag times based on the  
14            column leach testing and we looked at some of those charts.  
15            Is the effect of this limestone addition then to -- when we  
16            talked in terms of I think a year to a few years, is the  
17            affect of this limestone --

18                   MR. EGGAN:  Your Honor, I think this is a leading  
19            question and again, I would just ask that the questions be  
20            non-leading.  This is direct examination.

21                   MR. LEWIS:  So far it's just a little foundation  
22            before I ask the question, your Honor.

23                   MR. EGGAN:  Well, I think it's -- I think it's an  
24            editorialization of what Mr. Lewis's perspective on what  
25            prior evidence has, and so -- look, this is not a

1 complicated objection; just don't ask leading questions.  
2 That's my request.

3 MR. LEWIS: If the objection is that he disagrees  
4 with my characterization of the evidence, I will take that  
5 objection and I will ask a different question. I didn't  
6 understand that to be the objection originally.

7 Q Dr. Miller, just to be clear here, in terms of the time at  
8 which this material can be expected to develop acidic  
9 conditions and leach concentrations of metals, what is the  
10 effect of the limestone on the time by which this material  
11 will do that?

12 A I can't be specific in answering that. All I can really say  
13 is that it will certainly extend the lag time.

14 Q Okay. Will it extend the lag time so that -- sufficiently  
15 so that we get to the point where the development rock is  
16 back into the mine and reflooding occurs?

17 A That is certainly the objective of adding the limestone.  
18 The objective is not to neutralize every -- all the  
19 potential acidity.

20 Q And if we can go to the next slide, what will be the effect  
21 then in addition to adding the limestone and this affect of  
22 delaying these events, what will be the additional affect of  
23 the flooding of the mine which is required by the permit to  
24 be done after mining's concluded?

25 A Well, flooding of the mine will essentially exclude

1 atmospheric oxygen, and hence, shut down the oxidation  
2 process -- the sulfide oxidation process. And because the  
3 development rock is -- if it is still within the lag phase  
4 and that's the purpose of the -- the objective of adding  
5 limestone, then there will be very little soluble salts or  
6 soluble products within the development waste to be  
7 redissolved into the water. So those two things really are  
8 very -- it is really best practice strategy to hold your  
9 material within a lag period while it's exposed to  
10 atmospheric oxygen, then with the long-term permanent  
11 solution to inundate it and place it below a permanent water  
12 cover.

13 Q And I think if we could turn to the next slide I'd like you  
14 just to review your overall conclusions as a way to  
15 summarize this testimony, Dr. Miller.

16 A Okay. Overall conclusions are that the Kennecott Eagle  
17 Mining Company's geochemical program is certainly  
18 comprehensive and is consistent with accepted practice. The  
19 important point in this sort of modeling -- in geochemical  
20 modeling in trying to predict premining what the behavior of  
21 mine waste materials, particularly sulfidic materials, it's  
22 not -- it cannot accurately predict but it certainly  
23 provides an indication of the implications for water quality  
24 and the implications for mining during mining and with  
25 closure; what is needed to be done to mitigate potential

1 impacts. The key purpose of the geochemical investigations  
2 and modeling, as I said, is to identify what those  
3 implications are. And Geochimica did identify those  
4 implications and the need for active management with updated  
5 mine water inflow volumes and massive development rock,  
6 which certainly result in some higher concentrations than  
7 had been predicted and reported in Appendices D-1 to D-5,  
8 but those -- but that wouldn't change the conclusions of the  
9 need for mitigation and active management.

10 Q And the next slide, please?

11 A Well, the GLIFWC surface area assumptions are basically  
12 flawed and the water quality predictions are invalid as  
13 those data are just not relevant or realistic.

14 Q That's the Dr. Coleman report?

15 A Yes. Dr. Maest's predictions are based on some worst-case  
16 assumptions and are potentially invalid because of the lack  
17 application of solubility considerations, but they're likely  
18 to fall or may fall within range that you might expect  
19 during mining without mitigation; with mitigation you would  
20 certainly not see those sorts of concentrations predicted.  
21 But they could be observed if -- without mitigation.

22 Q Without limestone and reflooding?

23 A Uh-huh (affirmative).

24 Q Is that what you mean?

25 A That's what I mean. And with the modern selective mining

1 techniques and the routine sampling and classification  
2 mapping of both ore and waste Strauss predictions are likely  
3 to be overly conservative because of the lack of limestone  
4 addition and because of modern techniques of being selective  
5 of mining different rock types.

6 MR. LEWIS: That completes my direct examination  
7 of Dr. Miller, your Honor. I would offer the slides as a  
8 demonstrative exhibit for the court's reference. They are  
9 marked as Intervenor Exhibit Number 631.

10 MR. HAYNES: Your Honor, with the caution that  
11 these slides are not actual evidence but they are simply  
12 demonstrative, with that caution I've no objection.

13 MR. EGGAN: I'm going to maintain my objection,  
14 your Honor. I would amend it to simply say that while I  
15 believe the conclusions of the -- within this document would  
16 be helpful to you, I believe the rest of this document is  
17 essentially a report and it is a report that we really did  
18 not have until this morning -- excuse me -- until yesterday  
19 afternoon. And so on the basis of the fact that this 44-  
20 slide document is essentially a report by this witness that  
21 we did not have an opportunity to review in advance, which  
22 was not submitted as part of the exhibits in this matter and  
23 which this person could have easily created much earlier in  
24 this litigation, we would object. I would object.

25 MR. REICHEL: No objection.

1 JUDGE PATTERSON: I'm going to admit it over  
2 objection. Again, as a -- for lack of a better term -- a  
3 summary of the testimony that I can utilize as opposed to an  
4 actual exhibit as part of the record. It basically -- I  
5 guess I can't find a better term than summarizes the  
6 testimony. I will admit it over objection with that  
7 limitation.

8 (Intervenor's Exhibit 631 received)

9 JUDGE PATTERSON: Do you want to take a break  
10 before cross?

11 MR. HAYNES: Yes. We'd like to, yes. Thank you,  
12 your Honor.

13 (Off the record)

14 JUDGE PATTERSON: Who's up first?

15 MR. HAYNES: I'm up first. I don't recall; did  
16 Mr. Reichel make his standard reservation?

17 JUDGE PATTERSON: I don't believe he did.

18 MR. REICHEL: I have no questions at this time.

19 MR. HAYNES: With that I'll begin. Dr. Miller,  
20 good morning. My name is Jeff Haynes; I represent the  
21 National Wildlife Federation and the Yellow Dog Watershed  
22 Preserve.

23 CROSS-EXAMINATION

24 BY MR. HAYNES:

25 Q Dr. Miller, you testified on direct examination that you

1 believe that the proposed Eagle Mine is really a small-scale  
2 operation compared to some that you've had experience with.  
3 Do you remember that?

4 A Yes.

5 Q All right. You're not suggesting, are you, sir, that the  
6 proposed Eagle Mine is a small-scale operation in the  
7 context of Michigan mining, are you?

8 A No.

9 Q Okay. You also suggested that the amount of ore -- excuse  
10 me -- rock that would be moved in one day -- excuse me --  
11 moved for this entire mine would be moved in one day in  
12 other mines that you have experience with. Do you remember  
13 that?

14 A Yes.

15 Q And were those underground mines or were those above-ground  
16 open pit mines?

17 A Open pit.

18 Q Open pit. Different kinds of mines; correct?

19 A (No verbal response)

20 Q So that comparison really doesn't relate to what we're  
21 talking about today, does it?

22 A Yes, it does.

23 Q We have an open pit mine versus an underground mine; right?

24 A Yes.

25 Q Okay. So different kinds of mines; correct?

1 A Different operating strategies.

2 Q Yeah. Thank you.

3 MR. HAYNES: Now, with Mr. Lewis's permission I'd  
4 like to go through the slides that you used before so we  
5 have to use his folks, because we don't have those slides on  
6 our machines we all got this this morning. So if we could  
7 go to slide five, please.

8 JUDGE PATTERSON: Still a dollar a page?

9 MR. LEWIS: Yes.

10 MR. HAYNES: Let me get my wallet out. It's cheap  
11 if they had -- cheap at twice the price, your Honor.

12 MR. LEWIS: I thought I was helping. I actually  
13 reduced the number of slides and moved some around, but I --  
14 apparently I've created a problem for Mr. Haynes.

15 MR. HAYNES: Well, only in renumbering, your  
16 Honor. And we only have two slides that were removed and  
17 they were large title slides, but we'll work with what we  
18 have.

19 Q On slide number five, Dr. Miller, this slide shows -- I  
20 count them five reports and exhibits of the petitioners that  
21 you reviewed. Do you see that?

22 A Yes.

23 Q Including the Stratus report of October 16, 2007, which is  
24 the geochemical review that you designate as Stratus 2007-A?  
25 Do you see that?

1 A Yes; yeah.

2 Q So you reviewed that report?

3 A Yes.

4 Q And relied on it for purposes of preparing your testimony  
5 today?

6 A Yes.

7 Q And the second -- the second report is the Stratus  
8 Consulting which you designate 2007-B, which is the Stratus  
9 report relating to comments of the Keweenaw Bay Indian  
10 community in opposition to the proposed mine dated October  
11 16, 2007? You reviewed that report?

12 A Yes.

13 Q And you relied on that report for purposes of preparing your  
14 testimony for today?

15 A Yes.

16 MR. HAYNES: Your Honor, with that comment, I move  
17 the admission of that report labeled 2007b, which is the  
18 October 16, 2007, report by Stratus Consulting relating to  
19 comments of the Keweenaw Bay Indian Community. It is  
20 Petitioner's Exhibit 31, Appendix 8-B, which was previously  
21 offered by Mr. Eggan and was objected to and refused  
22 admission. But I think if this witness has relied on that  
23 report for purposes of his testimony, I think the report  
24 ought to be in evidence. Because he relied on it, and we're  
25 going to examine him based on his reliance on that report.

1                   MR. LEWIS: The fact that the witness relied on  
2 that report has no relevance to whether it's admissible or  
3 not, your Honor. The witness obviously reviewed various  
4 aspects of the testimony of Dr. Maest and Dr. Coleman,  
5 including the various prior reports, in the context of  
6 addressing the specific criticisms that they presented at  
7 this hearing earlier in their testimony. The fact that this  
8 witness did review them as part of his preparation for his  
9 testimony and his rebuttal to the points made by Dr. Coleman  
10 and Dr. Maest in their prior testimony in this proceeding  
11 does not create or satisfy the foundational requirements for  
12 the admission -- for the admission of those documents. And  
13 that's what was lacking before, in addition to other  
14 problems as I recall with one of them, the inclusion in a  
15 report of basically a recitation of someone else's reporting  
16 on groundwater modeling and so forth. So it was a lack of  
17 foundation primarily. And the fact that this witness has  
18 reviewed them in the context of preparing his testimony does  
19 not eliminate that fundamental problem that should bar the  
20 admissibility of those reports.

21                   MR. EGGAN: Your Honor, this is Eric Egan. If he  
22 had only reviewed them but had not relied upon them, I would  
23 agree. But the witness has testified -- just testified that  
24 he not only reviewed them, but he relied upon them. And he  
25 testified about all of these reports, but especially Ms.

1 Maest's conclusions. And so from our perspective, your  
2 Honor, the one issue that remains now -- or that remained  
3 after Mr. Lewis' objection previously to this has been  
4 removed. We have a witness who reviewed and relied upon  
5 them independent of Dr. Maest.

6 JUDGE PATTERSON: And I think formulated opinions  
7 based on that report.

8 MR. EGGAN: Yes.

9 JUDGE PATTERSON: Based on that I'm going to admit  
10 them.

11 MR. EGGAN: Thank you, your Honor.

12 MR. LEWIS: If I could clarify, your Honor, the  
13 Petitioners are attempting to offer these exhibits now, not  
14 really on the basis that it was material reviewed by Dr.  
15 Miller, but they are attempting to offer them for any and  
16 all purposes, I would think, including for the proof of the  
17 matters stated therein. And they ought not be allowed into  
18 evidence for that purpose. If they are allowed, I think  
19 they ought to be restricted to the limited purpose of being  
20 information that Dr. Miller reviewed for the purposes of his  
21 testimony and not any other purpose. Again, what we spent  
22 time with Dr. Miller doing in his testimony is rebutting the  
23 opinions offered by Maest and Coleman. Now, the act of  
24 rebutting and disagreeing does not create the foundation for  
25 those reports and opinions to be admitted into evidence for

1 the truth of the matters stated therein. So I would  
2 request, if there is going to be admission of them, that it  
3 be a limited admissibility for a limited purpose, that being  
4 that it was information that Dr. Miller relied on for  
5 purposes of his rebuttal to their opinion.

6 MR. HAYNES: Your Honor, on the contrary, you've  
7 already ruled in one of the motions that was -- one of the  
8 pre-trial motions that if witnesses relied on various  
9 reports submitted by Petitioners as part of the comments  
10 submitted before this -- prior to this contested case, that  
11 if those reports were relied on, then they would be  
12 admissible. So I think -- and again, I think counsel now is  
13 asking for reconsideration of your ruling, which I think is  
14 improper. But in any event, I think you've already ruled  
15 that if witnesses rely on reports that were submitted as  
16 part of the commenting process, that they would be  
17 admissible.

18 JUDGE PATTERSON: I'm going to admit them without  
19 limitation.

20 MR. HAYNES: I'm sorry? Without --

21 JUDGE PATTERSON: I'm going to admit them without  
22 limitation.

23 MR. HAYNES: Thank you, your Honor.

24 (Petitioner's Exhibit 31-31 received)

25 MR. HAYNES: Now, if we could go to slide number

1 8?

2 Q Dr. Miller, we're at slide 8, which is a chart that Mr.  
3 Logdston testified about yesterday and you testified about  
4 today. Looking at this chart which you said was an  
5 important chart as I recall -- correct? --

6 A Yes.

7 Q -- we have represented here by the red dots the 15 column  
8 samples -- correct? -- that were subjected to kinetic  
9 testing?

10 A Yes.

11 Q And the blue line then represents the distribution of the  
12 rest of the samples that were taken -- that were analyzed;  
13 is that right?

14 A No.

15 Q Oh, I see. The blue line is just -- is just connecting the  
16 red dots?

17 A No.

18 Q All right. Explain what the blue line, then, is.

19 A The blue line is not a line. It's a series of points. It  
20 looks like a line because there are 6,000 points.

21 Q Okay. So if I characterize it as a blue line, forgive me.  
22 But the series of points, the 6,000-plus points are the  
23 other samples that were taken in addition to the column test  
24 samples; correct?

25 A They are the samples from the geological database,

1 Kennecott's geological database.

2 Q For purposes of the acid generation tests; correct?

3 A They're not the samples that were -- they include the  
4 samples from the static test work, but they're additional  
5 samples as well. It's the complete --

6 Q The geochemical samples; correct?

7 A The geochemical samples are included in those dots.

8 Q I see. All right. Now, looking at this slide and this  
9 chart, Dr. Miller, if we can go from the top right to the  
10 bottom left, we have a red dot that I think you testified  
11 here -- which is approximately 35 percent total sulfur.  
12 That's a test from the massive sulfide unit; correct?

13 A Yes.

14 Q And if we go down -- could I call it a line just --  
15 A You can call it a line.

16 Q Thank you. You understand what I'm talking about when I say  
17 "a line"?

18 A Yes; yes.

19 Q Because 6,000 dots in a very small space looks like a line;  
20 right?

21 A (No verbal response)

22 Q "Yes"?

23 A Yes.

24 Q If we go down this line to the next red dot, that appears to  
25 be a sample that shows a percent sulfur of, say, 12 or 13

1           percent; right?

2       A     Yes.

3       Q     And the next dot shows a sample that has, say, 7 or 8

4           percent sulfur; correct?

5       A     Yes.

6       Q     And you said those two samples were in the semi-massive

7           sulfide unit; correct?

8       A     Yes. My understanding is that's where they are.

9       Q     And you talked about the inflection of the line showing the

10          change in the rock type; correct?

11      A     Uh-huh (affirmative).

12      Q     "Yes"?

13      A     Yes.

14      Q     And so the inflection here for these two samples shows, to

15          your mind, anyway, that that -- that those two samples were

16          taken from the semi-massive sulfide unit; correct?

17      A     Yes.

18      Q     And if we move down the line, the next red dot at least that

19          I can see -- and correct me if I'm wrong. The next red dot,

20          which would be the fourth in our descending order here,

21          shows up at about, oh, say, two or three percent sulfur;

22          correct?

23      A     Yes.

24      Q     That's the fourth. And then the fifth dot, which looks to

25          be on the 2000 line -- the 2000 vertical line of samples, is

1           about, say, something less than two percent?

2       A     Yes.

3       Q     And I think you testified that the three -- that the two  
4           samples that are below five percent in this cell that's  
5           between 2,000 and 4,000 and above between zero and 5 percent  
6           sulfur, those are from the prototype; is that right?

7       A     Sorry?

8       Q     That the two samples that are represented at -- below five  
9           percent but between the 2,000 and 4,000 numbers those  
10          samples, those are from the peridotite?

11      A     I'm not sure. That sample there is from peridotite, but I'm  
12          not sure whether that's country rock or intrusive.

13      Q     So the point that is represented on -- somewhere above 2,000  
14          but below 4,000 and below five percent is the prototype  
15          sample; correct?

16      A     That's one of the prototype samples.

17      Q     Okay. Now, if we could turn now to slide 10, do you have  
18          that, Dr. Miller?

19      A     I do, yes.

20      Q     In this slide you show the various sulfur concentrations in  
21          the various rock types -- correct? -- sulfur percentages?

22      A     Yes.

23      Q     And we know that the massive sulfide unit has a relatively  
24          high sulfur percentage; correct? 30 percent?

25      A     Yes.

1 Q You would characterize that as high?

2 A Yes.

3 Q And the semi-massive has between 10 and 15 percent sulfur,  
4 which -- not as high but still higher than the development  
5 rock; correct?

6 A Yes.

7 Q By several times; correct?

8 A Yes.

9 Q And the disseminated sulfidic ore which you say is up to ten  
10 percent sulfur, is that what we've been calling the  
11 peridotite?

12 A No.

13 Q Explain, please, for us what you mean by disseminated  
14 sulfidic ore in relation to what we've been calling  
15 peridotite for weeks now in this hearing.

16 A Well, I'm not a geologist.

17 Q All right.

18 A But my understanding is that some of the intrusive is ore  
19 grade but is not classified as semi-massive sulfide or  
20 massive sulfide. And that is a disseminated sulfidic ore.

21 Q So it would be ore-grade rock that's in the peridotite?

22 A Yes.

23 Q And to your understanding, that disseminated sulfidic ore  
24 that's in the peridotite is intended to be mined as part of  
25 this project?

1 A Ore-grade material would be mined, would be my  
2 understanding.

3 Q Not left in place?

4 A My understanding it would not be left in place.

5 Q And so for the -- and the disseminated sulfidic ore is not  
6 development rock -- correct? -- if it's going to be mined?

7 A Correct.

8 Q Now, if we could turn back to slide 8 that we've just gone  
9 through, we have one sample used for kinetic testing that  
10 was in the massive sulfide unit; correct? One?

11 A Correct.

12 Q We have two samples that were used for -- two samples from  
13 the semi-massive sulfide unit that were used for kinetic  
14 testing; right? Two?

15 A As they are classified, two.

16 Q And for the sulfidic -- the disseminated sulfidic ore as you  
17 call it, which is up to ten percent sulfide, we apparently  
18 have one sample; right?

19 A Yes.

20 Q Just one?

21 A Yes.

22 Q For kinetic testing?

23 A Yes.

24 Q And you consider that to be adequate?

25 A For ore, yes.

1 Q For ore. I see. And then how many samples do we have of  
2 the peridotite that will not be mined; do you know?

3 A If we move to another slide, we can clarify that.

4 Q Which slide?

5 (Witness reviews documents)

6 A 22.

7 Q Let's go to slide 22.

8 A Can you repeat your question, please?

9 Q The question is, how many samples were taken in the  
10 peridotite that won't be mined?

11 A The blue samples are intrusive, peridotite samples.

12 Q And there were, I believe you testified, five; right?

13 A Five.

14 Q And that's the peridotite that won't be mined? Or is this  
15 the disseminated sulfidic ore?

16 A This is development waste.

17 Q In the peridotite?

18 A Yes.

19 Q And so we have -- and on slide 22 we have three samples in -  
20 - three kinetic samples in the massive sulfide unit;  
21 correct?

22 A Three samples of ore.

23 Q Of ore. Five in the non-mined peridotite and then seven in  
24 the development rock; correct?

25 A No.

1 Q That adds up to 15, doesn't it?

2 A But the development rock includes the country rock in those  
3 intrusive samples.

4 Q For the development rock, then, we have 12 samples?

5 A Correct.

6 Q So we have no -- so if we have three samples in the ore,  
7 that includes the sulfidic -- the disseminated sulfidic ore?

8 A They're classified as semi-massive sulfide and massive  
9 sulfide.

10 Q Well, I'm trying to figure out how many samples were taken  
11 in the disseminated sulfidic ore. And right now it sounds  
12 like none.

13 A My understanding was that at the time these were classified,  
14 the disseminated sulfidic ore classification had not been  
15 defined.

16 Q So there were no samples taken in the disseminated sulfidic  
17 ore; right?

18 A As I said, these samples were classified as semi-massive  
19 sulfide and massive sulfide.

20 Q I understand that. My question is, how many samples then  
21 were taken in the disseminated sulfidic ore? None?

22 A None in this sample set are classified as disseminated  
23 sulfide ore.

24 Q So the answer is "none in this sample set"?

25 A The answer is "none."

1 Q If we could turn to slide 11, please? Dr. Miller, on slide  
2 11 in the second bullet you talk about the high number of  
3 samples -- you testified that you believed that there was a  
4 high number of samples selected for the small scale of the  
5 Eagle operation. That's on the slide and that's what you  
6 testified to; correct?

7 A Yes.

8 Q Dr. Miller, are you familiar with the EPA -- the United  
9 States EPA guidelines on the number of samples to be used  
10 per tons of ore?

11 A I'm aware of those guidelines, yes.

12 Q You're aware of that. Do you know whether or not the  
13 numbers of samples selected here for kinetic testing comply  
14 with the EPA guidelines for the numbers of samples per ton  
15 of ore?

16 A Per ton of waste they apply, absolutely.

17 Q They apply?

18 A Yes.

19 Q Do they comply with the EPA guidelines per ton of waste?

20 A Per ton of waste? Yes.

21 Q But not for the entire project?

22 A I don't understand your question.

23 Q Well, we have waste rock which is sometimes called  
24 development rock; correct?

25 A Correct.

1 Q And then we have ore; right?

2 A Correct.

3 Q So there's -- we're going to add those two together to get  
4 the amount of rock taken out of the -- taken out of the  
5 ground; correct?

6 A Correct.

7 Q And so the EPA guidelines apply to all the rock taken out of  
8 the ground, don't they, not just waste rock?

9 A Not to my understanding.

10 Q Okay. Dr. Miller, when were you first asked to consult on  
11 this project?

12 A Late last year is my recollection.

13 Q I'm sorry? I didn't hear the last part.

14 A Late last year is my recollection.

15 Q And what was your assignment?

16 A My assignment was to review the geochemical program carried  
17 out by Kennecott Eagle Mines and to review documents  
18 prepared by others.

19 Q I see. Were you asked to prepare any sort of a report for  
20 the people who asked you to do the work?

21 A No specific report.

22 Q I see. And when, then, did you prepare the slides that  
23 we're looking at today?

24 A Within the past month, six weeks, two months. I'm not  
25 exactly sure, --

1 Q When were you --  
2 A -- because it has been progressive.  
3 Q I see. When were you first asked to prepare slides are your  
4 testimony?  
5 A Just prior to the slides which were in Exhibit -- the four  
6 slides which include the graphs which were in Exhibit  
7 Number -- I'm not sure.  
8 Q 212 or 202, one of those numbers; right?  
9 MR. LEWIS: 210, I believe.  
10 Q 210.  
11 A Okay.  
12 Q Yes, Exhibit 210, Dr. Miller. When were you asked to  
13 prepare those slides?  
14 A Two weeks before that -- two or three weeks before that was  
15 submitted is my recollection.  
16 Q Before they were submitted?  
17 A Yes.  
18 Q Which was April 1st. So it would have been sometime in  
19 March?  
20 A Sometime in March.  
21 Q I see. And the slides in Exhibit 210 have been incorporated  
22 in your slides that you've shown today?  
23 A Yes.  
24 Q So those slides basically operated as a report, didn't they,  
25 of your testimony?

1 A I don't understand the question.

2 Q From Exhibit 210, the slides that you prepared then were  
3 basically a report, weren't they? Your testimony, your  
4 impressions of --

5 A They were -- those slides are an analysis of the kinetic  
6 test work.

7 Q Prepared before April 1st; correct?

8 A If you've got the dates, that is correct.

9 Q The slides were sent to us sometime around April 1st with  
10 the rest of the Kennecott exhibits.

11 A Okay. So it would have been prepared in March.

12 MR. HAYNES: Your Honor, at this point I move to  
13 strike those slides and any testimony related to those  
14 slides, which they were an analysis, which means they were a  
15 report. They weren't identified in the witness disclosure  
16 as a report from Dr. Miller. They were identified as an  
17 exhibit, but his name appears nowhere on Exhibit 210, which  
18 the witness testified were incorporated into the slides that  
19 he testified to today. And so in fact there apparently was  
20 a report that we weren't told was Dr. Miller's report for us  
21 to prepare for his cross-examination. So at this point I  
22 move to strike the testimony relating to the charts that he  
23 showed today.

24 MR. EGGAN: I would join the objection and add the  
25 fact that this is a witness who was invited to participate

1 as a consultant in this case back in -- at the end of 2007.  
2 So Kennecott has known all this time that this witness was  
3 going to testify. Again, he's been presented as somebody  
4 who's going to testify on rebuttal. But he's offered  
5 substantive testimony, but it's not rebuttal. And from my  
6 perspective, this is a violation of the court's scheduling  
7 conference order. And again, I think there's an element of  
8 unfairness here.

9 MR. LEWIS: I'm not clear I really understand the  
10 objection, your Honor. We did provide as an Exhibit 210, by  
11 the date set forth to provide exhibits, slides, some of the  
12 charts that Dr. Miller used in his presentation today. They  
13 were provided with the exhibits. What he did today was talk  
14 about those to illustrate his testimony. The slides  
15 themselves, neither Exhibit 210 which counsel have just  
16 referred to, which was a disclosure earlier of what they  
17 were to them -- neither 210 nor the slides shown today have  
18 been offered in evidence by me. It was merely used as a  
19 summary of his testimony. So I'm not clear what the  
20 objection here is. He's certainly entitled to offer his  
21 testimony, his opinions and his conclusions. And it has no  
22 relevance -- the objections don't seem to have any relevance  
23 to that fact.

24 MR. HAYNES: Let me make the motion perfectly  
25 clear if counsel hasn't understood it. The slides -- there

1 are seven slides in Exhibit 210. Those slides are  
2 reproduced in the slides that Dr. Miller testified about  
3 today as the charts. And just so the record is clear, they  
4 are the slides on pages -- slide 18, slide 19, slide 20,  
5 slide 21, slide 22, slide 29 -- those slides. The witness  
6 testified that these charts are an analysis of others'  
7 materials. An analysis to me sounds like a report. If they  
8 are a report -- which, the witness has testified these are  
9 equivalent to a report -- it should have been identified in  
10 the witness disclosure as a report from this witness. We  
11 then would have been able to connect these slides with what  
12 Dr. Miller was going to testify about. There's no  
13 connection made. And this court's order required that  
14 reports be at least identified in the witness disclosure.  
15 They weren't identified. So any testimony based upon these  
16 slides I move to strike.

17 MR. LEWIS: Let's be clear on one point. The  
18 witness lists were provided before the exhibit disclosure  
19 date, your Honor, so at the time that the witnesses were  
20 provided, there were no slides; there was no Exhibit 210.  
21 We did provide those slides later, at the time that the  
22 exhibits were due. And just to be clear here, this witness  
23 testified that his opinions and in fact these charts are  
24 based on the data in Intervenor Exhibits 309, 310 and 595,  
25 which were all introduced in evidence earlier through Mr.

1           Ware. That is the basis and foundation for not only those  
2 charts but his testimony today on those points. That is  
3 sufficient and adequate foundation for that testimony. The  
4 complaint here seems to have no relevance to that point. We  
5 had no obligation, in fact, to give counsel slides of this  
6 presentation before this testimony. We could have  
7 proceeded, you know, just to elicit the testimony and the  
8 opinions. These slides are used to illustrate the opinions  
9 and testimony of this witness, and that's the only reason --  
10 only purpose for which they've been offered and accepted by  
11 this court.

12                   JUDGE PATTERSON: Mr. Reichel, do you have  
13 anything to add?

14                   MR. REICHEL: If I understand the motion to  
15 strike, it's -- part of the premise for it is that the  
16 slides in question that were included in this Exhibit 210  
17 are being characterized as a report. I'm not sure that the  
18 witness -- as I understood the examination, the witness  
19 didn't agree that they were a report. I'm not sure that  
20 they are. I mean, what the witness has testified is simply  
21 that they reflected his attempt to look at or review some  
22 data that had been prepared by others. It was certainly not  
23 a report in any sense that I would understand the term or  
24 necessarily understand -- would have inferred from the  
25 language used in the court's scheduling order. So to the

1 extent that the motion to strike is based upon the notion  
2 that these were reports, I don't think that's established.

3 MR. HAYNES: Well, your Honor, certainly the  
4 witness testified that these slides represent his analysis  
5 of materials prepared by others. That to me sounds like  
6 substantive testimony that is basically a report. It's in  
7 written form. And secondly, although counsel suggests that  
8 he had no obligation to identify the exhibits produced on  
9 April 1 as the witness's report, he certainly had an  
10 obligation to amend his witness disclosure to say that the  
11 witness's analysis constituted Exhibit -- proposed Exhibit  
12 210. So I think there was an obligation there to notify us  
13 at some point that these slides were going to be related to  
14 this witness's testimony.

15 MR. LEWIS: We got all kinds of new information  
16 and documents in the Petitioner's exhibits, your Honor.  
17 This is nonsense, frankly.

18 JUDGE PATTERSON: The slides were disclosed?

19 MR. LEWIS: Yes.

20 JUDGE PATTERSON: The problem is, there wasn't any  
21 reference to them being prepared or anticipated testimony of  
22 Dr. Miller; is that --

23 MR. HAYNES: That's right. There's no connection  
24 in Exhibit 210 between Dr. Miller and these slides.

25 MR. LEWIS: Clearly it's geochemistry, your Honor.

1 It clearly is geochemistry. Clearly we've got both Mark  
2 Logdston and Dr. Miller on our witness list. So, you know,  
3 if the issue here is, "We couldn't guess whether it would be  
4 Dr. Miller or Mr. Logdston," again I think that's an issue  
5 without any substance.

6 JUDGE PATTERSON: Well, all right. Based on the  
7 fact that these were at least disclosed -- I'm not sure, as  
8 Mr. Reichel has -- should they really constitute a report in  
9 the sense that I anticipated? I'm going to deny the motion  
10 to strike the testimony.

11 MR. HAYNES: Thank you, your Honor.

12 JUDGE PATTERSON: You're welcome.

13 Q Dr. Miller, if we could now turn to slide 23? Oh, I'm  
14 sorry. I'm getting ahead of myself. Slide 13. Dr. Miller,  
15 on slide 13 the second bullet talks about the conservative  
16 material used by Geochimica. Do you see that?

17 A Yes.

18 Q And it also talks about the estimate of at least 75 percent  
19 of the development waste is expected to be -- "PAF," by the  
20 say, is "potentially acid-forming"?

21 A Correct.

22 Q So when you say here that Geochimica estimated that at least  
23 75 percent of the development rock is potentially acid-  
24 forming, is that a lower bound; that is, by "at least" you  
25 mean 75 percent or more?

1 A Correct.

2 Q Let's turn to slide 15. Dr. Miller, slide 15 is a chart  
3 that you put together, isn't it?

4 A Correct.

5 Q And you plotted on slide 15, on this chart, the various  
6 sample results from the NAG testing; correct?

7 A Yes.

8 Q And correct me if I'm wrong, but while you were testifying I  
9 tried to total up the number of sample results here. And  
10 maybe you'll have to count them with me. But for the dots  
11 here I count 37.

12 A Correct. Well, yes.

13 Q There are 37 dots here; correct?

14 A I think there were more in the database because some plot on  
15 top of each other.

16 Q Oh, I see. But at least we have 37 here; right?

17 A Yes.

18 Q How many were on top of each other?

19 A I'm not exactly sure.

20 Q 1, 2, 20, 50?

21 A I'd have to check the database.

22 Q Do you have an estimate of how -- I mean, is it --

23 A No.

24 Q You don't have an estimate of how many?

25 A No, I don't.

1 Q Well, at least we have 37 here; correct?

2 A Correct.

3 Q And if we look at the red lines that you've drawn on this  
4 chart, the horizontal red line is a 4.5 pH; correct?

5 A NAG pH, correct.

6 Q And explain to us what "NAG pH" means.

7 A The NAG test involves adding peroxide -- a solution of  
8 peroxide to a crushed sample, allowing it to react. The  
9 peroxide oxidizes the sulfide; the acid is released and is  
10 allowed to react with the gang minerals within the sample.  
11 At the completion of the reaction the pH is then measured.  
12 And there are other determinations made on the sample as  
13 well, but the pH is measured and -- to indicate the net  
14 result of the reaction, whether it is greater than 4.5 or  
15 less than 4.5.

16 Q And explain why you picked 4.5 for this test?

17 A There are two reasons. One is that looking at hundreds of  
18 thousands of these test results from various operations, we  
19 tend to get a very clear demarcation within that pH range of  
20 4.5 to 5 or 4 to 5. The other reason is that the NAG -- the  
21 peroxide solution that's used has a pH of 4.5. So without  
22 any reaction, the pH would be 4.5.

23 Q So 4.5, which is less than the normal pH -- was is what?  
24 6.5, 7?

25 A What normal pH?

1 Q Well, 4.5 in the pH range is acidic; correct?

2 A Correct.

3 Q So you're using the NAG pH. I guess I meant to say "neutral  
4 pH," which was 6.5, 7, in that range; correct?

5 A That's correct. But that's a different pH.

6 Q Right. But here, for purposes of your -- for the NAG  
7 testing, the 4.5 represents in your view the demarcation  
8 between samples that are probably not acid-forming or  
9 uncertain, versus the samples that would show that the rock  
10 is acid-forming?

11 A Or uncertain, yes.

12 Q Or uncertain. Okay. That's the horizontal red line on this  
13 chart; correct?

14 A Correct.

15 Q And on this chart you have a red line that's a vertical line  
16 that's on the 1 -- it's on the 1.00 X-axis; correct?

17 A Correct.

18 Q And I don't recall in your direct testimony that you  
19 explained what that red line is for. What does that  
20 signify?

21 A That's where the neutralizing potential, the NP, and the  
22 acid potential, AP, are balanced, ratio of 1.

23 Q I see. Now, the vertical red line here at 1, which is where  
24 the neutralizing potential and the acid potential are  
25 balanced, that line is not one that appears in any of the

1 Geochimica reports, does it?

2 A My recollection is that it does.

3 Q At 1.0?

4 A I think there's a line at 1.0 and at 3, or it might be  
5 plotted as an NNP of zero, same thing.

6 Q I don't mean to make this a memory test for you, Dr. Miller,  
7 but I want to show you something. Could we go to DEQ  
8 Exhibit 28? Dr. Miller, I've put up DEQ Exhibit 28, which  
9 is the Appendix D-2 to the mining permit application, which  
10 is one of the Geochimica reports. You've seen this report;  
11 correct?

12 A Correct.

13 Q And you've seen this chart that's on page -- it's on the  
14 39th page of the PDF. It's actually on page 32 of 47 of the  
15 report. This chart talks about the criteria used for acid-  
16 generating potential, does it not?

17 A Correct.

18 Q Or this table does. And it talks about -- on this table  
19 when it talks about NPR, that's the net --  
20 A Potential ratio.

21 Q Net potential ratio; correct?

22 A Yeah.

23 Q And this says that if the net potential ratio -- which I  
24 take it is your AP -- or your NP slash -- over AP; is that  
25 right?

1 A That's what the ratio is.

2 Q Okay. So the NPR on this -- not National Public Radio, but  
3 NPR for this table is equivalent to your NP over AP?

4 A Correct.

5 Q And this table says that if the NPR is less than one, then  
6 there's a likely acid generation; correct?

7 A Correct.

8 Q And if the NPR is between one and three, then it's  
9 uncertain; correct?

10 A Correct.

11 Q And if the NPR is over three, then we have a low or  
12 negligible acid generation potential; correct?

13 A Correct.

14 Q All right. Dr. Miller, we're back to slide 15. According  
15 to the table that we just saw in Mr. Logdston's report, the  
16 NPR, which is the net --

17 A Potential ratio.

18 Q -- potential ratio, which is equivalent to your NP over AP -  
19 - there ought to be a second red line here, shouldn't there  
20 be? A second vertical red line on the 3 -- on the "3"  
21 digit, shouldn't there, according to that table?

22 A Not necessarily.

23 Q Well, Mr. Logdston says in his report that if we have an NPR  
24 -- a net potential ratio of one to three, it's uncertain  
25 whether the rock will be acid-generating; correct?

1 A Correct.

2 Q All right. In your chart here we have an uncertain area  
3 that's bounded, at least in the upper left, by one; correct?

4 A Correct.

5 Q But Mr. Logdston would suggest that that uncertain range  
6 actually moves over to the right on your chart to the 3  
7 line, shouldn't it?

8 A Correct.

9 Q So he disagrees with you on this chart, doesn't he?

10 A No.

11 Q Well, the figures do. The figures are different, aren't  
12 they?

13 A No.

14 Q He says that the -- for the area of between 1 and 3 NP over  
15 AP, that that's an uncertain range; correct?

16 A Yes.

17 Q And that uncertain range, if I'm pointing my pointer  
18 correctly above your NAG pH, would include a whole series --  
19 and I count them as nine samples that ought to be labeled  
20 "uncertain"; correct? That's what he would say?

21 A You're just using the NPR; correct?

22 Q That's what he would say?

23 A That's what he said and that's what I said in my testimony.

24 Q So we have actually nine more samples here that ought to be  
25 labeled "uncertain" rather than "not acid-forming"?

1 A No.

2 Q Well, that's what the numbers show, isn't it?

3 A No.

4 Q And doesn't in fact Mr. Logdston use -- in his phase 1  
5 report, doesn't he use a ratio of 4 rather than 3, for  
6 purposes of dividing non-acid-forming from uncertain?  
7 Aren't you aware of that?

8 A I'm not sure.

9 Q By the way, Dr. Miller, the NAG test, the NAG test that  
10 we've been talking about, does not take account, does it, of  
11 the time basis for generating acid from rock? Because it's  
12 a fairly quick test?

13 A I don't understand your question.

14 Q Let me rephrase it. The net acid generation test doesn't  
15 take account of the time of -- the time dimension for  
16 neutralizing acid versus acid generation from rock that is  
17 potentially acid-forming, does it?

18 A I'm not sure you understand the NAG test.

19 Q That's certainly a possibility, Dr. Miller. I haven't had a  
20 lot of time to digest a lot of this, as you heard about  
21 yesterday. Had I had enough time to look at your reports  
22 from when they were shown in the exhibit list to understand  
23 that they were your reports, I might have had more time to  
24 understand it. So you'll have to forgive me for my lack of  
25 knowledge on this. But the net acid generation test is

1 really a screening test, isn't it?

2 A Yes.

3 Q So it's a screening test that is then used to compare with  
4 the kinetic tests that are time-dependent; correct?

5 A Yes.

6 Q So the net acid generation test really is not as complete as  
7 the kinetic test, for purposes of showing the time -- the  
8 time dimension of either acid generation or neutralization  
9 capacity; correct?

10 A It is more complete as far as its extent of oxidation. More  
11 complete oxidation occurs in the NAG test than in the column  
12 leach test, unless you run the column leach test to  
13 completion, which may be five years, may be ten years.

14 Q Right. So over time the column leach test is actually more  
15 complete than the net acid generation test; correct?

16 A I don't understand what you mean by "complete."

17 Q Well, it's more representative of reality?

18 A Absolutely.

19 Q Could we go to slide 19, please? Dr. Miller, slides 19, 20,  
20 21 -- excuse me -- 19, 20 and 21 are your slides showing the  
21 pH trends in the various rocks; correct?

22 A Country rock, intrusive rocks and the ore; correct?

23 A Correct.

24 Q On slide 19, on the table that's on the right-hand side of  
25 this slide, you have a label for this table called NNP.

1 Explain for us what that means again, 'cause I didn't recall  
2 that you explained that during your direct testimony.

3 A I did explain it, but I'll explain it again.

4 Q Perhaps I missed it. Could you explain it again?

5 A It's the net neutralizing potential. It's the balance  
6 between the acid potential and the neutralizing potential.

7 Q And the numbers that are reported in this column of NNP, the  
8 net neutralizing potential, the numbers obviously mean  
9 something?

10 A Sure.

11 Q And there's probably a scale that would help us interpret  
12 those numbers, isn't there? Or some explanation of what the  
13 numbers mean? For instance, is there a significance to the  
14 fact that one of the numbers on this chart is a 61 and the  
15 other numbers are all negative?

16 A Yes.

17 Q What is the significance of having a positive number versus  
18 a negative number?

19 A Well, in my testimony I explained that the negative number,  
20 it means there is an deficiency in the neutralizing  
21 potential.

22 Q Which means that the rock is acid -- potentially acid-  
23 forming?

24 A Potentially acid-forming.

25 Q It's PAF, to use that acronym; correct?

1 A Yes. And if it's a positive number it has an excess of  
2 neutralizing potential.

3 Q And is the dividing line zero?

4 A In that analysis, yes.

5 Q Isn't there a method to look at these where we have -- if we  
6 have a positive number greater than 20 --

7 A Yes.

8 Q -- as a net neutralizing potential? And then between  
9 positive 20 and negative 20 were uncertain, and below  
10 negative 20 it's acid-forming?

11 A That is a -- that's a guideline.

12 Q It's a guideline?

13 A For an uncertain zone.

14 Q Okay. And that's a guideline you recognize?

15 A Yes.

16 Q That you use?

17 A Yes.

18 Q So if we look at this slide 19 and we look at the net  
19 neutralizing potential numbers here of the seven samples  
20 from the column leach test, then -- the column leach test is  
21 also what we've also been referring to as the humidity cell  
22 test; correct?

23 A Well, they are column leach tests rather than humidity  
24 cells. It's a lot different.

25 Q All right. If we look at these seven tests, we have one of

1           them in the country rock that is actually not potentially  
2           acid-forming; correct? That's the one with NNP of 61?

3       A       On the basis of NNP criteria, yes.

4       Q       Well, I mean, that's what we're looking at here is --

5       A       Yes; yes.

6       Q       -- these criteria; correct?

7       A       Yes.

8       Q       We're not looking at something else, are we?

9       A       We should be, but yes.

10      Q       We should be but we're not. Okay? We're just dealing with  
11      the slides that you prepared, Dr. Miller.

12      A       Okay.

13      Q       Let's go to slide 20, which is the intrusive rock samples.  
14      And here we have the five samples that you testified about  
15      earlier. And looking at the net neutralizer potential  
16      column here, again looking at the positive versus negative  
17      numbers of these five samples, two have the net neutralizing  
18      potential of about 20; correct? And three are negative  
19      numbers?

20      A       Correct.

21      Q       And in fact, two of them fall within the uncertain range and  
22      one is clearly acid?

23      A       Correct.

24      Q       Potentially acid-forming?

25      A       Potentially.

1 Q And then if we go to the next slide, slide 21, we have three  
2 samples from the ore. And here we have net neutralizing  
3 numbers that are quite low; correct?

4 A Correct.

5 Q And also sulfur numbers that again are quite high, compared  
6 to the other rocks; correct?

7 Q Would it be an accurate summation of these three slides --  
8 strike that. The second column of the tables on these three  
9 slides is the percent sulfur; correct?

10 A Correct.

11 Q And there seems to be a correlation, Dr. Miller, between  
12 high sulfur numbers and low net neutralizing potential  
13 numbers?

14 A Correct.

15 Q Is it accurate to say, then, the higher the sulfur, the more  
16 likely the rock will be acid-generating?

17 A Yes, provided we're talking about a consistent neutralizing  
18 potential.

19 Q And by the way, the neutralizing potential in the rock  
20 that's going to be mined in the Eagle mine is not perfectly  
21 consistent, is it?

22 A No.

23 Q So we should take that into account in any modeling that  
24 would occur; that we have variations in the neutralizing  
25 potential?

1 A It is already taken into account in the classification of  
2 the samples.

3 Q I see. That is, the ore versus the intrusive versus the  
4 development rock; is that what you're saying?

5 A No. I'm talking about individual samples and their  
6 classification is based on the balance between the two in  
7 the NAG test as they qualify.

8 Q Let's go to slide 22. Dr. Miller, in slide 22 you described  
9 in your view the comparative rates of sulfidic release;  
10 correct?

11 A Correct.

12 Q And you classified these as high, moderate, low and  
13 negligible; correct?

14 A Correct.

15 Q And you compared -- well, you said that you were comparing  
16 the column leach tests that are represented on this very  
17 dense -- this very dense graph, to other sites; correct?

18 A Yes. There are other samples that have been -- to other  
19 column leach test results.

20 Q Other column leach test results from what?

21 A From numerous samples at sites.

22 Q Other sites? Not the Eagle site?

23 A Not the Eagle site.

24 Q Which sites?

25 A At least 250, maybe 400 sites.

1 Q So if we were to try to actually check your work here, Dr.  
2 Miller, we'd have to get the samples from those 250 or so  
3 sites to check your work?

4 A Well, yes. And it would be hundreds of thousands of  
5 results.

6 Q Hundreds of thousands of samples; right?

7 A Uh-huh (affirmative).

8 Q So you haven't provided that date in your analysis, have  
9 you?

10 A No.

11 Q You haven't provided even the summary of those hundreds of  
12 thousands of samples in your report here, have you?

13 A No.

14 Q So there's no way that we can really check your work, based  
15 on what you've given us today, is there?

16 A No. This is my opinion.

17 Q Your opinion. And there's no way that we can check the  
18 basis for your opinion based upon what we have in your  
19 slides today, is there?

20 A No.

21 Q Are those data available somewhere? Do you have them in  
22 your office in Australia?

23 A Yes. Lots of the data, yes.

24 Q Do you have summaries of the data in your office that you  
25 based your opinion on?

1 A The results are contained in reports to mining companies.

2 Q I see. Are those reports confidential?

3 A Some are; some aren't.

4 Q If Judge Patterson were to ask you to provide those reports  
5 to us, could you provide the non-confidential ones?

6 A I could.

7 Q I'm going to ask that he ask you to provide those reports to  
8 us. I don't know if he'll grant it; I'm not sure.

9 MR. HAYNES: But that's my motion, that those be -  
10 - provide us with those reports.

11 JUDGE PATTERSON: Okay.

12 MR. LEWIS: This witness certainly can be and  
13 should be allowed to characterize the character of these  
14 sulfide release rates based on his own rather enormous  
15 experience with doing exactly this kind of testing in  
16 hundreds of other mines and thousands of other samples, your  
17 Honor. To the extent his testimony has characterized this  
18 material as compared to other material he's had experience  
19 with, I think there's adequate and sufficient foundation for  
20 him to do so. The slide itself is not in evidence; it's  
21 only in as a demonstrative exhibit. So I think the opinion  
22 itself is adequate and sufficient foundation. And if the  
23 objection is to the specifics on the slide, that -- the  
24 slide has not been accepted into evidence for that purpose.

25 MR. HAYNES: Well, your Honor, I think the

1 response misses two issues: First, the slide may not be in  
2 evidence, but the witnesses' testimony is in evidence. So  
3 we have now testimony in which the witness has, based upon  
4 his apparent experience, compared Eagle tests to other tests  
5 that he has knowledge of. I haven't seen any of that, but  
6 that's his testimony, so that's in evidence. Now, I should  
7 be entitled to double check that.

8 And as to the foundation, well, the witness  
9 obviously has a foundation for his opinion. I just haven't  
10 been able to see it. So I don't know if his foundation is  
11 correct or incorrect. It may be correct, but then again it  
12 may be incorrect. And I have no way of checking without  
13 seeing at least some of the data that he relies on to offer  
14 his opinion today about the comparison in sulfate release  
15 rates to this wealth of mines that the witness has looked  
16 at, but I haven't been able to. So that's the -- so the  
17 response I think misses the point of my request that we be  
18 able to see the data.

19 MR. REICHEL: I would just make the observation,  
20 your Honor, that this witness, like any other expert  
21 witnesses in this proceeding, can and legitimately is  
22 allowed to testify based upon their professional experience  
23 in a variety of contexts without having to disclose every  
24 piece of written documentation that may exist that supports,  
25 details that experience. I think that the witness'

1 testimony that -- his testimony on direct examination  
2 clearly shows that he had extensive experience in the  
3 industry in doing -- looking at these kinds of data in a  
4 variety of settings. I think, if I understand this, this  
5 testimony is being offered -- was offered for the fairly  
6 limited purpose of explaining in a relative sense in the  
7 range of this witness' experience at many sites how the  
8 projected release rates here compare to those. I don't  
9 think it is -- the admissibility of that testimony depends  
10 upon a requirement that the witness produce each and every  
11 piece of paper that he may have access to that forms some  
12 part of the basis of his more broadly described professional  
13 experience.

14 MR. HAYNES: Well, again, your Honor, the witness  
15 may have the professional experience. He probably does. I  
16 haven't had a chance to examine him before today, so I can't  
17 verify his experience. Let's say that he does have that  
18 experience. The trouble is that if I am going to try to  
19 effectively understand this testimony so that perhaps on  
20 rebuttal we can address it, it would be useful and, in fact,  
21 essential to have access to the wealth of experience or at  
22 least some portion of it that is not confidential upon which  
23 he bases his opinion. The idea that Dr. Miller can come  
24 here today and testify even for the limited purpose of  
25 comparing the sulfate release rates of the proposed Eagle

1 Mine to other mines, even for that limited purpose it's  
2 probably relevant. Otherwise Counsel wouldn't have had the  
3 witness testify about it.

4 And if I'm going to try to rebut it, I would at  
5 least -- it would at least be useful for me to -- at the  
6 minimum be useful to me to have some of the other mines that  
7 he has experience in. And so again we're playing hide the  
8 ball. Kennecott has information that their witnesses have  
9 in their offices that we haven't been provided so that our  
10 witnesses can take a look to see what the information says  
11 to judge whether or not the witness' testimony ought to be  
12 believed. So it's again -- we're playing hide the ball  
13 again, and we're at a distinct disadvantage and prejudiced.

14 JUDGE PATTERSON: Let me ask, did you rely on any  
15 specific reports on other mines or just your general  
16 experience?

17 THE WITNESS: It's my general experience.

18 JUDGE PATTERSON: Based on that, I'm going to deny  
19 the motion that he turn over anything. If he didn't refer  
20 to any specific report on any other mine in formulating  
21 this, he just did it on his general experience, I think  
22 that's a sufficient foundation for his opinion.

23 Q Dr. Miller, is there somewhere in the mine geochemistry  
24 literature that I could go to see whether or not sulfate  
25 release rates of between 1 milligram per kilogram per week

1 and 10 milligrams per kilogram per week are low?

2 A Yes; yes.

3 Q Can you point me to some article or something that you've  
4 written?

5 A Not specific articles, but I could point you to some  
6 articles.

7 Q Fire away.

8 A I'm not -- I don't have them on my -- I can't recall  
9 specific articles, but there is numerous data reported in  
10 conference proceedings from the International Conference on  
11 Acid Drainage.

12 Q Can you name me one conference and one article from the  
13 conference?

14 A No, I can't, not the author, date, title, everything, no.

15 Q What about the year of the conference?

16 A 2000, 2003, 2006.

17 Q And which conference?

18 A The -- just to make sure, probably the best ones are the --  
19 The ICARD conferences are probably the appropriate -- ICARD.

20 Q I'm sorry, Dr. Miller. Your voice is dropping.

21 A International Conference on Acid Rock Drainage, ICARD. The  
22 years we would be looking at would be 2000, 2003, 2006.

23 Q All right. Thank you. If we could go to slide 23, please,  
24 Dr. Miller, in slide 23 on the fourth bullet point you  
25 testified that in your view you identified no gaps in the

1 geochemical characterization by Geochimica; correct?

2 A Correct.

3 Q Now, we earlier talked about the characterization of the  
4 intrusive rocks, and we had, I think, one sample for the  
5 intrusive rock -- is that right? -- one leach test for the  
6 intrusive rock; correct?

7 A No.

8 Q Or, no, I'm sorry. There were five; right? Those were the  
9 blue lines in the various charts; correct?

10 A Five.

11 Q Five. And we had -- but on the chart that was on page --  
12 excuse me -- slide 8 between -- for the rock between about 2  
13 percent sulfur and 10 percent sulfur we have 2 samples --  
14 right? -- 2 or 3?

15 A Correct.

16 Q And you consider that to be sufficient and not a gap?

17 A It's not a gap. I don't see a gap in the data.

18 Q If we could go to slide 26, please, Dr. Miller, slide 26 in  
19 the first bullet point in the third item there you talk  
20 about -- sorry. The first bullet point talks about input  
21 values and assumptions used by Geochimica; correct? "Yes"?

22 A Correct.

23 Q And the third item there talks about an assumption of  
24 minimum ore exposure time and mining phases; correct?

25 A Correct.

1 Q Now, you understand that there will be a substantial amount  
2 of ore left in the mine when the mine is completed.

3 A I'm not aware of that.

4 Q I see. And you're aware, aren't you --

5 A Excuse me. Could you define "substantial"?

6 Q Well, more than a trivial amount. I mean, substantial is --  
7 we haven't seen any quantification yet, Dr. Miller, so I'm  
8 sorry I can't define it any more than that.

9 A Okay. Okay.

10 Q But you're not aware that there's a substantial amount of  
11 ore to be left in the mine?

12 A I wouldn't think there's a substantial amount of ore there.

13 Q And you're aware that there will be ore left in the crown  
14 pillar, aren't you?

15 A I am aware that there will be ore in the crown pillar.

16 Q And you're aware that there will be mineralized host rock  
17 left in the crown pillar as well; correct?

18 A I would assume that there would be.

19 Q Let's go to slide 28. Dr. Miller, slide 28 talks about the  
20 kinetic test data collected by Stratus and by Geochimica;  
21 that is, by Dr. Maest and by Mr. Logsdon; correct?

22 A Correct.

23 Q The second bullet talks about the kinetic test samples used  
24 by each of them. And it says that Stratus; that is, Dr.  
25 Maest; selected data later in the leaching phase. Do you

1           see that?

2       A     Yes.

3       Q     That wasn't wrong to select the data later in the leaching  
4           phase, was it?

5       A     No, not at all.

6       Q     And in the third bullet, the first item you talk about Mr.  
7           Logsdon using the peridotite or the intrusive samples at an  
8           early stage of leaching; correct? And that was what was  
9           available to him at the time; correct?

10      A     Correct.

11      Q     There's no reason why Mr. Logsdon couldn't have updated his  
12           modeling based upon more recent data, was there?

13      A     If he needed to update his model, there's no reason not to.

14      Q     You're not aware that he has updated his model, are you?

15      A     No.

16      Q     So you're not suggesting that it was unreasonable for  
17           Stratus, for Dr. Maest, to use more recent data in her  
18           modeling?

19      A     Not unreasonable at all, no.

20      Q     If we could turn to slide 29, please, Dr. Miller, slide 29  
21           shows the -- you prepared this chart, didn't you? --

22      A     Correct.

23      Q     -- both the lines and the various symbols for the Stratus  
24           and the Geochimica sample points; correct?

25      A     Correct, based on the data from the kinetic test.

1 Q Right. I'm not suggesting that the lines are somehow false.  
2 They're based -- but you prepared the report; correct?

3 A Uh-huh (affirmative).

4 Q "Yes"?

5 A Prepared the chart.

6 Q The chart, yes.

7 A Yes.

8 Q Okay. Now, is it an accurate summary to say that this chart  
9 shows that the ore samples show a very -- well, show a  
10 fairly rapid increase in nickel compared to, say, the  
11 country rock?

12 A Yes.

13 Q And that at least some of the intrusive; that is, the blue  
14 lines; show a fairly rapid increase in the nickel  
15 concentrations compared to the country rock?

16 A Correct.

17 Q But we also -- this chart also shows that for some of the  
18 country rock we also have fairly rapid increases in nickel  
19 concentrations; correct?

20 A Correct.

21 Q Dr. Miller, are you aware of the water quality standards for  
22 nickel in Michigan?

23 A No.

24 Q So if I were to tell you that the water quality standard for  
25 nickel in Michigan is 0.05 milligrams per liter, you would

1           have no reason to disagree with that, would you?

2       A       I wouldn't.

3       Q       And on this chart if we were to draw a line at 0.05

4           milligrams per liter, that line would appear on the y axis

5           between the 0.01 and the 0.1, wouldn't it?

6       A       Correct.

7                       MR. LEWIS:  Objection; relevance, your Honor.

8           It's an objection I've made before that's been stated that

9           these standards have no relevance to the permitting

10          standards applicable in this case.

11                      MR. HAYNES:  And I think you've overruled that

12          objection, your Honor.

13                      JUDGE PATTERSON:  I did?

14                      MR. HAYNES:  He's made it before.  We've had this

15          testimony before.

16                      JUDGE PATTERSON:  I'll allow the testimony.

17                      MR. HAYNES:  Thank you.

18       Q       Dr. Miller, a 0.05 milligrams per liter nickel water quality

19           standard would appear on this chart on the fifth dashed line

20           above the 0.01 line; is that right?

21       A       No.

22       Q       Well, this is a log chart, isn't it?

23       A       Fourth line; the fourth line.

24       Q       Oh, the fourth line.

25       A       'Cause you start at .1.

1 Q Okay. Fourth line up. Okay. And, you know, if we had  
2 one -- if we had this exhibit in a physical form that were  
3 in evidence we'd start drawing on it right now, but we  
4 don't; get your marker out and we'd have fun, wouldn't we?  
5 But that line would appear on -- about where the red box is  
6 on the y chart -- on the y axis, wouldn't it?

7 A Uh-huh (affirmative).

8 Q I'm sorry. It's above the red box.

9 A It is there (indicating).

10 Q Right there (indicating); correct?

11 A Correct.

12 Q Sorry. It's not the red box on the y axis. There's  
13 actually -- there appears to be a diamond -- a green diamond  
14 there. Am I seeing that right?

15 A Yes, you are.

16 Q Okay. So the green diamond below the 0.1 is the 0.05  
17 milligrams per liter line; correct?

18 A Correct.

19 Q So that the samples that are -- that show above that line  
20 would be above this water quality standard; correct?

21 A The leachates from the columns.

22 Q Right, the leachate from the columns from the samples;  
23 right?

24 A Yeah, from the samples.

25 Q Let's go to slide 31. Dr. Miller, in slide 31 you talk

1           about mine inflow volumes, and you say in the slide that  
2           those predictions are to be addressed by others.  You see  
3           that, of course?

4        A     Yes.

5        Q     But certainly Mr. Logsdon used an assumption of an inflow  
6           volume that I think he testified that he obtained from  
7           Kennecott; do you recall that?

8        A     Yes.

9        Q     You were here yesterday; right?  "Yes"?

10       A     Yes.

11       Q     All right.  And your second bullet here talks about an  
12           inflow volume provided by KEMC at the time of modeling.  
13           Your statement here suggests that there are other inflow  
14           volumes that would be applicable to this modeling exercise.  
15           Is that a fair statement?  Is that an accurate statement?

16       A     Well, my understanding is that Mr. Logsdon used 180 gpm.

17       Q     And that is not a number, is it, Dr. Miller, that appears in  
18           the applications, in the various applications for mine  
19           inflow volumes?

20       A     As I understand it, it is within the range, but it is not  
21           base-case values that apparently is now --

22       Q     Is now being used; right?

23       A     As a base-case value, yes.

24       Q     And that number is, in fact, 75 gallons per minute; correct?

25       A     That is my understanding.

1 Q So the inflow volumes then that Mr. Logsdon used are, in  
2 fact -- for his modeling are more than twice the inflow  
3 volumes used in the applications; correct?

4 A More than twice the base-case values, yes.

5 Q The base-case value; right?

6 A Uh-huh (affirmative).

7 Q And the base case, that's the realistic case value --  
8 correct? -- by a base case?

9 A I'm not a groundwater engineer or geologist, so I can only  
10 read what's there.

11 Q I understand that, but if we used the base case that is used  
12 by Kennecott in their documents of 75 gallons per meter,  
13 that would substantially change the model outputs from Mr.  
14 Logsdon, wouldn't they?

15 A It would change the predicted concentrations but not  
16 necessarily by that dilution factor of the difference in  
17 flows.

18 Q You're saying there is not a linear relationship between the  
19 mine inflow and the concentrations?

20 A Not where there is some solubility considerations.

21 Q Okay. But at least we would have -- I mean, you would agree  
22 with me, wouldn't you, that we would have different numbers  
23 for the model outputs if we reduced the mine inflows?

24 A As I testified, yes.

25 Q What would stop Mr. Logsdon from re-running his model based

1           upon the base-case value of 75 gallons per meter? Nothing,  
2           I take it.

3       A     Not up to me to answer that.

4       Q     It's up to Mr. Logsdon to answer that, you'd say; right?

5       A     Well --

6       Q     So would you agree with me that we should take his modeling  
7           conclusions with at least a grain of salt if he's using the  
8           mine inflow value of 180 versus the 75 which is the base  
9           case value?

10      A     No. His conclusions, his purpose of doing the modeling, was  
11         to provide an indication of the need for communication, the  
12         need for what the implications would be for the operation.

13      Q     Okay. Let's go to slide 32. Dr. Miller, in slide 32 you  
14         talk about the massive development waste used for the  
15         backfill; correct?

16      A     Correct.

17      Q     And we have certain amounts here of 66 million -- excuse  
18         me -- .66 million tonnes and .38 million tonnes. And you  
19         say in the slide -- and you testified that apparently Mr.  
20         Logsdon was unaware of these numbers when he did his  
21         modeling; correct?

22      A     Yes.

23      Q     And I think he testified about that yesterday, didn't he?

24      A     Correct.

25      Q     You were here, weren't you?

1 A Yes.

2 Q Okay. So using a figure that was different than the actual  
3 plan figures would make a difference in the modeling  
4 outputs, wouldn't it?

5 A To some extent.

6 Q Yeah. Okay. And to some extent then we couldn't trust the  
7 outputs of the model; correct?

8 A Not necessarily.

9 Q Do you actually know the figure that Mr. Logsdon used for  
10 his calculations, the actual development waste rock figure  
11 that he used for his calculations?

12 A In the development rock stockpiles?

13 Q Yes.

14 A Yes. I'm not sure what the question is.

15 Q What figure do you -- what is the figure that you understand  
16 he used?

17 A As the massive material?

18 Q Yes.

19 A It's about half the 3- -- .38 million tonnes.

20 Q How about 175- or so?

21 A I don't remember the exact number, but --

22 Q Okay. Sorry. We're going to have to do another switch  
23 because I have to go into an exhibit we have that's on the  
24 other projector. All right. Dr. Miller, I put up  
25 Petitioner's Exhibit 75a that was introduced through Dr.

1 Coleman. Have you reviewed this exhibit at all?

2 A Yes.

3 Q You have?

4 A Yes.

5 Q Okay. If we could go to -- Dr. Miller, I apologize for the  
6 small figures here, but if we look at Step 4 on -- this is  
7 page -- I think this is the first page of the spread sheet.  
8 And I'm looking at lines -- sorry, Dr. Miller. I'm dealing  
9 with something on my screen that's different on that screen,  
10 but bear with me. All right?

11 A Okay.

12 Q Step 4 we have -- it says, "Calculate reactive sulfite  
13 surface area within stockpile based on estimated lithology."  
14 Do you see that?

15 A Correct.

16 Q And we have in this step various assumptions including an  
17 assumption that says, "Assume average particle diameter of  
18 10 centimeters." Do you see that?

19 A Correct.

20 Q All right. We're going to get back to that in a minute, but  
21 for right now I want to talk about the stockpile volumes for  
22 the intrusive and the country rock. Do you see that?

23 A Yes.

24 Q And these are numbers that were prepared by Mr. Logsdon.  
25 You know that?

1 A Correct.

2 Q For the rock mass tonnes, which is the -- about the sixth  
3 column over -- do you see that?

4 A Correct.

5 Q The rock mass tonnes appear to be about 12.5 times e to the  
6 plus 4. Did I add those correctly?

7 A Approximately half the maximum of .38, as I mentioned to you  
8 previously.

9 Q It would be about 125,000 tonnes; right?

10 A Correct.

11 Q All right. Half of 380- would be about 170,000 tonnes.

12 A Yeah, in there approximately, yes.

13 Q So now we're at 125,000 tonnes -- correct? -- in the --

14 A I can't quite read the numbers, but, yeah, whatever you tell  
15 me.

16 Q Well, don't -- don't go there.

17 A Okay.

18 Q Okay? I'll caution you on that. The numbers are in this  
19 column, 6.40 e+4?

20 A Uh-huh (affirmative).

21 Q And 6.16 e+4.

22 A Okay.

23 Q Which would be about 125-or-so-thousand tonnes; correct?

24 A Uh-huh (affirmative).

25 Q Yes?

1 A Yes.

2 Q And that's about 2/3 of the 170,000 that you testified to --  
3 right? -- about 2/3 of that?

4 A Of the?

5 Q Of the 170,000 tonnes that you said was 1/2 of the 380,000  
6 tonnes.

7 A Well, yes.

8 Q Okay. Are you with me so far?

9 A Yeah, close.

10 Q And that's the quantity stored at the surface; right? So it  
11 isn't really 1/2. It's more like 1/3 of the .38; correct?

12 A Yes. I think I'm following you; yes.

13 Q And so the modeling that Mr. Logsdon did was not based on a  
14 1/2 of the .38; it was based on the 1/3; right? And that  
15 would be a significant number for purposes of using the  
16 model to determine outcomes for the amount of rock that's  
17 going to go back into the mine; correct?

18 A I understood that this is for the development waste  
19 stockpile, this model we're looking at; is that correct?

20 Q Yes, that's what we're looking at.

21 A So that mass, as I understand it, relates to an average  
22 value or a value that is an average or a median value  
23 through the time of construction of the stockpile and  
24 removal of the stockpile. We go to a maximum and then we  
25 come back down again. So it's some estimate of what

1 reasonable median value that would be stockpiled over the  
2 seven-year period.

3 Q And what Mr. Logsdon used for that was, in fact, one third  
4 of the value that's actually going to be used rather than  
5 one half; right?

6 A I'm not sure what the value is, so I just --

7 Q Well, it's .38 according to your slide -- .3 million tonnes,  
8 which is 380,000.

9 A What I'm trying to explain is that my understanding of the  
10 value, whether it's 1/2 or 1/3 or 1/5, is that it's a value  
11 that Mr. Logsdon evaluated as a reasonable median mass  
12 through the time period of the stockpile's existence. You  
13 start with nothing, you reach your maximum and then you  
14 remove it all.

15 Q All right. So but for purposes of modeling, Dr. Miller, the  
16 amount that Mr. Logsdon used here for the total tonnes of  
17 intrusive and country rock in the stockpile during the time  
18 on the surface was about -- he used about -- excuse me --  
19 about 180,000 tonnes; right? That was the average value of  
20 the amount on the surface during the mining; correct?

21 A Not exactly. I don't have the figures.

22 Q And that's about 1/5 of the amount of the rock that's going  
23 to be put back into the mine for the backfill; correct?

24 A Well, some of that backfill material doesn't come out and go  
25 back. That doesn't come out of the mine and go back. It's

1           actually directly used as fill.

2       Q     In the mine workings?

3       A     In the mine workings.

4       Q     Right. I understand. But we're dealing with about a -- as

5           you said in your slide 32, the development waste for

6           backfill is about 660,000 tonnes; right?

7       A     True.

8       Q     And so the amount that we're using here of 120,000 or so is

9           about 1/5 of that amount; correct?

10      A     That's the amount that was used for storage on the surface

11         for the modeling, yes.

12      Q     All right. Okay.

13      A     Yeah.

14                         MR. HAYNES: Your Honor, I'm going to move into

15           another area, so perhaps we should take a break now.

16                         JUDGE PATTERSON: Let's break.

17                         (Off the record)

18                         MR. HAYNES: We're ready.

19                         JUDGE PATTERSON: Okay.

20                         MR. HAYNES: Although I'm not sure

21      Q     Dr. Miller, you have slide 33 in front of you, don't you?

22      A     Yes.

23      Q     Okay. In slide 33, the slide talks about the surface area

24         of rock exposed to oxidation and leaching; correct?

25      A     Correct.

1 Q And in the third bullet you talk about the assumption by Mr.  
2 Logsdon of a mean particle diameter of 100 millimeters.  
3 That's 10 centimeters; correct?

4 A Correct.

5 Q You're not aware, are you, in any of the reports prepared by  
6 Mr. Logsdon of where he explained why he picked the 10  
7 centimeter size?

8 A I don't think it's documented in the report, no.

9 Q Now, Dr. Miller, you testified and we had some discussion  
10 both with you and with Mr. Logsdon about the particle size  
11 distribution -- correct? -- in general? And there's an  
12 obvious correlation between reducing the particle size and  
13 increasing the likelihood of acid generation -- correct? --  
14 of potentially acid forming in rock? That is, if you reduce  
15 the particle size, you tend to create more acid?

16 A Not always.

17 Q But that's a general -- in a general statement, that would  
18 be true, wouldn't it?

19 A Now, in many cycles we look at, when you crush the rock, you  
20 expose more of a neutralizing potential in certain rock  
21 types and therefore you actually get less acid generation.

22 Q Okay. All right. That's fine. So, in fact, when you're  
23 doing the column tests, if you crush the rock to smaller  
24 sizes, then you actually can have more neutralizing -- more  
25 neutralizing chemicals that would be exposed to -- that

1           would then alter the results if you had larger sized  
2           particles; correct?

3        A     It goes both ways.

4        Q     Okay.  It goes both ways.  So we'd have to take that into  
5           account, wouldn't we, in terms of --

6        A     Yes.

7        Q     -- extrapolating the results from the tests to the proposed  
8           mine; correct?

9        A     Correct.

10       Q     Now, would it be accurate to say that reducing -- the  
11           particle size is one of the largest determinants of the --  
12           of determining the concentrations in any sort of modeling  
13           from these tests?

14       A     Sorry.  I don't understand the question.

15       Q     Let me rephrase it.  Would it be accurate to say that the  
16           size of the particles that go into the column tests is one  
17           of the largest determinants of the outputs of the tests?

18       A     The size of the -- if I understand what you mean, if you're  
19           crushing the sample down smaller size and you have full --  
20           you have availability of oxygen throughout the column and  
21           throughout the sample, then the smaller the particle size  
22           and the greater the surface area, the greater the acid or  
23           potential acid loading.

24       Q     Right.  And so particle size makes a very big difference in  
25           the results of the tests; correct?

1 A Yes.

2 Q If you have larger particles versus smaller?

3 A Yes.

4 Q Either from an acid generating --

5 A From a geochemical perspective, yes.

6 Q How about from a neutralization perspective?

7 A Yes.

8 Q Now, you've testified that -- and I think Mr. Logsdon also

9 testified that there is a -- that his models did not try to

10 come up with a deterministic number for the water quality in

11 either the stockpile or the reclaimed mine; correct?

12 A Correct.

13 Q The models as he testified, I think, were more directional;

14 that is, they're trying to head you in one direction versus

15 another. Correct?

16 A Correct.

17 Q All right. So you understand, don't you, that the results

18 of his modeling were used to size and to determine the scope

19 of the mitigation that's going to be -- that's proposed for

20 this mine? You understand that, don't you?

21 A I would understand that that was an input to determining.

22 Q All right. So if his modeling results are an input into

23 what mitigation would be proposed either for the treatment

24 of the development rock or for how the re-flooded mine will

25 act, you understand that, once the mine is -- once the ore

1 is brought out of the mine and the mine is re-flooded, that  
2 there will be a pump and treat program for the mine? You  
3 understand that, don't you?

4 A I'm aware of that.

5 Q Okay. You haven't studied that in any detail, have you?

6 A No.

7 Q So you understand that the outputs from Mr. Logsdon's model  
8 were used to determine the scope of the pump and treat  
9 program? You're aware of that, aren't you?

10 A I'm well aware of that.

11 Q All right. I want you to assume that for purposes of my  
12 next question. If Mr. Logsdon's models are not  
13 deterministic; that is, they don't come up with a number;  
14 then how is it that a pump and treat program can be  
15 determined for any length of years based upon an uncertain  
16 model result?

17 A As far as the treatment side of the mitigation is concerned,  
18 I'm not a treatment engineer so I cannot comment on that.

19 Q Okay. So you couldn't testify the degree to which the  
20 treatment program will actually work?

21 A Not the treatment plant, no.

22 Q So you don't know how effective or ineffective the treatment  
23 program will be in reducing the risk of acid mine drainage?

24 A I wouldn't have thought treatment from the -- I think -- if  
25 we're talking about the water treatment plant, it is not

1           there, I would assume, to minimize the generation of acid.  
2           It is there to treat the water.

3       Q     I understand that.  But you can't testify as to the  
4           effectiveness of that in treating the water?

5       A     No.

6       Q     And let me just step back for a moment, Dr. Miller.  The  
7           pump and treat program I'm talking about is the -- is not  
8           the treatment during the plant's operation but the pump and  
9           treat when the mine is closed; right?  You understand that  
10          there's that program?

11      A     That's after closure, after re-flooding?

12      Q     Yes; right.

13      A     Okay.

14      Q     And there will be a pump and treat program where the water  
15           will be pumped out and then treated --

16      A     Okay.  I understand now.  Okay.

17      Q     So you don't have any opinions as to whether or not that  
18           program will be effective, do you?

19      A     I would assume it would be highly effective.  If you  
20           eliminated the oxygen from the underground mine by  
21           re-flooding, then there'll be no further oxidation or  
22           further acid generation.

23      Q     You're assuming that.  But you don't know how effective it  
24           will be, do you?

25      A     It will be 100 percent effective.

1 Q It will be 100 percent effective?

2 A If it's excluding oxygen and stopping sulfide oxidation.

3 Q All right. So the pump and treat program is, in your view,  
4 going to be effective to 100 percent surety?

5 A Flooding the workings with the backfill in place, with the  
6 limestone added to it, will be 100 percent effective in  
7 preventing ongoing oxidation and acid generation.

8 Q Okay. That's not my question. My question is whether the  
9 pump and treat program will be 100 percent effective in  
10 treating the acid water that's in the mine after it's been  
11 re-flooded?

12 MR. LEWIS: I'll place an objection as to form,  
13 your Honor. I think the question is implying and assuming  
14 facts that are contrary to evidence in this case so far, and  
15 that being the facts are and the permit conditions are that  
16 this so-called pump and treat will only be required based  
17 on -- if testing and monitoring shows the need for it. And  
18 I think the questions are directly implying that this is  
19 some kind of required pump and treat program that's  
20 necessarily going to take place after the end of the mining.

21 MR. HAYNES: I think for purposes of asking this  
22 witness, that's a fair assumption to make. And I can ask  
23 him that question in a hypothetical.

24 JUDGE PATTERSON: Yeah. As a hypothetical, I  
25 mean, he go ahead.

1 Q Dr. Miller --

2 A Could you --

3 Q Are you testifying that the pump and treat program will be  
4 100 percent effective in preventing any -- excuse me -- in  
5 treating any acid mine drainage in the mine after it's been  
6 re-flooded?

7 A As I understand -- as far as pumping and treating is  
8 concerned, I'm not able to comment on the treatment -- water  
9 treatment.

10 Q That was my question. Thank you.

11 (Counsel reviews notes)

12 Q In slide 40, Dr. Miller, on the third point -- the third  
13 bullet point, you talk about Mr. Logsdon following accepted  
14 practice and validating predicted chemistries using  
15 speciation modeling; right?

16 A That is correct.

17 Q And I don't think I've heard explained yet exactly what  
18 speciation modeling is. We've talked about it, but I  
19 haven't heard a very good explanation. What is that?

20 A Speciation modeling is looking at the geochemistry -- the  
21 concentrations -- the total concentrations of constituents  
22 in solution from the mass balance, and applying the  
23 speciation model makes -- in simple terms, I suppose, it  
24 corrects the chemistry for chemical stability or chemical  
25 equilibrium. So what I'm saying is that you can't just keep

1 increasing concentrations in solution. At some point you'll  
2 get precipitation, because you exceed the solubility product  
3 of a particular mineral or pump handle or -- and so -- and  
4 at different pH's, you have different solubilities of  
5 different minerals and different elements. So the justice  
6 for those on the basis of pH and concentrations to be  
7 thermodynamically and chemically correct.

8 Q I see. And in saying that Mr. Logsdon used speciation  
9 modeling, do you understand that his speciation modeling was  
10 used only for the TDRSA; correct?

11 A It was used for the TDRSA and also for the underground mine,  
12 I understand, during mining before backfilling.

13 Q I see. But not for the re-flooded mine?

14 A Not for the re-flooded mine.

15 Q Thank you. On direct examination you talked about the  
16 process by which limestone may be affected by a process that  
17 we call armoring. Do you remember that testimony?

18 A To me --

19 Q That is, that the limestone, when added to the backfill --  
20 added to the development rock for backfill is going to --  
21 may be affected by the amount of iron in the block and  
22 therefore the limestone may be less effective because of  
23 that?

24 A I'm sorry. Was that directed to me in direct examination?

25 Q Yes.

1 A I don't recall that now.

2 Q All right. Maybe I do, but you don't. But you understand  
3 that there is this process called armoring of limestone,  
4 don't you?

5 A I do.

6 Q Okay. And that effect will occur -- we can predict that  
7 that effect will occur at this mine, can't we?

8 A Armoring occurs both to the sulfides and to the limestone.  
9 And in some situations, if there's a close association  
10 between the limestone and the pyrite surfaces, the balance  
11 tends to move towards armoring of the pyrite or the sulfides  
12 rather than armoring of the limestone. If you have  
13 limestone in layers where you have acid water percolating  
14 through a waste layer and then contacting limestone  
15 underneath that layer, you will get armoring of the  
16 limestone. Where they are intimately blended and mixed,  
17 that process is not as significant. In fact, the reverse is  
18 more significant. You get more armoring of the sulfides.

19 Q I see. And none of that has been modeled in this case, has  
20 it? None of those effects have been accounted for in the  
21 models that Mr. Logsdon did?

22 A I think in modeling -- in the evaluation that Mr. Logsdon  
23 gave on the limestone requirement, he put an adjustment in  
24 there of some percentage to account for some ineffectiveness  
25 of the limestone.

1 Q But I thought on direct examination you said that the  
2 limestone was not considered in the modeling by Mr. Logsdon?  
3 A It wasn't.  
4 Q It was not?  
5 A Not in the modeling of the development stockpile or the --  
6 Q Okay. So we actually don't have any outputs that would show  
7 the effect of adding limestone or whether the limestone  
8 would be armored or not; right? We have none of that in the  
9 mine?  
10 A I don't think there's any in the evidence, no.  
11 Q Okay. So, in fact, we don't know right now the effect of  
12 limestone on the mine chemistry in the re-flooded mine, do  
13 we?  
14 A As far as in the re-flooded mine, the purpose of the  
15 limestone, as I think I explained in my direct examination,  
16 was that the limestone is applied to the development waste  
17 to extend the lag period so that we don't have acid  
18 generation while the development waste is exposed to  
19 atmospheric conditions.  
20 Q But that's -- you're saying that as a general statement, not  
21 in terms of any prediction of how the limestone will  
22 actually in the future affect the acidity of the re-flooded  
23 mine; correct?  
24 A I don't understand the question.  
25 Q There's been no modeling of the effect of the limestone;

1 correct?

2 A I think there was some modeling of the effect of limestone  
3 which was put up on a slide yesterday.

4 Q But we don't know -- but we haven't seen any modeling of the  
5 actual effect of adding the limestone to the waste rock for  
6 purposes --

7 A No; no.

8 Q -- of determining the water chemistry in the re-flooded  
9 mine; correct?

10 A Correct; yes.

11 Q Dr. Miller, would I be correct in saying that, when the  
12 mining is completed, there will be mine salts left on the  
13 walls of the mine? There will be salts left on the walls of  
14 the mine after the mining is completed?

15 A There could be in places where it's already been washed off.  
16 That will only occur where you've had drying and --

17 Q The metal sulfates salts -- right? -- on the mine walls?

18 A Could be some, yes.

19 Q Okay. And there will be some metal sulfate salts on the  
20 backfill development rock, too, won't there?

21 A Minor amounts with the limestone addition which is  
22 controlling the oxidation extending the lag period.

23 Q Okay. So when the development rock is backfilled into the  
24 mine and we have the mine -- the metal sulfate salt left on  
25 the wall, when the mine is re-flooded, those salts will then

1           leach out into the water, won't they? They'll dissolve into  
2           the water?

3        A     Yes, they will.

4        Q     Okay. Which will tend to increase the acidity of the water  
5           in the mine; correct?

6        A     I think the modeling that was carried out for the  
7           underground assumed a certain amount of the wall was  
8           reactive, which would account for those -- those salts.

9        Q     I see. In your direct testimony, you said that the  
10          geochemical program that Kennecott has proposed is  
11          comprehensive and consistent with accepted practice. That's  
12          on slide 43, Dr. Miller, the top point.

13       A     Yes; yes.

14       Q     You aren't testifying -- by the way, have you had a chance  
15          to read the statute that was Part 632 that is the basis for  
16          this hearing?

17       A     No.

18       Q     Okay. So you aren't testifying, are you, that, in your  
19          opinion, the proposed geochemical program proposed by  
20          Kennecott will be consistent with Part 632, are you?

21       A     No.

22       Q     And you aren't testifying, are you, Dr. Miller, that -- with  
23          any certainty, that the proposed mitigations will actually  
24          work in this?

25       A     I'm sorry. I missed the start of that.

1 Q That's fine. You've talked about, in your view, that Dr.  
2 Maest's predictions were overly conservative for purposes of  
3 mitigation planning. Do you remember that?

4 A Yes.

5 Q Okay. And for impact assessment. You aren't however  
6 testifying -- you don't have an opinion, do you, on whether  
7 or not there's any mitigations that are proposed actually  
8 will work? That's not your area of expertise, is it?

9 A Whether the mitigation will work?

10 Q Yes.

11 A As far as limestone blending is concerned, it is very much  
12 part of my expertise.

13 Q It's very much?

14 A Part of my expertise.

15 Q Okay. Part of your expertise. But you're not -- you can't  
16 testify today whether the proposed mitigations that are  
17 proposed by Kennecott here actually will prevent pollution  
18 of the water? You're not testifying to that, are you?

19 A That will prevent pollution of the water. The limestone  
20 blending and flooding of the workings will mitigate ion  
21 degeneration.

22 Q Okay. Mitigate. It will reduce the acid rock generation?

23 A Flooding the mine will stop acid rock generation.

24 Q But there will be some acid that will be already in the  
25 water; correct?

1 A There will be some acid in the water which will be  
2 significantly diluted and then, as you explained to me, will  
3 be pumped and treated.

4 Q But you're not saying that the re-flooding of the mine will  
5 prevent pollution of all water in the mine and outside the  
6 mine, are you?

7 A I'm not a hydrologist.

8 Q So you're not going to -- you can't testify that there will  
9 be complete prevention of any acid pollution; correct?

10 A I can testify that flooding the mine will stop ongoing acid  
11 generation.

12 Q But not that it will prevent pollution of the waters?

13 A The transport of whatever is in the water to the outside  
14 world is not my expertise.

15 MR. HAYNES: All right. Thank you. Dr. Miller,  
16 thank you. I have no further questions at this time.

17 MR. EGGAN: Doctor, I just have a few questions, I  
18 promise.

19 CROSS-EXAMINATION

20 BY MR. EGGAN:

21 Q I would like to go to back to slide 31, if we could, please.  
22 Doctor, this is the slide that relates to mine inflow  
23 volumes. And I just want to confirm with you that we're all  
24 operating from the first -- from the right page of the  
25 application here. And we're looking at the first bullet

1 point, "Stratus and GLIFWC used a low inflow volume  
2 resulting in less dilution and higher concentrations." That  
3 was a conclusion that you reached after reviewing the  
4 documentation?

5 A Yeah. That's a fact.

6 Q Okay. Now, what I want to do is show you what is page 14  
7 from the groundwater discharge permit. It's part of MDEQ  
8 Exhibit 141. And this is a report that was prepared by Foth  
9 and VanDyke. And it relates to inflow. And I want to read  
10 this first bullet point. You've read, I assume, these  
11 documents?

12 A No.

13 Q You didn't read the groundwater permit --

14 A Not all of it; not all of it, part of it.

15 Q Let me just ask if you agree with this line from that  
16 document. It said:

17 "The expected inflow rate of water to the mine  
18 will be approximately 75 gallons per minute on a  
19 sustained basis as described in the technical  
20 memorandum from Golder Associates, Limited, contained  
21 in Appendix Exhibit 1."

22 A Correct.

23 Q Were you aware of that?

24 A I was aware of that.

25 Q Okay. You were aware that at least Golder and Associates

1 had described a predicted inflow rate of 75 gallons per  
2 minute?

3 A Right.

4 Q Okay. And from what we understand from your testimony and  
5 from the testimony yesterday is that Geochimica used an  
6 inflow volume provided by KEMC at the time of modeling that  
7 was 180 gallons per minute?

8 A Correct.

9 Q Okay. Which, as Mr. Haynes pointed out, is a little bit  
10 more than two times --

11 A Correct.

12 Q -- two times the amount predicted here? Okay. So maybe we  
13 can rephrase these two sentences together. Okay. "Stratus  
14 and GLIFWC used a low inflow volume." But maybe that  
15 should -- maybe that should be amended to say, "Stratus and  
16 GLIFWC used the inflow volume provided in the application  
17 resulting in less dilution and higher concentration." We  
18 can say that, can't we?

19 A He can say that, yes.

20 Q Okay. And Geochimica used an inflow volume that was  
21 provided by KEMC at the time of modeling which resulted in  
22 more dilution and lower concentrations?

23 A Yes.

24 Q Okay. So we can amend that sentence to say that and it  
25 would probably be more accurate than the statement that you

1           have here on the document?

2       A     No.  I don't think it's any different.

3       Q     Well -- all right.  I suppose we could -- we could agree to

4           disagree on that.  But we do agree that Geochimica used an

5           inflow volume provided by KEMC at the time of modeling that

6           resulted in more dilution -- more dilution of the

7           contaminants and lower concentrations of those contaminants?

8       A     Correct.

9       Q     Very good.  Now, if we could go to slide 34, please.  This

10          is just a clarification.  And I'm making sure that I

11          understand what we're saying.  I want to look at the

12          scale-up factor issue.  What we're dealing with here, I

13          believe, is the surface area of the rock that is being --

14          that is being tested.  It's this issue of what size rock

15          should we use.  Bottom line is that the scale-up factors

16          used by Geochimica and Stratus are both reasonable

17          estimates?

18       A     Yes.

19       Q     Okay.  You referred in your direct testimony to some other

20          consultations you may have had with Rio Tinto.  Have you had

21          other instances where you've been asked to consult for Rio

22          Tinto?

23       A     Correct; yes.  Of course I have.  Yes.

24       Q     I think I changed subjects on you pretty fast, and I

25          apologize.  Let's go back.  During your direct examination

1 testimony, I thought that Mr. Lewis asked you about some  
2 other consultations you may have had, other opportunities to  
3 consult with Rio Tinto or Kennecott. And that's what I'm  
4 getting at.

5 A Yes.

6 Q Have there been other instances?

7 A Yes.

8 Q How many times do you think that you've been asked to  
9 consult for Rio Tinto?

10 A On a Rio Tinto project?

11 Q Yes.

12 A I would -- as far as the percentage of my time, probably the  
13 order of 10 percent of my time on Rio Tinto projects.

14 Q So 10 percent of the work that you do generally --

15 A Generally, yes.

16 Q -- is for Rio Tinto-related projects?

17 A Correct.

18 Q And what about Kennecott-related projects?

19 A I've done a little bit of work for Kennecott projects, but  
20 they aren't Kennecott anymore. Probably two or three.

21 Q Two or three other times?

22 A Yeah.

23 Q Do you have some kind of a retainer arrangement with Rio  
24 Tinto?

25 A No.

1 Q Okay. It's just they contact you when they need you?

2 A Yes.

3 Q And that represents about 10 percent of your total time?

4 A Yes.

5 MR. EGGAN: I don't have anything else. Thank  
6 you.

7 MR. LEWIS: I saw Mr. Wallace came in. I was  
8 waiting to see if there was a third round or not.

9 MR. WALLACE: No, sir. Thank you.

10 REDIRECT EXAMINATION

11 BY MR. LEWIS:

12 Q You were asked some questions earlier, Dr. Miller, about  
13 this -- on this slide the term "disseminated sulfide ore"  
14 and what that meant. And I believe you were asked a series  
15 of questions getting at whether there had been testing of  
16 that particular category, as you've used that term there.  
17 And I think you indicated that it was not a classification  
18 that had been used in the earlier categories. But I wanted  
19 to ask you, if we look -- in this slide, you say  
20 "disseminated sulfide" -- you've characterized it up to 10  
21 percent sulfur. Is that sulfur or sulfide? Sulfur?

22 A Sulfide.

23 Q And I know on the same slide you show that the development  
24 rock is characterized as less than one-tenth to 3 percent  
25 sulfur and that the ore -- you've got MSU, the massive

1 sulfide, 30 percent, and the semi-massive sulfide 10 to 15  
2 percent. So if we just keep that picture a minute. And  
3 again the disseminated sulfide you've characterized as up to  
4 10 percent sulfur. And I'd like to look back at slide 8.  
5 And this slide you talked about a few times already on  
6 direct and cross. But we can recall that this shows in the  
7 blue the 6,00-some numbers of sulfur samples and in red, I  
8 think, you overlaid what you call the column or the leach  
9 column test sample results?

10 A Correct; yes.

11 Q And if we look at the red dots, is, in fact, this category  
12 of disseminated sulfide ore meaning between 3 percent  
13 sulfide and 10 percent sulfide -- it is represented by a  
14 column leach test on this figure?

15 A The sample -- there is a sample in that range that was  
16 originally classified as a semi-massive sulfide which could  
17 possibly be reclassified as a disseminated sulfide sample.  
18 But that would be a geological description.

19 Q And if we look at it in terms of -- if we think of this as  
20 disseminated sulfide and again based on the prior slide of  
21 something having a sulfur content between 3 percent and 10  
22 percent, would that range of sulfur content also be well  
23 represented by the sampling shown on the blue line on this  
24 figure?

25 A Absolutely.

1 Q It would be some hundreds perhaps of sample?

2 A Yes.

3 Q If you look at slide 15, please, now, I think Mr. Haynes had  
4 asked you about this figure in reference to a figure that  
5 Mr. Logsdon had in one of his reports. And I think the line  
6 of questioning was something to the effect that, to be  
7 consistent with what Mr. Logsdon said when he was looking at  
8 NPR, should have removed the vertical red line to the right  
9 over to the 3 spot. And I believe you disagreed with that.  
10 But you weren't given an opportunity to explain why the  
11 figure in Mr. Logsdon's report is not applicable to what  
12 you've done here in this figure.

13 A The figure in Mr. Logsdon's report uses criteria based only  
14 on one parameter, the NPR or this ratio of neutralizing  
15 potential to acid potential. And the criteria in that  
16 document was less than 1 is considered potentially acid  
17 forming. From 1 to 3 is considered uncertain. And greater  
18 than 3 is considered non-acid forming. What we do here with  
19 having a second assessment of the acid potential using the  
20 net acid generation test is, by having two independent  
21 assays, we're able to be much more confident with our  
22 predictions. And based on using the criteria of 1 and the  
23 4.5 defines these classifications of non-acid forming,  
24 potential acid forming and the uncertainties are defined by  
25 the two parameters, not a range on the one parameter.

1           They're actually defined because there is inconsistency in  
2           the results.

3       Q     And finally, Dr. Miller, I think you were also at the end of  
4           the first cross-exam asked some questions to the effect that  
5           Mr. Logsdon did not do the so-called solubility adjustment  
6           for your slide we were looking at, the speciation for the  
7           predictions for the quality of the water in the mine after  
8           mining. Do you recall that?

9       A     I recall that.

10      Q     And would you explain briefly again why Mr. Logsdon did not  
11           do that speciation or solubility control adjustment for that  
12           scenario?

13                   MR. HAYNES: Objection. Calls for speculation.  
14           It seems to be that Mr. Logsdon has to explain it, not this  
15           witness.

16                   MR. LEWIS: Well, let me rephrase it.

17      Q     Can you explain why someone who does what you do would not  
18           do a solubility adjustment for that scenario?

19      A     Based on the chemistries predicted for the mass balance and  
20           the pH predicted by Mr. Logsdon or myself or whoever,  
21           because the chemistries -- because the concentrations are  
22           sufficiently low not to indicate any approach of solubility  
23           for any particular nickels or any particular precipitates  
24           that might form in these waters, you can make a judgment  
25           that it's not necessary to do it because of the high pH and

1 because of the low concentrations on the mass balance  
2 calculation.

3 Q And again just briefly we talked about this. But that was  
4 not the case in the Dr. Maest and Mr. Coleman calculations;  
5 is that correct?

6 A The concentrations that they predicted for the mass balance  
7 is sufficiently high that the speciation modeling should  
8 have been applied.

9 MR. LEWIS: That's all I have.

10 MR. REICHEL: I have no questions, Doctor.

11 MR. HAYNES: I have one follow-up question from  
12 redirect.

13 RECROSS-EXAMINATION

14 BY MR. HAYNES:

15 Q Dr. Miller, on the slide 10, which Mr. Lewis just talked  
16 about, the rock that you called disseminated sulfide ore,  
17 sulfidic ore, when was -- do you know when that label was  
18 attached to that particular kind of rock or is that a label  
19 you attached?

20 A No, it's not a labeled I attached. It was attached. It was  
21 in the Exhibit 309. I think it's within those exhibits of  
22 the ore classifications. It was provided to me by Andrew --

23 MR. LEWIS: Ware.

24 A -- Ware.

25 Q Do you know whether or not that ore has ever been classified

1 as development rock at any point in time?

2 A No; no, not that I know of.

3 Q And how was the ore classified when the NAG testing and the  
4 column tests were performed? Was it classified as  
5 disseminated sulfide ore or as development rock or something  
6 else?

7 A Ore is -- as I understand, it was classified as semi-massive  
8 sulfide or massive sulfide ores. And the ore, of course, is  
9 classified on its metal content.

10 Q Right. And, I mean, if it's disseminated sulfidic ore here  
11 and it's neither in the massive sulfide unit or the  
12 semi-massive sulfide unit; correct? So it wouldn't have  
13 been classified in those at the time of the test; correct?

14 A The semi-massive sulfide unit did extend to lower sulfur  
15 grades at that time, as I understand it.

16 MR. HAYNES: I see. Thank you. Nothing further.

17 MR. EGGAN: Nothing further, Judge.

18 JUDGE PATTERSON: Thank you, Dr. Miller.

19 THE WITNESS: Thank you.

20 MR. LEWIS: We're going to change witnesses and  
21 attorneys, your Honor. If I could have a --

22 (Off the record)

23 MR. BRACKEN: Kennecott's next witness, your  
24 Honor, we call John Fassbender.

25 REPORTER: Would you raise your right, please? Do

1           you solemnly swear or affirm the testimony you are about to  
2           give will be the whole truth?

3                       MR. FASSBENDER:   Yes.

4                               JOHN J. FASSBENDER

5                   having been called by the Intervenor and sworn:

6                               DIRECT EXAMINATION

7   BY MR. BRACKEN:

8   Q     Sir, would you state your full name and spell your last name  
9           just for the record?

10  A     John J. Fassbender, F-a-s-s-b-e-n-d-e-r.

11  Q     Mr. Fassbender, where were you born?

12  A     I was born in Ironwood, Michigan.

13  Q     And where were you raised?

14  A     I was raised in Escanaba, Michigan.

15  Q     And where were you educated?

16  A     I was educated in Houghton, Michigan at Michigan Tech  
17        University.  I graduated from Michigan Tech in 1982 with a  
18        BS degree in chemical engineering.

19  Q     Okay.  And after your graduation from Michigan Tech did you  
20        get a job?

21  A     Yes, I did.  I had a job as an engineer for a company called  
22        Chicago Bridge and Iron Company.  I worked for CBI for about  
23        14 years as an engineer.

24  Q     Okay.  And subsequent to your employment with CBI for about  
25        14 years who did you become employed by then?

1 A I've worked with Foth Infrastructure and Environment for  
2 over ten years, the last ten years.

3 Q Okay. Does that 24 years or so take up your postgraduate  
4 employment?

5 A That's correct.

6 Q Okay. And in what capacity do you work for Foth?

7 A I work as an engineer.

8 Q And where is Foth located?

9 A Foth is located in Green Bay, Wisconsin.

10 Q Do you have any licenses or certifications?

11 A Yes. I am a professional engineer in three states:  
12 Michigan, Illinois and Wisconsin. I've been a professional  
13 engineer for approximately 20 years.

14 Q Do you hold any patents in wastewater treatment equipment or  
15 processes?

16 A Yes, I do. I hold seven patents in wastewater treatment and  
17 water treatment. Six of the patents are with regards to a  
18 process called solids contact clarifiers or metals  
19 precipitation type processes, which are similar to the  
20 processes used on the Kennecott project.

21 Q Let's talk about your experience right now at CBI. What was  
22 the focus of your employment at CBI?

23 A At CBI I was a engineer. I worked there for 14 years, as I  
24 said. I worked in their water and wastewater division  
25 called CBI Walker. While working there I was the

1 engineering manager for the division. When I left that  
2 water and wastewater division worked extensively with a  
3 process called solids contact clarification; that's where I  
4 had my patents in.

5 Q So what kind of projects did you work on in that job?

6 A Quite a bit of water treatment projects. Approximately I've  
7 been on I would say dozens of metal removal processes  
8 projects in the context of both the design of the process,  
9 startup of the process and construction of the project.

10 Q Okay. And how is your work at Foth now; similar or  
11 different?

12 A At Foth it's a little bit different. It comes from the  
13 consultant's standpoint, but I've also been working on --  
14 extensively on water and wastewater treatment at Foth.

15 Q Is that your specialty?

16 A Yes, it is, process engineering with water and wastewater  
17 treatment. With Foth I've worked on several metals removal  
18 projects. I've worked on ion exchange projects. I've  
19 worked on -- extensively with regards to the Eagle project.  
20 I worked on the Crandon Mine project for three or four  
21 years. The Crandon Mine was very similar to the Eagle  
22 project with regards to wastewater treatment. It was a  
23 sulfide mine also. The design of the project wastewater  
24 treatment consisted of similar types of unit operations  
25 namely metals precipitation processes, RO processes and

1           evaporation processes.

2       Q     Is that a project that ended up going forward after you  
3           designed --

4       A     No, it didn't. It was worked on extensively but did not go  
5           forward.

6       Q     So is it right to characterize that you worked both on the  
7           design of the plants and the systems that are used in those  
8           plants?

9       A     That is correct.

10      Q     Have you ever done any work for a state agency at Foth?

11      A     Yes. Yes, I have. I've worked for the Wisconsin DNR on a  
12           project. This was a Wisconsin cone \* 2:08:20 project where  
13           we had an ion exchange of -- similarly \* 2:08:25 for metals  
14           remediation.

15      Q     All these projects, when we talk about wastewater projects  
16           or the treatment, the design of plants and the treatment of  
17           wastewater from various -- that include various contaminants  
18           as part of their structure?

19      A     Yes.

20      Q     Okay. I've heard you talk about at least three different  
21           projects -- or processes that you've worked with. I'll call  
22           one metal hydroxide or precipitation?

23      A     Yes.

24      Q     One in the design phase reverse osmosis or RO?

25      A     Yes.

1 Q And evaporated crystallization; is that right?

2 A That's correct.

3 Q And I think you also said ion exchange is one?

4 A That's correct.

5 MR. BRACKEN: Your Honor, it's my understanding --  
6 I haven't been here every day -- is that the parties have  
7 agreed by stipulation to the admission of the CV's for all  
8 the witnesses and, therefore, I move for the admission of  
9 Intervenor Exhibit 139, which is Mr. Fassbender's CV.

10 MR. EGGAN: We have agreed to that, your Honor,  
11 and we have no objection to the admission of Mr.  
12 Fassbender's CV.

13 MR. HAYNES: It's agreed; no objection.

14 MR. REICHEL: Agreed.

15 MR. BRACKEN: Thank you, your Honor.

16 (Intervenor's Exhibit 139 received)

17 Q Are you familiar with the Kennecott Eagle Mine project?

18 A Yes, I have. I've worked on that project for three or four  
19 years now.

20 Q Okay. And in what capacity have you worked on that project?

21 A I worked on it as a lead process engineer.

22 Q Okay. And in that regard you provided certain engineering  
23 services to the Kennecott mine project?

24 A That is correct.

25 Q Are you also the certifying engineer for the groundwater

1 discharge application in this case?

2 A Yes, I am.

3 Q And what does that mean, that you're the certifying  
4 engineer?

5 A The certified engineer; that I had -- familiar with the  
6 project. I worked through the process calculations,  
7 familiar with the process calculations for the treatment  
8 facility. I'm familiar with all aspects of the discharge  
9 permit application; that they're done in a sound and  
10 professional manner.

11 Q Even though you didn't do all the work, you're satisfied  
12 yourself before signing it that the engineering principals  
13 used during the application was sound?

14 A That's correct.

15 Q Okay. You've called yourself a lead process engineer  
16 leaving the question of what that means.

17 A A lead process engineer would select the process, design the  
18 process for, let's say, a treatment system. That would  
19 consist of characterizing or obtaining characterization of  
20 the influent wastewater, consist of understanding what the  
21 effluent requirements are, consist of knowing what unit  
22 operations or processes could be implemented to meet the  
23 effluent limits and then having an overall design with an  
24 overall calculation of what the projected effluent would be.

25 Q Okay. So let's see if I got all of this. You determined

1 the design basis for the treatment plant that's proposed at  
2 the Kennecott Eagle Mine?

3 A That's correct.

4 Q And did you base that on calculations of influent wastewater  
5 that you did or that that others did?

6 A That others did; other experts, other hydrologists,  
7 geochemists on the concentrations.

8 Q Okay. And that would be both the amount of concentrations  
9 and the flow rates?

10 A That's correct.

11 Q Okay. You reviewed the available technologies that you  
12 could use in treating the water?

13 A Yes.

14 Q Did you -- were you the person who selected the ones that  
15 ended up in the design that was approved by the State in the  
16 application?

17 A Yes.

18 Q And were you also involved in estimating the effluent  
19 characteristics of the water that would be discharged from  
20 the mine into the ground?

21 A Yes, I was.

22 Q Is there anything else you did as lead process engineer?  
23 That's it, huh?

24 A Yeah.

25 Q Okay. I'd like to direct your testimony now to a

1 description of what you did, and more specifically I guess.  
2 First of all, how did you determine the water that was going  
3 to be treated by the treatment plant?

4 A Determine the characteristics of the water?

5 Q Yes.

6 A I worked with other experts in the field, namely the  
7 geochemists to obtain the influent characteristics of the  
8 water. It was a combination of mine drainage water,  
9 precipitation, water runoff from the TDRSA; miscellaneous  
10 users, such as truck wash water all went into the influent  
11 characterization.

12 Q Would the influent include any contact water?

13 A Yes. The precipitation and snow melt and any precipitation  
14 that came into contact with the ore or development rock  
15 would be considered the contact water.

16 Q That would be all sent to the wastewater treatment plant  
17 under your design?

18 A That's correct.

19 Q On what basis did you select the technologies you decided to  
20 use; what bases?

21 A You know, we group the parameters -- there's certain  
22 classifications, such as chlorides which need to be treated  
23 by reverse osmosis and then there's some metals which need  
24 to -- which are -- need to be treated by some other  
25 processes, so I'm sure --

1 Q Okay. So you chose the -- is it fair to say you chose  
2 technology based on the characteristics of the influent?  
3 A Absolutely.  
4 Q Okay. And how did you decide which technologies would be  
5 used for the influent characteristics?  
6 A The technologies used were to -- were selected to meet the  
7 effluent criteria, effluent limits.  
8 Q Did you make those decisions based on your own experience or  
9 --  
10 A Oh, yes. Based on my own experience, based on industry  
11 literature, based on discussions with other experts in the  
12 field.  
13 Q And is that a customary generally accepted way to make those  
14 kind of decisions as to what processes to use?  
15 A Yes, it is.  
16 Q Were any of the technologies you used new technologies?  
17 A No, they aren't.  
18 Q Did you use in your calculations as a new process engineer  
19 any particular inflow rate?  
20 A Yes, we did. We used a maximum mine inflow rate of 250  
21 gallons per minute. The design rate of the RO system was  
22 set at 350 gallons per minute.  
23 Q Okay. And did you consider any other mine inflow rate?  
24 A Yes. We had a range of between 75 and 250 gallons per  
25 minute. We considered the effect of all those different

1 ranges on the concentrations and the performance of the  
2 treatment system.

3 Q I think right now I'd like to direct your attention to the  
4 specific processes you propose to be used in this facility.  
5 And in that regard I'd like to direct your attention to -- I  
6 think it's Intervenor Exhibit 15 and -- which is the  
7 application, the groundwater discharge permit application,  
8 particularly Section 5. And it is part of the application?

9 A Yes, it is.

10 Q Okay. And what's the purpose of this section of the  
11 application?

12 A It's to evaluate the different alternatives that are  
13 available to treat the wastewater.

14 Q Okay. And I'm going to pull up on the screen Section 6 of  
15 the application. What's been projected on the screen, Mr.  
16 Fassbender, is part of Intervenor Exhibit Number 15, the  
17 application, isn't it?

18 A Yes, it.

19 Q Okay. And at the top of the screen we have Section 6, the  
20 "Basis of Design for Proposed Wastewater Treatment System";  
21 is that correct?

22 A That's correct.

23 Q Did you author this part of the application?

24 A Yes, I did.

25 Q And what's the purpose of this part of the application?

1 A It's to provide a basis for the design for the treatment  
2 system.

3 Q Describes the design that you are proposing for --

4 A That's correct.

5 Q Okay. In this design -- in the design what was the first  
6 process that you proposed to use on influent into the  
7 system?

8 A The first process is a metal hydroxide precipitation  
9 process. This process consists of taking the influent  
10 wastewater, the water from the contact water basins, we add  
11 lime to it, increase the pH to a pH of approximately ten.  
12 What that does, it reduces the solubility of the metals, of  
13 the divalent metals and they precipitate out in the  
14 clarifier as a solid and they are removed from the clarifier  
15 and handled in accordance with the applicable regulations at  
16 an offsite facility.

17 Q Okay. So you've been with me a few days. I'm going to ask  
18 you to put that in something that even I could understand.

19 A Sure.

20 Q I understand you pump -- the water's pumped into a clarifier  
21 into this system; is that correct?

22 A That's correct.

23 Q And it's -- pH is treated?

24 A That's correct. The water will come in at varying pH's.  
25 we'll have a pH adjustment system that are -- automatically

1 keep the pH at a constant level, like I say, approximately  
2 ten.

3 Q This is the influent that we talked about before contact  
4 water basically?

5 A That's correct.

6 Q And precipitation?

7 A Correct.

8 Q Okay. And there would be -- would there be anything in the  
9 water?

10 A Yes, there'll be -- the contaminants will be in the water;  
11 the metals, the salts.

12 Q And they'll be dissolved?

13 A That's correct.

14 Q And you talked about divalent metals being subject --  
15 particularly subject to this kind of treatment; is that  
16 correct?

17 A That's correct.

18 Q What kind of examples do you have?

19 A Divalent metals would be looking at nickel, copper, zinc,  
20 cadmium, calcium magnesium, those types of metals; as  
21 opposed to sodium, which is monovalent, which won't be  
22 treated by this process.

23 Q Okay. So once you bring this water in, you add something to  
24 it; is that correct?

25 A That's correct.

1 Q And what do you add to it?

2 A Well, add lime.

3 Q And that's called a reagent?

4 A That's called a reagent, yes.

5 Q And what does the lime cause to happen in the clarifier?

6 A Pardon?

7 Q What does the lime cause to happen?

8 A Oh, the lime increases the pH in the clarifier and the

9 metals that have reduced solubility at the pH, and so

10 they'll come out a solution as a solid.

11 Q They'll come from solution to a solid?

12 A That's correct.

13 Q And do they drop? Where do they go?

14 A They'll be pumped out of the clarifier.

15 Q Okay. In the clarifier where will they go?

16 A Oh, they'll silt to the bottom of the clarifier.

17 Q Okay. Will you be able to see them?

18 A Yes, you will. You'll see a sludge blanket if you look in.

19 Q Okay. And that'll be those divalent metals that you had

20 talked about?

21 A The metal hydroxide sludge.

22 Q So at the -- when this process is done what happens to the

23 sludge at the bottom?

24 A The sludge is pumped out to a filter press to remove the

25 moisture from it.

1 Q Okay. And then what happens to the rest?

2 A The press sludge is hauled to an offsite facility for  
3 disposal in accordance with applicable regulations.

4 Q And what happens to the water that's taken off the  
5 clarifier?

6 A The clarified water is sent to a sand filter where it's  
7 filtered; suspended solids are removed from the filter.

8 Q Okay. Let's back up just a little bit. Okay? Is copper a  
9 divalent metal?

10 A Yes, it is.

11 Q So is copper one of those metals that is removed from the --  
12 in the clarifier process?

13 A Yes, it is.

14 Q If concentrations of a metal are higher than you've  
15 predicted or the values you used, how is that handled in the  
16 clarifier?

17 A Well, with the metal hydroxide sludge the clarifier will --  
18 the clarified effluent will be at a constant solubility with  
19 regards to the metal. Increasing amounts of the metal that  
20 are above the solubility will still leave the clarifier at  
21 the constant level. So if you have -- restate your -- the  
22 answer, if you have ten times the amount of, let's say,  
23 copper or nickel you will still leave the clarifier at the  
24 same concentration as the previous amount.

25 Q Okay. So how do you do that? If you have more

1 concentration how do you treat it?

2 A Well, it's done by keeping the pH at a constant level. If  
3 you had a higher amount of a metal it will consume, you  
4 know, some of the hydroxides and they'll tend to lower the  
5 pH but you have an automatic adjustment system to maintain  
6 the pH at a constant level.

7 Q Okay. Let me see if I understand this. When you add the  
8 reagent you bring in a higher concentration of, let's say,  
9 nickel, you expect if there's a higher concentration and the  
10 pH is kept at the right level you'll get more precipitation  
11 from that?

12 A At a higher incoming concentration?

13 Q Yes.

14 A Yes.

15 Q Okay. And effluent that leaves, will it have a higher or --  
16 A It'll remain constant in nickel.

17 Q So even though there's more concentrate coming in the  
18 effluent will have the same level as -- fo concentration of  
19 that particular metal if it's treated in the clarifier?

20 A Yes.

21 Q Have you ever in your jobs at CBI and Foth used this metal  
22 hydroxide process successfully?

23 A Yes, I have, dozens of times.

24 Q And are you -- the patents that you told us about before  
25 related to this clarifying process?

1 A Yes. They're similar types of equipment.

2 Q Okay. Is it fair to say that regarding these divalent  
3 metals, the hydroxide process or clarifier process will  
4 remove a great variability of concentrations in these  
5 metals?

6 A Yes.

7 Q Okay. Let's go on to the next process. You said the  
8 effluent from the clarifier process will move on to a  
9 filtration system?

10 A Yes.

11 Q Can you describe that for me?

12 A A filtration system is a vessel that's filled with a media,  
13 such as sand. The clarifier water flows through the sand.  
14 There may be some small particles that remain of suspended  
15 solids in the clarified water; the sand filter catches those  
16 particles and the filtrate is a cleaner water as it leaves  
17 the filter.

18 Q Okay. So some of the divalent metal -- some fo the  
19 contaminants in the clarifier not all of them come out and  
20 precipitate to the bottom; is that what we're talking about?

21 A That's correct. There will be a small percentage of  
22 suspended solids that will -- that may want to leave and we  
23 catch those in the sand filter.

24 Q Okay. And run the water through and then the water that  
25 comes through the filter goes on to the next process?

1 A Yes, it does.

2 Q What do you do with the solids that get caught in the sand  
3 filter?

4 A That is backwashed back to the front of the plant.

5 Q Okay. So washed out of the filter and sent back to the  
6 beginning of the process?

7 A Yes; yes.

8 Q So as we follow your design, after the water leaves the  
9 clarifier and filtered water leaves the filtration, where  
10 does it go in the plant?

11 A Then it goes to a reverse osmosis system.

12 Q Okay. Tell me what a reverse osmosis system is.

13 A A reverse osmosis system consists of a -- it's a process  
14 that has membranes with very small pores in them. You put  
15 high pressure on the membrane and the water is  
16 preferentially passed through into the permeate of the  
17 system, the clean water of the system. The ions concentrate  
18 in another stream called the concentrate. In that way it  
19 could -- it purifies the water; makes a pure water stream  
20 and a concentrate stream.

21 Q Okay. Excuse me for a second. Now, is the purpose of the  
22 reverse osmosis process somewhat different than the metal  
23 hydroxide or clarifier process?

24 A That's correct. Predominantly reverse osmosis is required  
25 on the Kennecott project because of the presence or the

1 potential presence of chlorides which could exceed the  
2 groundwater discharge permit limit. Chlorides are pretty  
3 much most effectively or only effectively removed by a  
4 reverse osmosis process.

5 Q And there -- are there other contaminants in the inflow  
6 water to the wastewater treatment plant that are also  
7 treated by the reverse osmosis process?

8 A Yes. All the ions will be further treated by the reverse  
9 osmosis process including the metals that remain after the  
10 clarifier.

11 Q So they'll have some affect on the metals that came -- that  
12 got through the first step, the clarifier process as well as  
13 some non-divalent metals?

14 A That's correct. It'll, you know, remove 95 percent of the  
15 metals in the reverse osmosis process.

16 Q Okay. Let's see if I can break this down. These are  
17 membranes that are the kind of the main part of the reverse  
18 osmosis system?

19 A Pardon me?

20 Q The membrane is --

21 A Oh, membranes, yes. I didn't understand. Yes, they have  
22 membranes.

23 Q Okay. And how do you determine -- how did you determine in  
24 your design what percent of these various contaminants would  
25 go through or would be rejected by the membrane?

1 A We work with reverse osmosis manufacturers, equipment  
2 manufacturers and look at literature, design criteria to  
3 decide what percent will go through the membrane.

4 Q Okay. And is that commonly, customarily used in your  
5 industry?

6 A Yes, it is.

7 Q At the end of this process you -- I understand you separate  
8 the two flows of water; one that has -- call it "purified"  
9 but that's not probably the right word.

10 A Permeate.

11 Q -- permeate, which has had the ions removed and -- removed  
12 ions?

13 A Yes.

14 Q Is there some possibility that there's still something in  
15 the permeate that hasn't been picked up by the -- to that  
16 point?

17 A Yes. Depending on the pH of the first pass reverse osmosis  
18 process the -- boron could go through that into the  
19 permeate.

20 Q And when you say "go through," go through at level -- at  
21 certain levels?

22 A Yeah, at certain concentrations. And we can -- we have a  
23 second pass reverse osmosis where we can adjust the pH and  
24 remove that boron also.

25 Q Okay. Is the clarifier project a process that's been used

1           for a while in this country?

2       A     Clarifier?

3       Q     The clarifier.

4       A     Yes.  The clarification process has been used for decades,  
5           as has the reverse osmosis process.

6       Q     These are well established and used processes in wastewater  
7           treatment?

8       A     Yes, they are very well established, very robust.

9       Q     And by "robust" what does that mean?

10      A     It means that they've been using it in industrial  
11           applications and they're very strong and forgiving.

12      Q     Okay.  I think you said that because boron doesn't get  
13           picked up in the first time through the processor -- reverse  
14           osmosis process it goes through a second time?

15      A     Yeah, there is a second reverse osmosis unit that's called a  
16           double pass system.  Depending on what the pH is through the  
17           first pass, boron can go through and go into the permeate.  
18           If we increase the pH in between the two passes we'll reject  
19           that boron.  We also have an alternative to capture the  
20           boron in a boron ion exchange unit.

21      Q     So is there any purpose in this particular design for the  
22           second pass RO unit, the reverse osmosis unit, other than  
23           boron?

24      A     Well, the -- it adds a level of conservativeness to the  
25           facility.  The parameters will meet -- all the parameters

1 will meet the discharge limits through the first pass, with  
2 the possible exception of boron. But it does add a little  
3 conservativeness to have the second pass system.

4 Q And the second pass not only removes the boron, it also  
5 marginally removes other --

6 A Yes, it will. It will continue to improve the water  
7 quality.

8 Q Okay. And did I hear you say that at the end of the second  
9 pass the water quality would meet -- what standards?

10 A It'll meet the permit limits.

11 Q Now, there's been a criticism along the way that you did not  
12 specify in the application the types of membranes that  
13 you're going to use in the reverse osmosis process when you  
14 submitted the application in 2006.

15 A At the application stage it would be very unusual to commit  
16 to a certain manufacturer and type of membrane. When the  
17 project proceeds two or three years down the road that --  
18 you know, that commitment is -- just would have to be  
19 reevaluated.

20 Q And that would be subject to approval by the DEQ; right?

21 A That's correct. Final plans and specs are then forwarded to  
22 the DEQ.

23 Q Okay. What happens to the permeate from the second pass RO?

24 A The permeate from the second pass RO is adjusted in pH if  
25 necessary and forwarded to the treated water infiltration

1 system.

2 Q Okay. What happens to the concentrate, the stream that  
3 contains the rejected ion?

4 A The concentrate is forwarded to another process called the  
5 concentrate reduction process or alternatively we can  
6 forward that directly to the evaporator system.

7 Q Okay. It's my understanding in the application you had a --  
8 you had both of -- you had the concentrate reduction process  
9 described; is that right?

10 A Yes.

11 Q And as an alternative the evaporation crystallization  
12 process?

13 A Yes, as an alternative to sending the concentrate to the CRT  
14 process we could forward that to the evaporator.

15 Q Okay. And are those similar -- they have similar purposes,  
16 those two processes?

17 A They both serve to reduce the volume of the concentrate.

18 Q How do they do that?

19 A The concentrate reduction process has a series of equipment  
20 that uses metal hydroxide precipitation, reverse osmosis and  
21 ion exchange to reduce the volume. The evaporator reduces  
22 the volume through the process of evaporation.

23 Q Okay. And have you decided at this point which of those to  
24 use?

25 A We've evaluated the alternatives. It appears most likely

1 that we will be forwarding the concentrate directly to the  
2 evaporator. There's certain advantages to doing that;  
3 namely, that the distillate off the evaporator is a cleaner  
4 -- it's cleaner and it has less contaminants than the CRP  
5 process. Both processes will meet the discharge limits from  
6 the permit. The other -- another advantage to going  
7 directly to the evaporator is that it's a less complex  
8 process. CRP does have a lot of pieces to it and we can  
9 simplify the operation facility if we sent it directly to  
10 the evaporator.

11 Q Okay. If you use the evaporator you evaporate the water off  
12 it with heat; is that what's happening?

13 A Basically that's the -- a simplified description; you  
14 evaporate the water, you form a -- what's called a  
15 distillate, which is distilled water.

16 Q And what happens to that distilled water?

17 A The distilled water is forwarded -- adjust the pH if  
18 necessary and forwarded to the treated water infiltration  
19 system.

20 Q Okay. So that meets up with the water you've treated  
21 through the reverse osmosis process?

22 A That's correct.

23 Q and then both of those are combined and discharged?

24 A That's correct.

25 Q In this case even though -- once your area \* 2:34:32 the

1 discharge is through the TWIS, what they call the TWIS?

2 A Yes; yes.

3 MR. BRACKEN: At this point, your Honor, I would  
4 move for admission -- and I think this has been done and I  
5 apologize to the court since I haven't been here every day,  
6 but at least these two parts of the groundwater discharge  
7 permit I'd move for their admission, 5 and 6. And I think  
8 that's how we've been doing on a piecemeal basis based on  
9 the authors of those particular parts.

10 MR. REICHEL: Your Honor, we have no objection. I  
11 would note for the record that these reference pages are  
12 also included in DEQ Exhibit 141, which is the water permit  
13 application.

14 MR. BRACKEN: That's what happens when you're not  
15 here every day.

16 MR. EGGAN: I have no objection.

17 MR. HAYNES: No objection. I note that -- at  
18 least my notes say that Exhibit -- that DEQ Exhibit 141 was  
19 admitted on May 8.

20 MR. REICHEL: Yeah, I believe already is in  
21 evidence.

22 MR. BRACKEN: It's already in evidence.

23 MR. HAYNES: Right.

24 JUDGE PATTERSON: Oh, okay.

25 MR. BRACKEN: So I guess it's redundant to do

1 that.

2 MR. HAYNES: Right.

3 MR. BRACKEN: It's in evidence and there's no  
4 objection to that.

5 JUDGE PATTERSON: Better twice than not at all;  
6 right?

7 MR. BRACKEN: It's better to be in --

8 JUDGE PATTERSON: It will be admitted.

9 (Respondent's Exhibit 141, Sections 5 and  
10 received)

11 MR. BRACKEN: Thank you.

12 Q Do you know what this is, by the way, Mr. Fassbender?

13 A Yes, it's a -- it's the detail calculation sheet that  
14 identifies all the parameters reviewed in the system design.  
15 It identifies the method for characterizing the influent to  
16 the wastewater treatment system and it identifies the unit  
17 operation change of each parameter throughout the system.

18 Q So on the top --

19 A Ultimately we'll receive an effluent concentration that will  
20 meet the discharge limits.

21 Q Okay. So this is the -- this is the table that reflects  
22 your calculations; is that right?

23 A That's correct.

24 Q And the -- if I understand it, on the left-hand column you  
25 list a series of potential contaminants in the inflow water?

1 A Yes.

2 Q Starting with aluminum and ending up at zinc at the bottom?

3 A Yes.

4 Q And across the top -- or across the -- yes, across the top,  
5 so the columns are -- relate to values of what?

6 A Concentrations of that parameter at the various points --  
7 the various points in the system and concentrations are in  
8 micrograms per liter.

9 Q Okay. And then about two-thirds of the way over is a column  
10 that looks like it's "WWTP, Wastewater Treatment Plant,  
11 Influent Wastewater"; is that right?

12 A That is correct.

13 Q Okay. And that is the estimation given to you -- given to  
14 you?

15 A It was calculated by myself, but there are various  
16 components that go into that that were given to me by  
17 outside personnel, such as the groundwater concentrations,  
18 the increase due to the geochemistry. But the final value  
19 was calculated by myself by sort of an arithmetic type of  
20 process to average those values.

21 Q Okay. And then from then on you have listed in columns -- I  
22 think and correct me if I'm wrong -- the various  
23 technologies that you propose to use to treat this water?

24 A Yes.

25 Q Line clarifier effluent, so would that show what happens

1 after the process of -- clarifying process has been done?

2 A yes, it would.

3 Q Okay. And then the next one would be the RO or reverse  
4 osmosis effluent; is that correct?

5 A I think you have -- the next main treatment stage would be  
6 that. I think on this example right here there's some  
7 intermediate stages that show that.

8 Q Okay. I see. I have a different one. But that's what  
9 happens; those across the top --

10 A That's correct.

11 Q It will show you a value that relates to -- what? -- the  
12 level of that contaminant is after the conclusion of that  
13 particular process, whether it's the clarifier, the reverse  
14 osmosis, the evaporator; is that right?

15 A Yes; yes.

16 Q And at the end you -- near the end you get an effluent  
17 column, which is your estimation of what the effluent will  
18 be after these treatment processes are completed?

19 A That's correct.

20 Q Okay. And then I think you put in Part 22 standards and the  
21 percentage of -- that the effluent to the Part 22 standards?

22 A Yes; that's also right.

23 Q And the calculations that led to this from the -- to this  
24 particular exhibit, are yours; is that right?

25 A That is correct.

1 Q And these are the kind of calculations that you do  
2 customarily in your expertise as -- in the wastewater  
3 treatment area; right?

4 A Yes, I do.

5 Q Okay. And this was submitted as Exhibit G-1 as part of the  
6 application -- or Appendix G-1 -- excuse me -- as part of  
7 the application?

8 A Yes, it was.

9 MR. BRACKEN: Gentlemen, again I'll ask out of my  
10 ignorance, is this part of what the prior -- this part of  
11 what was admitted as part of the MDEQ exhibit?

12 MR. REICHEL: This document is contained in DEQ  
13 proposed Exhibit 151.

14 MR. BRACKEN: Okay.

15 MR. REICHEL: Which I don't believe has been  
16 offered into evidence.

17 MR. EGGAN: It has not been.

18 MR. BRACKEN: I will therefore offer this table to  
19 Appendix G-1 to the application into evidence, your Honor.

20 MR. REICHEL: We have no objection.

21 MR. EGGAN: May I do a brief voir dire on this  
22 particular exhibit?

23 JUDGE PATTERSON: Sure.

24 VOIR DIRE EXAMINATION

25 BY MR. EGGAN:

1 Q Sir, from what I understand of your testimony you created  
2 part of the calculations on this document, but another part  
3 of the calculation on the document was prepared by someone  
4 else?

5 A Some of the inputs were prepared by someone else.

6 Q Okay. So the inputs that have resulted in the calculations  
7 themselves were created by others?

8 A The input values were provided by others, yes.

9 MR. EGGAN: On that basis, your Honor, I'm afraid  
10 I have to object. Until those other people come in and  
11 confirm those or give us the basis of those calculations I  
12 think that we don't have a proper foundation for this  
13 exhibit.

14 MR. HAYNES: Join in the objection.

15 MR. REICHEL: Well, your Honor, first of all, I  
16 don't think there's any factual dispute that what's  
17 displayed here is in fact part of the application materials  
18 that were submitted to and considered by the Agency; number  
19 one. So I don't see any basis on which this tribunal should  
20 refuse to consider or include in the record the permit  
21 application that was submitted under Part 31. As to this  
22 issue of foundation, I mean the witness has testified, as I  
23 understand it, that he created this document and that  
24 consistent with customary practice in his field as to  
25 certain pieces of information that form part of the basis

1 for this were provided by others, but I don't believe that  
2 makes this inadmissible.

3 MR. BRACKEN: I would join Mr. Reichel and recall  
4 for the court that, for instance, Dr. Maest has -- was  
5 allowed to have things admitted that she didn't have all the  
6 values; she took values from other places and put them in.  
7 So all this gentleman has done is took some values from  
8 other people. Now, in the end, obviously after the  
9 admission of this document this court would have to decide  
10 whether the record would allow it to give weight to the  
11 conclusions drawn from it or the calculations done, but it  
12 seems to me we've done this a lot, even in the few days that  
13 I've been in this -- before this tribunal for this case that  
14 we've allowed people and we've allowed exhibits based on  
15 some data that might have come from elsewhere and  
16 calculations here from that data are, of course, this  
17 witness's and he's testified to.

18 MR. EGGAN: Brief response, your Honor.

19 JUDGE PATTERSON: Sure.

20 MR. EGGAN: And that would be initially responding  
21 to what Mr. Reichel had to say, and that is to the extent  
22 these were considered by the Agency they should be admitted.  
23 We believe that as a result of that particular analysis the  
24 comments that we offered and which have been objected to and  
25 are not in the record should also be admitted, because they

1           were considered by the Agency. So if Mr. Reichel is willing  
2           to concede that our comments can come in and be part of this  
3           hearing and be considered as truth of the matter asserted,  
4           then we're all for it. In terms of -- in terms of what this  
5           witness has got to say, this is a document with a great deal  
6           of calculations with a great deal of conclusions you see as  
7           it goes across. It's a great deal of conclusions on a host  
8           of issues. And it would be very difficult for us to  
9           cross-examine on a document like this without knowing what  
10          was his and what was someone else's. and all I'm asking for  
11          is -- you know, break it out so that his conclusions -- if  
12          they're calculations that he did they can remain, but  
13          calculations done by others should not be admitted.

14                 MR. BRACKEN: I think he's testified that all the  
15                 calculations are his; certainly the calculations of the  
16                 effluent based on data he got from others he calculated what  
17                 that would translate to in the effluent column. From that  
18                 point on this is all his work, so the only issue here is the  
19                 foundation for those influent and I think that's an issue  
20                 that will come in but in -- as to the -- this it's based on  
21                 -- it's just like any other document; it's based on some  
22                 underlying data and we'll have to -- we'll have to tie that  
23                 up at some point. But we have that data and I think it  
24                 should be admitted on that basis.

25                 JUDGE PATTERSON: All right. I'm going to admit

1           it over the objection.

2                   MR. EGGAN: Just so that we're all clear. What is  
3 this document numbered and titled?

4                   MR. BRACKEN: This is Exhibit -- it's G-1 to the  
5 application.

6                   MR. REICHEL: It's contained in DEQ Exhibit 151;  
7 that's what I have, 151.

8                   MR. EGGAN: Do we have a page number within the  
9 DEQ 151?

10                   MR. REICHEL: I can give you --

11                   MR. EGGAN: Maybe it's part of the document  
12 itself.

13                   MR. REICHEL: I'm looking here. I'm looking at a  
14 PDF.

15                   MR. EGGAN: No, it's --

16                   MR. REICHEL: It's page three I believe of that.

17                   MR. HAYNES: It's page three of a four-page  
18 exhibit, Exhibit 151.

19                   MR. REICHEL: The document I'm looking at does not  
20 have -- it has title pages; it doesn't have numbers on them.

21                   MR. BRACKEN: I can tell you on the Bates stamp  
22 the KEMC Bates stamp it's 111114 and 111115 is the next  
23 page, which is the continuation of that.

24                   MR. REICHEL: Again, it's page -- the PDF page  
25 number is three and four.

1 MR. EGGAN: Thank you.

2 (Respondent's Exhibit 151, Appendix G-1 received)

3 DIRECT EXAMINATION

4 BY MR. BRACKEN (continued):

5 Q Mr. Fassbender, subsequent to the time the application was  
6 submitted to the DEQ did the DEQ ask for clarification or  
7 explanation of these calculations that are shown on Exhibit  
8 -- DEQ 151?

9 A Yes, they did. They asked for a detailed calculation for  
10 how these were -- how these various columns were determined.

11 Q Okay. What we've placed on the screen, Mr. Fassbender, is  
12 the first page of proposed Intervenor Exhibit 235, which is  
13 a letter to Jeanette Bailey and Mr. Jonathon Cherry at  
14 Kennecott. A little hard for me to see what the date is on  
15 that, if it is dated. It doesn't appear to have a date.  
16 Not the best thing to do when sending a letter?

17 MR. HAYNES: Counsel, the exhibit number again?

18 MR. BRACKEN: It's proposed 235.

19 MR. HAYNES: Thank you.

20 Q Have you ever seen that letter before?

21 A Yes, I believe -- yes, I have.

22 Q Okay. And if we could go to the next page, please, which is  
23 the attachment to this document. Do you recognize that, Mr.  
24 Fassbender?

25 A Yes. This is Table 6-1 from the -- that has been revised

1 from the groundwater discharge permit application.

2 Q Okay. And was this revised in connection with the request

3 from the DEQ to give some explanation to the wastewater

4 flows and the pollutant concentrations that you had included

5 in the application?

6 A I don't recall specifically what was changed in this table.

7 I know that we had additional calculations that followed

8 this that gave more detailed explanation of how the

9 calculations were obtained.

10 MR. BRACKEN: Excuse me, your Honor.

11 Q And are you familiar with that exhibit?

12 A Yes, I am.

13 Q And what is that? You prepared that?

14 A I prepared this.

15 Q And what is it?

16 A It's a detailed calculation for identifying the process that

17 was done for all the parameters. This detailed calculation

18 is for nickel specifically.

19 Q Okay. The DEQ when it looked at Appendix G asked you what

20 question? Appendix G-1. Did they ask you to -- how you

21 came to those numbers?

22 A Oh, they wanted, yeah, further detailed explanation of how

23 the estimated effluents were obtained.

24 Q Okay. And what does this exhibit show?

25 A Well, this exhibit shows the -- how each one of those

1 columns were obtained. It gives a detailed explanation  
2 starting from the groundwater inflows from the various  
3 chemistry up front through each one of the processes and  
4 has, you know, both numbers and the calculations and some  
5 verbiage to explain the calculation procedure.

6 Q Now, did you do -- was a similar calculation done with  
7 respect to every one of the contaminants in G-1?

8 A That's correct.

9 Q This is just an example for the DEQ for them to see how you  
10 did -- how you would have done it if you had handwritten it  
11 out?

12 A That's correct.

13 MR. BRACKEN: I would move for admission of this  
14 exhibit, your Honor. Something that Mr. Fassbender prepared  
15 and provided to the DEQ at their request.

16 MR. REICHEL: Counsel, what was the number of this  
17 one?

18 MR. BRACKEN: 138; Intervenor Exhibit 138.

19 MR. REICHEL: No objection.

20 MR. EGGAN: I have no objection.

21 MR. HAYNES: No objection.

22 JUDGE PATTERSON: No objection it will be  
23 admitted.

24 (Intervenor's Exhibit 138 received)

25 Q When we look at the analysis that you provided in G-1 and

1 explained in Exhibit 138, did you characterize as  
2 conservative or not conservative what you tried to do with  
3 respect to how the various technologies would treat the  
4 water?

5 A Yes, it was generally a conservative estimate. It was  
6 especially conservative with some of the metals up front.  
7 We were -- some of the metals, such as copper and mercury,  
8 we did not take any reduction through the hydroxide process.  
9 We understood that there would be a reduction through the  
10 process, but at the time of the application we were looking  
11 at groundwater limits and we did not need to account for  
12 that reduction, so we basically said it was not going to be  
13 treated through that process. After the -- you know, after  
14 we received the permit then surface water limits were put in  
15 place and the parameters of copper still met the surface  
16 water limits, but came a little bit closer to the limit  
17 value.

18 Q Okay. So you originally prepared these -- the numbers in  
19 Appendix G-1 based on the fact that you anticipated that the  
20 DEQ would apply groundwater discharge limits?

21 A Yes.

22 Q And there came a time during the -- after the application  
23 was submitted and before the actual permit was issued where  
24 that changed?

25 A Yes. Yes, surface water limits were proposed by the DEQ and

1 implemented.

2 Q In general surface water limits tend to be more restrictive  
3 than groundwater?

4 A In general, yes. They can be very much more restrictive.  
5 One example is copper. I believe, the groundwater limit was  
6 approximately -- would be approximately 700 micrograms per  
7 liter. The surface water limit was seven. Excuse me. The  
8 surface water limit was ten.

9 Q Okay. So between 700 and ten that was a difference in the  
10 limit that you had to meet in copper?

11 A That's correct.

12 Q Okay. So with the -- what you anticipated when you did  
13 Appendix G-1 and the amount of copper was there any need to  
14 treat -- to show a treatment in the clarifier metal  
15 hydroxide technology?

16 A There was not a need. The influent water -- influent  
17 wastewater concentration of copper going into the plant  
18 would have met the groundwater standard; would not have met  
19 the surface water standard. We knew we had additional  
20 treatment with the RO process that would reduce it to a  
21 level below ten, but we didn't need to account for the  
22 additional removal in the hydroxide process as a measure of  
23 conservativeness.

24 Q So the anticipation or the prediction was that it would be  
25 under ten going through just the RO, but -- and that was

1 much, much less than the groundwater standard you thought  
2 you'd have to meet?

3 A Yes.

4 Q It's about what the surface water standard is, as a matter  
5 of fact.

6 A Well, we're approximately 35 percent below the surface water  
7 standard.

8 Q But that's after using the metal hydroxide --

9 A No, that's after using just the RO.

10 Q Just the RO?

11 A With no account -- no reduction through the metal hydroxide  
12 process.

13 Q Were there any other of the contaminants that you didn't  
14 give any credit to in Appendix G-1?

15 A There were several others. Mercury was one that comes to  
16 mind.

17 Q Okay. So in that regard you -- that's why you conclude that  
18 this is a conservative look, G-1, as to what the processes  
19 would do to treat the water?

20 A Yes, even though we knew we would have a reduction through  
21 that process we didn't take credit for it in that  
22 calculation.

23 Q Is there anything else about what you designed that you felt  
24 was conservative in its design? How about the technologies  
25 used?

1 A Well, the technologies used are very mature technologies.  
2 They've all been around for many decades.

3 Q When you finished your work on Appendix G-1 did you have  
4 anybody review that work?

5 A Yes, we did. We had internal professional engineers to  
6 review that work at Foth. It was reviewed externally by  
7 industry experts. We had -- specifically we had looked --  
8 worked with Siemens US Filter one of the largest wastewater  
9 companies. And also it was reviewed by the MDEQ.

10 Q Okay. Did you also provide for the DEQ any information  
11 regarding the membranes that were going to be used or might  
12 be used in the reverse osmosis process?

13 A Yes, we did. That was a part of their request. Along with  
14 the calculations we provided some standard literature that  
15 shows what the rejection rate would be for various  
16 constituents or parameters in the water.

17 Q You've talked about the fact that at some point you were  
18 anticipating the groundwater discharge standards would be  
19 applied to the effluent from the wastewater treatment plant  
20 and the DEQ then advised you that they wanted surface water  
21 standards submitted; is that correct?

22 A That's correct.

23 Q did you ever have that happen before; have to face surface  
24 water standards for discharge?

25 A Oh, typically a groundwater discharge would be subject to

1 groundwater standards. I thought it was very unusual to  
2 have surface water standards, but that's the MDEQ's job.

3 Q Did that cause you to do anything in regards to the  
4 calculations you had made about the effectiveness of the  
5 treatment plant?

6 A Well, the -- as proposed in the groundwater discharge  
7 application, all the estimated effluents did meet the  
8 surface water standards. We came close on some of the  
9 parameters such as copper. I believe our estimate was seven  
10 and a half. The surface water standard we had to meet was  
11 ten on a monthly average. So it became a little closer to  
12 the surface water standards.

13 Q As a matter of prudent engineering techniques did you do  
14 anything?

15 A Yes. At that time we decided to run a treatability study on  
16 the wastewater.

17 Q Tell me what a treatability study is.

18 A A treatability study for a project like this would consist  
19 of generating synthetic wastewater to simulate the water  
20 entering the facility, physically running that water through  
21 all the unit operations, all the processes that we wish to  
22 model and then measuring what the effect of those unit  
23 operations are and then measuring what the actual effluent  
24 concentrations would be for each one of those parameters.

25 Q And is that shown on proposed Intervenor Exhibit 140, I

1 believe?

2 A (No verbal response)

3 Q Was there a report generated as a result of that?

4 A Yes, there was.

5 Q And where was the work done?

6 A The work was done by US Filter in Warrendale, Pennsylvania.

7 I was involved with the review of the procedures for that.

8 I made several trips to that site to witness the report --

9 or witness the testing, and then I also reviewed the report.

10 Q I've heard the term used as a bench scale test. Was this a

11 bench scale test?

12 A It's somewhat like a bench scale test. A bench scale test

13 typically would be inferred to be a smaller type of test.

14 This was a fairly large-scale test. Instead of using liters

15 of wastewater we would use hundreds of gallons of wastewater

16 and ran it through the system for extended durations.

17 Q When you say "extended durations," for how long?

18 A It was a couple weeks.

19 Q And approximately when was this test done?

20 A I would have to refer to the treatability study. It was --

21 I would have to refer to the study.

22 Q Subsequent to the time you submitted the application and

23 prior to the time the permit was issued?

24 A It was after we received the permit, I believe.

25 Q Would you be surprised if I told you the test was dated May

1           15, 2007, the test report?

2       A     The final test report? That sounds familiar.

3       Q     And do you know when the permit was issued?

4       A     I would have to look.

5       Q     Would you be surprised if it was December of 2007, seven

6           months later?

7       A     December --

8       Q     Of 2007.

9       A     Yeah, I would have to look. If that's what it is, that's --

10      Q     The court has knowledge of when the --

11      A     Sure.

12      Q     And the purpose of this was to do a test run of what you had

13           proposed in the wastewater treatment plant?

14      A     That's correct.

15      Q     And the influent that was used in the test -- treatability

16           test was similar in its constituents? Tell me what that

17           was, the influent.

18      A     The influent --

19      Q     The influent that you used in the treatability test.

20      A     It was assimilated wastewater we added that -- the

21           contaminants that were expected to be present in the

22           wastewater; in turn, the full-scale facility.

23      Q     And Siemens or US Filter ran this test over a period of

24           time; is that correct?

25      A     That's correct.

1 Q And you were involved in the design of the test?

2 A I was involved with the review of the design of the test,  
3 yes.

4 Q And you witnessed the test?

5 A Yes, I did.

6 Q And did you review the report?

7 A Yes, I did.

8 Q Can you tell me how the metal hydroxide process works?

9 A The metal hydroxide process removes metals based on  
10 solubility of the metal hydroxide. It removes metals to a  
11 common concentration, based on their solubility.

12 Q And did they run that test as part of the treatability test?

13 A Yes, they did.

14 Q And how did that -- how did it perform?

15 A It performed as expected but better than what was put into  
16 the application, 'cause we didn't take into account several  
17 of the -- several of the parameters, such as copper, for  
18 reduction.

19 Q Were you surprised adversely by any of the results of the  
20 metal hydroxide?

21 A No.

22 Q Was the same filtration process always run in the  
23 treatability test?

24 A Yes, it was run.

25 Q And did that perform as expected?

1 A Yes, it did. I think there was a little bit of an issue up  
2 front with some calcification, but it was corrected.

3 Q And how was that corrected?

4 A By adjusting the pH.

5 Q And was the RO process tested as well?

6 A Yes, it was.

7 Q And did you do the evaporator crystalizer test?

8 A No. We did not run the evaporator crystalizer test. It's a  
9 fairly straightforward -- produces a very high quality \*  
10 (3:05:58). It was not required to be tested.

11 Q And as a result of this test, did you draw conclusions about  
12 whether the wastewater treatment plan would meet the  
13 limitations imposed in the application -- or in the permit  
14 that was eventually issued by the state?

15 A Yes. The wastewater treatment plant as proposed would meet  
16 the discharge limit, permit limits.

17 Q I've placed up on the screen proposed Intervenor Exhibit  
18 140. Is that the report that was issued by Siemens Water  
19 Technology, Warrendale, Pennsylvania, regarding the  
20 treatment of simulated mine wastewater for the Kennecott  
21 Minerals Company dated May 15, 2007?

22 A Yes, it is.

23 Q That's the first page?

24 A Yes, it is.

25 Q It's a multi-page report?

1 A Yes, it is.

2 Q And that's the report of the testing that you've testified  
3 to; is that right?

4 A That's correct.

5 Q Why did you decide not to assimilate the evaporator  
6 crystalizer process or the CRP?

7 A Well, we did simulate the CRP in this. The evaporator  
8 crystalizer process is a relatively straightforward process,  
9 being that it produces distilled water which we could  
10 estimate what the purity was. There were not any issues  
11 with that process.

12 Q Have you read the testimony of Dr. Glenn Miller in this  
13 hearing?

14 A I've reviewed it, yes.

15 Q Did you notice that Dr. Miller apparently was unaware that  
16 you had done anything like this, have a test like this  
17 performed?

18 A That's the way it appeared.

19 Q This is in fact the kind of test that he seemed to be  
20 talking about in his testimony that should have been done?

21 A Yes, it is.

22 Q Were you aware, Mr. Fassbender, that the design of the  
23 wastewater treatment plant has been criticized by the  
24 Petitioners in this case who have hypothesized that  
25 concentrations in metals and other contaminants in influent

1 would be much higher than you predicted in Exhibit -- or  
2 Appendix G-1?

3 A Yes, I'm aware of that.

4 Q And that would also apply to the treatability test, would it  
5 not?

6 A That's correct.

7 Q You used the same parameters and the same numbers --

8 A Yes, we did.

9 Q -- in the treatability test? If Dr. Maest's hypotheses are  
10 valid and there are greater concentrations of these  
11 contaminants on the inflow side of the wastewater treatment  
12 plant, can you tell me what your opinion is -- do you have  
13 an opinion as to whether or not that will affect the quality  
14 of the effluent that comes out of the wastewater treatment  
15 plant?

16 A Yes. I've reviewed Dr. Maest's concentrations. If we  
17 receive those concentrations on the influent, they will have  
18 little effect of the metal effluent concentrations as  
19 estimated in the --

20 Q Now, did you use a particular flow, when you made your  
21 calculations, into the mine?

22 A We used -- for the mine inflow calculations we used 180  
23 gallons per minute.

24 Q And why did you choose that number?

25 A It was a mid-range number. We had looked at numbers ranging

1 from 75 gallons per minute up to 250 gallons per minute and  
2 assessed the change in concentrations based on those. But  
3 in the application the numbers reported were based on 180  
4 gallons per minute.

5 Q And Dr. Maest used what number?

6 A 75 gallons per minute.

7 Q Would the difference between using 180 as you did and 75  
8 change your opinion as to whether or not the wastewater  
9 treatment plan you've designed would handle the  
10 concentrations of metals that come into it?

11 A No, it wouldn't.

12 Q Concentration of contaminants, I should say.

13 A No, it would -- it would still handle the influent  
14 concentrations and meet the permit limits.

15 Q And that would be for all the permit limits?

16 A That's correct, all permit limits.

17 Q There's another criticism that's been leveled at the design  
18 of your wastewater treatment plant, Mr. Fassbender, and that  
19 is that it is -- not that the individual components thereof  
20 are novel or untested, but that in combination, the entire  
21 system that you have in the plant is novel. Had you heard  
22 that?

23 A Yes, I've heard that.

24 Q Did you read Dr. Glenn Miller's testimony in that regard?

25 A Yes, I did.

1 Q Do you agree or disagree with that criticism?

2 A No. Not only are the individual components very mature and  
3 well-tested, but as a group the metal hydroxide, the reverse  
4 osmosis and the evaporation components have been used in  
5 hundreds of facilities at similar or larger flow rates.

6 Q And what kind of facilities are they, that a combination of  
7 these processes is in use?

8 A They're used extensively in some of the heavy industries  
9 such as petroleum, such as power plants, chemical  
10 refineries.

11 Q Did you run into any used in the mining situation?

12 A I haven't.

13 Q Is there any reason you can believe that something that has  
14 been well-tested and well-used in other industries couldn't  
15 be used here?

16 A No.

17 Q And in these other uses are the flow rates into these  
18 industrial plants or wastewater treatment the kind of flow  
19 rates we are anticipated to have here, whether it's 250 or  
20 as much as 3,000?

21 A Yes, they're very large. There's very large systems and a  
22 lot of systems at similar sizes as proposed at the Kennecott  
23 Project.

24 Q Does it change your opinion at all, the criticism that  
25 nobody in the mining industry has used these processes in

1 combination as you've proposed to do in the wastewater  
2 treatment plant?

3 A No.

4 Q Another criticism that's been leveled at you is that this  
5 plant will have to be operated on a continuous basis, 24/7.  
6 Did you read the testimony of Dr. Glenn Miller in that  
7 regard?

8 A Yes, I did.

9 Q And do you have any opinion about that?

10 A Yes. At the average mine inflow the plant will operate less  
11 than six hours per day. At the maximum expected upper \*  
12 (3:14:01) mine inflow, the plant will operate approximately  
13 18 hours a day.

14 Q What's the lower inflow rate that you talked about?

15 A The 75 gallons per minute.

16 Q At 75 gallons per minute it will operate approximately six  
17 hours a day, seven days a week?

18 A That's correct.

19 Q And at 250 or 215?

20 A At 215.

21 Q 215 gallons per minute it will run how many hours per day?

22 A Approximately 18 hours a day.

23 Q Now, it's also been suggested that there's not enough  
24 redundancy, I guess is what I'd say, in the processes that  
25 you provided. How many RO units have you proposed for this

1 plant?

2 A There are three parallel trains of RO units.

3 Q How many sand filtrations?

4 A There are three parallel trains of sand filters also.

5 Q How about evaporator crystalizer?

6 A I believe we have one evaporator crystalizer system. But

7 it's --

8 Q How about the up-front metal hydroxide clarifier?

9 A We have a minimum of one specified in the application.

10 Q Do you feel uncomfortable with the fact that you only have

11 one evaporator crystalizer?

12 A No, I don't.

13 Q Why not?

14 A It's a very robust process; it's well-tested.

15 Q Are there a lot of moving parts to it?

16 A Evaporator crystalizer, there are moving parts to it, but

17 it's a very industrial -- it's a well-tested process.

18 Q How about the metal hydroxide clarifier process? You only

19 have one of those; is that correct?

20 A That's correct.

21 Q Are you concerned about that?

22 A No. That's basically a -- it's basically a tank with some

23 mixers, et cetera. It's not unusual for an industrial

24 facility to have a single unit on that. There's just not a

25 lot of down time with regards to a clarifier.

1 Q And the clarifier is the process which you've patented  
2 equipment \*(3:16:09); is that right?

3 A That's correct.

4 Q There's also been discussion that in your calculations that  
5 you ignored certain parameters, including temperature,  
6 concentrations of total organic carbon, total dissolved  
7 solids, suspended solids and alkalinity. Do you have a  
8 response to those criticisms?

9 A Yes. Those parameters were not ignored in the design of the  
10 system. Parameters such as temperature were just not  
11 regulated; they were not mentioned in the application. But  
12 they are important to the design of the -- to the system,  
13 and they were considered.

14 Q So how would you consider, for instance, temperature in some  
15 of the processes you used?

16 A We would -- one, we would anticipate a minimum temperature  
17 that would be close to freezing in the wintertime. We'd  
18 forward that information to the appropriate suppliers and  
19 have them build that into their equipment design.

20 Q Is that what you did with all of those parameters?

21 A Yeah; that's correct, yes.

22 Q So did you ever anticipate that someone would want you to  
23 report that as part of the application?

24 A No, I didn't.

25 Q But in any event was it taken into consideration in the

1 design process?

2 A Absolutely.

3 Q One last issue with respect to nitrates, the issue of  
4 nitrates. Are nitrates to be treated in this facility?

5 A Yes, they will be.

6 Q Did you take that into consideration? Or how did you take  
7 that into consideration?

8 A Well, with regards to nitrates, we had received the total  
9 nitrogen estimate on the influent. We had partitioned the  
10 total nitrogen in between ammonia and nitrates. As a  
11 conservative measure we recognized that nitrates were very  
12 easy to treat in the RO process, ammonia less so. So we  
13 partitioned the nitrogen totally to ammonia, recognizing  
14 that there will be probably equal amounts of nitrates and  
15 ammonia, based on the total --

16 Q And -- I'm sorry. I apologize for interrupting.

17 MR. EGGAN: Lack of foundation, your Honor. I  
18 don't think we know whether this witness has reviewed these  
19 kind of permits in the past or whether he has experience  
20 doing that. I'd like to know a little bit more.

21 MR. BRACKEN: I'll try to do that, your Honor.  
22 I'll rephrase, try to lay more foundation.

23 JUDGE PATTERSON: Okay.

24 Q Were you told why there was a differentiation by the DEQ as  
25 to -- between some that had limits and some that only had

1 reporting requirements?

2 A Yes.

3 MR. EGGAN: If we are about to hear what someone  
4 at DEQ said, that's going to be hearsay and I'm going to  
5 object on that basis.

6 MR. BRACKEN: I don't think it's hearsay in this  
7 regard. I think we're entitled to know what the DEQ says  
8 about this particular differentiation. And I will ask this  
9 witness about his understanding of it. And if it turns out  
10 his understanding of it is not the same as the MDEQ's, it  
11 will stand as being --

12 MR. EGGAN: I think he's going to be testifying  
13 and offering, as truth of the matter asserted, a statement  
14 uttered by someone else.

15 MR. BRACKEN: I'll ask the question and see what  
16 his understanding of it is, based on his conversations. And  
17 it will be up to the DEQ, and you'll be able to cross-  
18 examine them as to whether he's wrong in his assumptions. I  
19 don't think that's hearsay at all. It's his understanding  
20 of the permit.

21 JUDGE PATTERSON: If it's confined to his  
22 understanding --

23 Q You had conversations about that difference?

24 A Yes. There were conversations. I've also -- I've read some  
25 of the rules. Although I'm not an expert in effluent

1 limitation determinations, I have read the rules and  
2 understand them that way also.

3 Q What's your understanding of why those were treated  
4 differently?

5 A They were so much lower than -- the estimated concentrations  
6 were so much lower. There's a certain factor that they were  
7 lower than the -- any proposed limit that they did not  
8 require a limit.

9 Q And if those particular -- and you're talking about the ones  
10 that only require reporting?

11 A Yes.

12 Q And if those -- let me withdraw that. On Attachment 1 there  
13 are predicted levels of effluent?

14 A Yes.

15 Q If those contaminants that are listed as having only  
16 reporting requirement exceed what's on the attachment,  
17 Attachment 1, is there some way that a contaminant can be  
18 changed from a reporting requirement to something else, or  
19 that some action can be required by the DEQ?

20 A Yes. There's a -- if they exceed the levels in Attachment 1  
21 by I believe a factor of 5, it would be reported immediately  
22 to the DEQ or within a certain time frame, and the DEQ will  
23 take appropriate action.

24 Q Now, does the permit allow -- how does the permit deal with  
25 the fact of plans for this -- specific plans with respect to

1 the treatment plant?

2 A Final plans and specifications will be submitted to the DEQ  
3 for approval.

4 Q And can you start construction without that approval?

5 A No.

6 Q What happens once you construct the plant? Can you  
7 immediately go into use of the plant?

8 A No. We have to submit a --

9 Q Let me withdraw that. There was an issue raised by Dr.  
10 Glenn Miller about a plan of operation?

11 A Yes.

12 Q He criticized you because it wasn't provided in the  
13 application?

14 A An operations manual.

15 Q Yeah, operation --

16 A Yeah.

17 Q Do you have an opinion as to -- or a response to that?

18 A Well, I believe it's specified in the permit when an  
19 operations manual needs to be submitted to the DEQ. It  
20 would be fairly unusual to submit an operations manual with  
21 the permit application phase.

22 Q Until you find the final design is approved by the DEQ,  
23 would you be able to provide an operations manual?

24 A It would be difficult.

25 Q I'd like to direct your attention to page 16. Page 16,

1 beginning in the middle of the page at paragraph 12 says  
2 "Compliance Requirements." Do you see that?

3 A Yes.

4 Q Have you reviewed those before?

5 A Yes, I have.

6 Q What happens if the effluent from the treatment plant  
7 doesn't meet the requirements of the permit? Or what can  
8 happen?

9 A The plant can be shut down. Discharge will not occur.

10 Q Is that condition 10, "Close the facility or end the  
11 discharge that resulted in the application standard being  
12 exceeded"?

13 A Yes.

14 Q There are other provisions where you can, in "6," "Revise  
15 the operational procedures at the facility"?

16 A Yes.

17 Q "7. Change the design or construction of the wastewater  
18 operations at the facility"?

19 A Yes.

20 Q And "11. Remediate the contamination to comply with the  
21 terms of 201 if -- Part 201 if applicable"; correct?

22 A Yes.

23 Q Let me see if we can just turn our attention from that right  
24 now and -- Mr. Fassbender, and ask for kind of your final  
25 conclusions. Is it your opinion that the estimated effluent

1 from the treatment plant will meet all the limitations  
2 described in the application?

3 A Yes, it will.

4 MR. EGGAN: I guess I'm going to object. That's a  
5 purely leading question. I think if we're going to go  
6 forward, why don't we ask non-leading questions?

7 MR. BRACKEN: Well, you know, say but that is a  
8 leading question. I've watched several of the Petitioner's  
9 witnesses put their conclusions up on -- and read from them,  
10 and I don't think it's any different from this. All we're  
11 doing is restating conclusions he's already made, just to  
12 summarize what his testimony was in regards to those  
13 particular things. I don't think it's any different than  
14 what Petitioners have done throughout this trial in their  
15 case.

16 JUDGE PATTERSON: I'll let the answer stand. It  
17 was a leading question, --

18 MR. BRACKEN: Yeah, it is.

19 JUDGE PATTERSON: -- but he's answered it.

20 Q Do you have an opinion as to whether the estimated influent  
21 from the treatment plant -- or effluent from the treatment  
22 plant will meet all the standards set forth in the permit?

23 A The -- yes, I do. The estimated effluent will meet all the  
24 standards set forth in the permit.

25 Q And do you have an opinion as to whether the treatment plant

1 is designed conservatively to treat much higher  
2 concentrations of contaminants than predicted and to meet  
3 the permit discharge limits in those regards?

4 A Yes. The treatment plant can treat much higher  
5 concentrations of contaminants, particularly the metals, and  
6 meet the discharge limits.

7 MR. BRACKEN: I have no further questions at this  
8 time, your Honor. It's 3:30. We might want to take a  
9 break.

10 JUDGE PATTERSON: I do.

11 (Off the record)

12 MR. BRACKEN: Your Honor, I talked to Mr. Egan, I  
13 would like to move before he starts and interrupt him,  
14 Exhibit -- proposed Exhibit 138, the nickel report,  
15 calculation for nickel that he had testified to.

16 MR. EGGAN: You know, I looked through my notes.  
17 My notes indicate that 138 was admitted.

18 MR. HAYNES: So do mine.

19 MR. BRACKEN: Okay. I'm sorry then. I'm better  
20 than I thought I was.

21 JUDGE PATTERSON: It's Intervenor 138?

22 MR. BRACKEN: Okay. Thank you.

23 MR. HAYNES: Right.

24 MR. REICHEL: Your Honor, at this time I don't  
25 have any questions for the witness, but I reserve the right

1 to ask questions based upon the cross-examination.

2 MR. EGGAN: Very good. I think I'll begin with  
3 the cross-examination. Mr. Haynes, is that plan okay with  
4 you and Mr. Wallace?

5 MR. HAYNES: That's fine with me.

6 MR. WALLACE: Yes, sir.

7 MR. EGGAN: Okay. Good. Mr. Fassbender, I'm Eric  
8 Egan. I represent the Keweenaw Bay Indian Community and  
9 the Petitioners in this matter primarily in the Part 31  
10 permit application, part of this matter. And I've got some  
11 questions for you, at least in the beginning, regarding the  
12 groundwater discharge permit application and the assumptions  
13 that you applied in creating the wastewater treatment plant  
14 and the TWIS. Okay?

15 CROSS-EXAMINATION

16 BY MR. EGGAN:

17 Q Now, it's my understanding that the wastewater treatment plant  
18 was sized to infiltrate -- excuse me. The treated water  
19 infiltration system was sized to infiltrate something like  
20 400 gallons per minute.

21 A Yes.

22 Q Okay. And the wastewater treatment plant is presently sized  
23 to accommodate up to 350 gallons per minute in treatment  
24 capacity?

25 A Yes.

1 Q Okay. The maximum flow rate used to size the wastewater  
2 treatment plant is 350 gallons per minute?

3 A Correct.

4 Q And this is all based on an expected inflow rate into the  
5 mine of 700 -- excuse me -- of 75 gallons per minute on a  
6 sustained basis?

7 A It's based on a range of between 75 and 215 gallons per  
8 minute of mine inflow. I --

9 Q Well, let me ask the question maybe a little more artfully.  
10 What are the assumptions that you applied in designing the  
11 system? Was an expected flow rate of water into the mine at  
12 approximately 75 gallons per minute on a sustained basis as  
13 described in the technical memorandum from Golder  
14 Associates, Limited contained in Appendix E-1 of the  
15 application? Do you read that? Do you want to read that  
16 sentence?

17 A Yes. 75 was the minimum on the range expected, 75 to 215.

18 Q Okay. Well, I guess what I'm going for is the expected  
19 inflow rate on a sustained basis was predicted by Golder to  
20 be 75 gallons per minute.

21 A I would have to read the memo. I'm not --

22 Q Okay. Well, let's take a look at it. I'm going to show you  
23 what is a page from MDEQ Exhibit 141. It is a report from  
24 Foth & Van Dyke, page 14, MDEQ Bates number 010658. And  
25 here's the line I'm referring to right here (indicating):

1                   "The expected inflow rate of water to the mine  
2                   will be approximately 75 gallons per minute on a  
3                   sustained basis as described in the technical  
4                   memorandum from Golder Associates Limited contained in  
5                   Appendix E-1."

6       A       Yes.

7       Q       Okay.  Again, these are the assumptions that you applied in  
8                   designing the wastewater treatment plant?

9       A       Correct.

10      Q       Okay.  The inflow assumptions?

11      A       Yes.

12      Q       Okay.  And I think we covered this, but I want to make sure  
13                  the TWIS was sized to infiltrate at least 400 gallons per  
14                  minute.

15      A       Maximum 400 gallons.

16      Q       A maximum of 400 gallons per minute?

17      A       Yes.

18      Q       Okay.  And the system you presented to the Department of  
19                  Environmental Quality was based on these inflow rates?

20      A       Could you specify "these"?

21      Q       All of the rates that you and I just talked about.

22      A       It was based on 75 to 215 mine inflows.

23      Q       And as high -- let's be fair to you.  It's as high as 350  
24                  gallons per minute because of precipitation events, et  
25                  cetera.

1 A On total capacity of the treatment system.

2 Q All right. Good. And, again, the system you presented to  
3 the Michigan Department of Environmental Quality was based  
4 on that assumption in terms of inflow?

5 A I'm sorry. That was a question? "That assumption" being?

6 Q Well, let me -- let me just say it again.

7 A I'm confused with the --

8 Q The system that you presented to the Michigan Department of  
9 Environmental Quality, the wastewater treatment plant, the  
10 TWIS, the contact water basins all were based on the inflow  
11 rates that we just talked about?

12 A Groundwater inflow into the mines, 75 to 215 were the  
13 expected inflow. We actually within the water balance  
14 increased it conservatively up to 250 gallons per minute  
15 inflow.

16 Q Understood.

17 A And that was used in the basis of the design of the  
18 treatment system.

19 Q Okay. My point to you is, you didn't consider an inflow  
20 rate and did not size the system based on inflow rates that  
21 would exceed 500 gallons per minute?

22 A Correct.

23 Q Or 600 gallons per minute?

24 A Correct.

25 Q Or 7-?

1 A Correct.

2 Q Or 3,000?

3 A Correct.

4 Q And in terms of the water quality that is coming into the  
5 wastewater treatment plant itself, the wastewater treatment  
6 plant is "tailored" -- and I'm putting quotations around the  
7 word "tailored" -- to the water coming from the mine, isn't  
8 it?

9 A It's designed for the water coming from all the different  
10 sources.

11 Q But it's also -- it's also tailored as to the water quality?

12 A That's a factor in the design of the treatment system.

13 Q Okay. It's intended to treat water at the quality that you  
14 have predicted.

15 A It's intended to treat a range of water quality. We  
16 predicted values for the parameters, but we've looked at  
17 ranges of those values and understand the implications.

18 Q Understood. Understood. But it's based on certain  
19 assumptions that you have made?

20 A Yes.

21 Q And based on assumptions that you have made and input  
22 provided by geo folks from -- that were here testifying this  
23 morning, geochemists and hydrologists, all of those people.

24 A Yes.

25 Q And you put together the system that was presented to the

1 Michigan Department of Environmental Quality based on these  
2 assumptions?

3 A Yes.

4 Q Now, I want to talk to you for a moment about the components  
5 of the wastewater treatment plant that you and Mr. Bracken  
6 talked about a few minutes ago. Okay? This is a sequential  
7 system, isn't it?

8 A Yes, it is.

9 Q In other words, you couldn't take the influent and pull one  
10 of the components out and just treat it with just that.

11 A It's designed to be treated as a system.

12 Q Okay. And it's designed to be treated first by the  
13 precipitation step. Next it goes to the series of  
14 filtrations. Then it goes to the first-run reverse osmosis  
15 and so on. It's designed to treat water as it arrives at  
16 each one of those sequences in that sequential order, isn't  
17 it?

18 A That's correct.

19 Q Okay. And as I understand it -- and I want to make sure  
20 that I do understand the steps that this water is going to  
21 go through. It's first going to go through a precipitation  
22 step?

23 A Correct.

24 Q And then it's going to go through a series of filtrations?

25 A It goes through a gravity filtration process.

1 Q Okay. Very good. And then the first-run reverse osmosis?

2 A Correct.

3 Q And then there is -- then there is a reject water diversion

4 to another treatment area?

5 A Yes.

6 Q And then you're going to raise the pH in that remaining

7 water?

8 A Which water?

9 Q In the first water, in the --

10 A The permeate from the RO pass?

11 Q Yes.

12 A Yes.

13 Q And then it's going to go through a second-run reverse

14 osmosis?

15 A Yes.

16 Q Okay. Good. So those are the steps that we're talking

17 about. Now, my question for you is this: Can you tell me

18 the name of a hard-rock mine in the world that has a

19 sequential system that treats waters like this in this

20 particular sequence using this technology?

21 A Not a mine.

22 Q Not a mine. Okay. Well, when we talk about the term

23 "novel," in the hard-rock mine industry, we can agree that

24 this is a novel system; am I right?

25 A This system has been used in hundreds of similar types of

1 wastewater.

2 Q I heard you say that, and it may have been used to treat cow  
3 manure, but I'm talking about hard-rock mines. Tell me the  
4 name of one mine on earth that treats water in this sequence  
5 using these components.

6 A I don't know of any.

7 Q And you really can't tell me of a mine in the world, can  
8 you, that uses a reverse osmosis system to treat water 24  
9 hours a day, seven days a week, can you?

10 A The system as designed at average flow is to treat the water  
11 for six hours a day.

12 Q Why don't we answer my question? Can you tell me the name  
13 of a mine in the world that treats this kind -- and  
14 hard-rock mine, that treats this kind of water on a  
15 24-hour-a-day, 7-day-a-week basis?

16 A No, I can't.

17 Q Okay. Now, you talked about -- you talked about the fact  
18 that this mine may not operate or this particular wastewater  
19 treatment plant may not operate 24 hours a day. And I think  
20 you said 18 hours a day if the inflow is 250 gallons per  
21 minute.

22 A Correct.

23 Q Okay. But if the inflow rate is substantially higher than  
24 that, you're going to have to operate it more hours than  
25 just 18 hours, aren't you?

1 A At 215 gallons per minute it will operate for about 18 hours  
2 a day. At higher inflows it will operate at higher  
3 durations.

4 Q And if it's 350 gallons a day -- or gallons per minute, I  
5 assume it's going to be 24/7?

6 A That's the design of the facility is 350 --

7 Q That's the design capacity of this facility is 350 gallons.  
8 So I assume that if there are 350 gallons a minute coming  
9 into the system, you're going to have to operate 24 hours a  
10 day, 7 days a week.

11 A Correct.

12 Q And if that system sees an inflow that is 700, 800, 900,  
13 there aren't enough hours in the day, are there?

14 A The system is designed for 350 gallons per minute.

15 Q Now, you talked about other industries. What other industry  
16 can you identify that has the acid-rock drainage that we're  
17 looking at with this particular site?

18 A It's unique to mining.

19 Q It is unique to mining. What other industry can you tell us  
20 about that had acid-rock drainage and the metals that are  
21 predicted to be in this influent and has to treat them?

22 A I believe acid-rock drainage is unique to the mining  
23 industry.

24 Q Okay. And if you add copper and nickel to that equation,  
25 that even makes it more unique.

1 A Copper and nickel are treated by chemistry and solubility.  
2 Q But not in combination with acid-rock draining or acid  
3 itself.  
4 A That's not an issue with a system that uses a reagent such  
5 as lime.  
6 Q Did you visit other mines in the country to analyze the  
7 effectiveness of this particular wastewater treatment plant  
8 system?  
9 A No, I haven't.  
10 Q You did not? You didn't visit any other mines?  
11 A Correct.  
12 Q Did you conduct a study of other mines and the kinds of  
13 influent that they see?  
14 A I don't know if it was a formal study. There was certainly  
15 a review and discussions and a search of other facilities.  
16 Q And again, none of your searches ever uncovered a plan like  
17 the one that we have in place proposed for the Kennecott  
18 Eagle Mine Project?  
19 A That's correct.  
20 Q I want to look and if you have it in front of you -- do you  
21 have Exhibit 138, Intervenor Exhibit 138 in front of you?  
22 A I'm not sure which one that is.  
23 Q Okay. Well, I'll show you. This was the treatment plant  
24 treatment calculation for nickel.  
25 A Yes, I have that.

1 Q Okay. I'd like to look at page 2. Okay?

2 A Okay.

3 Q And I believe on page 2 we're talking about estimates in  
4 terms of what the permeate concentration is going to look  
5 like after various elements within the wastewater treatment  
6 plant system; am I right?

7 A That is correct.

8 Q Okay. And what I want to do is invite your attention to  
9 the -- it's down here at the bottom of the page, "Estimate  
10 first pass RO permeate concentration." Well, we're talking  
11 about what's going to happen as the water goes through the  
12 first-run reverse osmosis. Okay?

13 A Okay.

14 Q Now, what I'm seeing is that you have a section here titled  
15 "Basis." See that section? And right below that and to the  
16 right there is an estimate of the recovery, the recovery  
17 that's going to happen as a result of this particular  
18 treatment; am I right?

19 A Yes.

20 Q Okay. And what I'm seeing here is that you apply a recovery  
21 rate of 75 percent. Now, is that based on your experience  
22 in the industry?

23 A I've worked on other projects where that is a common  
24 recovery rate. I --

25 Q Well, what does it say here -- what does it say here in

1           parentheses next to that percentage?

2       A     The equipment manufacturer's recommendation.

3       Q     So you're basing that 75 percent recovery on equipment

4           manufacturer's recommendation?

5       A     And other bases.

6       Q     Well, it does say "and other bases." It says "equipment

7           manufacturer's recommendation." That's what I see. Do you

8           see anything else? Is there some other reference?

9       A     Well, my personal experience and personal knowledge of

10          rejection rates.

11       Q     Okay. But it doesn't say --

12       A     No, it doesn't say --

13       Q     It doesn't say that.

14       A     It does not say anything else.

15       Q     Okay. It says, "Equipment manufacturer's recommendation."

16          Now, you've bought products before, haven't you? Obviously.

17          We all go -- we all go to the store. We buy products.

18       A     Yes.

19       Q     Did you ever buy a product where the equipment

20          manufacturer's recommendation may not have been as accurate

21          as it could have been? They're trying to sell a product;

22          right? Right?

23       A     I guess I'm not understanding how this pertains to

24          wastewater process equipment.

25       Q     Well, let's move on to the second reference, second-pass RO

1 permeate concentration on page 3. Okay? There we have a  
2 recovery rate of 85 percent.

3 A Yes.

4 Q Okay? And that is based on equipment manufacturer's  
5 recommendation for the second pass; right?

6 A Yes.

7 Q So what we're doing is, we're really not -- you indicated  
8 that you applied some sort of conservative approach here.  
9 But your conservative approach was really based on the  
10 equipment manufacturer's recommendation as to what they said  
11 it would do.

12 A No.

13 Q Well, let's go to the -- let's go to the next one, "Estimate  
14 concentration reduction process, CRP RO permeate  
15 concentration." And this is on page -- what? -- 4 of 5. We  
16 have a recovery rate here of 84 percent.

17 A Yeah.

18 Q Is that what it's showing?

19 A Yes.

20 Q And it's based on -- that 84 percent is based on the  
21 equipment manufacturer's recommendation for CRP; right?

22 A Yes.

23 Q And here we have a rejection rate of 97.7 percent and we  
24 have a reference again to equipment manufacturer's  
25 recommendation for second pass; right?

1 A Yes.

2 Q Okay. And you suggest that your analysis applied some  
3 conservative approach, but what it really did was, for all  
4 of the reverse osmosis treatment systems involved in this  
5 project, you based it on the equipment manufacturer's  
6 recommendation, didn't you? That's what it says.

7 A The equipment manufacturer at this stage of a project is  
8 typically conservative.

9 Q So we're just supposed to assume that whatever they say is  
10 conservative and -- that's your suggestion?

11 A The conservativeness that we were referring to earlier was  
12 specifically in regard to the up-front metals precipitation  
13 process where we did not account for the precipitation of  
14 metals such as copper and mercury.

15 Q I want to talk to you about treatment study, the treatment  
16 study that you did. Now, as I understand it, that certainly  
17 isn't based on the amount of inflow you're going to be  
18 seeing in this particular mine. In other words, you're  
19 not -- you're not dealing with the volume that will be  
20 occurring at this particular mine; am I right?

21 A The study is based on the estimated concentrations.

22 Q It's based on the estimated concentrations?

23 A Yes.

24 Q And what you're doing is you're doing testing based on  
25 estimated concentrations that you provide?

1 A Yes.

2 Q And again, it's based on the estimated concentrations that  
3 you provided in the chart that you showed us on the screen a  
4 few minutes ago.

5 A I'm not sure which chart you refer to, but it's based on one  
6 of the charts that's provided.

7 Q I'm thinking of the one that had the yellow lines on it.

8 A That's correct.

9 Q That's the one. Okay. All right. So you didn't test it on  
10 the basis of concentrations that, say, Dr. Maest would have  
11 suggested could occur as influent?

12 A It was not tested, but that's -- the chemistry and the  
13 solubility --

14 Q It wasn't?

15 A -- and project experience, there's a clear understanding  
16 that these types of metals will precipitate to a common  
17 level in a clarifier to clear industry understands (sic),  
18 clear personal knowledge understanding, and it's a clear  
19 chemistry understanding.

20 Q Would the answer to my question then be "yes"?

21 A Could you restate the question?

22 Q Sure. It wasn't based on the calculations of influent that  
23 Dr. Maest suggested could occur?

24 A Correct.

25 Q Okay. You really can't tell us, can you, with a reasonable

1 degree of scientific certainty -- you're a scientist, I take  
2 it. You're a scientist?

3 A I'm an engineer.

4 Q Okay. You can't tell us with a reasonable degree of  
5 scientific certainty whether this particular system is going  
6 to work as predicted, can you?

7 A I can tell you it will work as predicted.

8 Q You can't tell us that it's going to work at the levels or  
9 at the inflow levels that are predicted by Dr. Prucha, can  
10 you, with a reasonable degree of scientific certainty.

11 A Could you restate those inflow levels that Dr. Prucha  
12 mentioned?

13 Q 3,000 gallons per minute.

14 A The system is designed for 350 gallons per minute.

15 Q Now, if we can, let's switch gears for just a minute and  
16 talk about your resume, which I hope I can find here among  
17 my stuff. Here it is. Now, I'm looking at your resume, and  
18 I'm seeing, beginning with "Introduction," and then  
19 "Relevant Experience," and then one of the references you  
20 offered is the Nicolet Minerals Company. And that's the  
21 mining project that you worked on, the Crandon Mine you  
22 mentioned earlier. Did you work on that project?

23 A Yes, I did.

24 Q Okay. And then down below that it says, "Mining, Wastewater  
25 Treatment." That too there's a lead process engineer for

1           permitting activities pertaining to wastewater treatment for  
2           a proposed metallic mine. Are we referring there to your  
3           experience here?

4        A     It may be. I would have to look at that.

5        Q     Okay. Well, it could also be Crandon, though, couldn't it?

6        A     The NMC and Crandon are the same project.

7        Q     Yeah. The Nicolet Mine Minerals Company in Crandon are the  
8           same project?

9        A     Yes.

10       Q     And that's one mining experience?

11       A     Correct.

12       Q     And then Eagle is another mine experience?

13       A     Correct.

14       Q     Okay. But reviewing, Crandon was never operated; right?

15       A     Is that a question?

16       Q     That is a question.

17       A     That's correct.

18       Q     So Crandon was never operated. The wastewater treatment  
19           plant that -- did you design it?

20       A     I was the lead process engineer for the wastewater treatment  
21           system.

22       Q     Okay. Never operated, never permitted; am I right?

23       A     That's correct.

24       Q     Okay. Likewise, Eagle, never operated; am I right?

25       A     No, it's not operating.

1 Q And never permitted -- no, I shouldn't say that. It has  
2 been permitted, but it's never operated.

3 A Correct.

4 Q And you don't have any other mining wastewater experience  
5 other than that?

6 A I don't believe so.

7 Q Well, think about it. Is there more?

8 A I've been on dozens and dozens of projects. I don't  
9 believe -- I may have been to a mine with regards to  
10 wastewater treatment. I've been on dozens of metals removal  
11 projects. I do not -- I cannot recall a specific mine  
12 project.

13 Q No other mine projects?

14 A No, other mine projects.

15 Q And never written any papers or any peer reviewed studies of  
16 mining activities --

17 A Correct.

18 Q -- or wastewater treatment plant options for mining  
19 activities?

20 A Correct.

21 Q At Crandon the wastewater treatment plant was never actually  
22 built, was it?

23 A It wasn't built.

24 Q Never got beyond the blueprint stage?

25 A Correct.

1 Q Now, the Crandon Mine was a zinc, copper orebody in  
2 northeast Wisconsin, wasn't it?

3 A I believe so.

4 Q Well, you were the lead project engineer. Was it?

5 A I --

6 Q What were the constituents? What were they --

7 A I believe it was -- zinc and copper were the main. There  
8 were multiple -- there were multiple metals, but I believe  
9 zinc and copper were the main one.

10 Q And you were the lead -- what do you call yourself? The  
11 lead process engineer for Crandon?

12 A Correct.

13 Q And you predicted the chemistry of the water to be treated  
14 at Crandon, didn't you?

15 A Yes, I did.

16 Q And the primary constituent of concern there I assume would  
17 have been, again, a metal, zinc?

18 A I cannot say without refreshing myself. I don't recall zinc  
19 as being a primary constituent.

20 Q Well, this was a zinc mine.

21 A Yes. With regards to a primary constituent, it would also  
22 have to do with the effluent limits. Zinc may have been  
23 predominant on the influent, but it may have been easily  
24 treated in other parameters such as copper, mercury may have  
25 been of primary concern, not necessarily on a mass basis but

1 on a treatment or concentration basis.

2 Q Okay. Can you give me a sense of whether the water here is  
3 more or less challenging than the water at Crandon?

4 A I believe they're similar, similar aspects.

5 Q Now, I want to talk to you about the design of that system  
6 of Crandon. Okay? That was a system that was designed --  
7 what? -- in the 1990's?

8 A I was involved with the project I believe from 1998 to 2002,  
9 thereabouts. I would have to check the exact dates.

10 Q Well, give me an estimate as to when you think the  
11 wastewater treatment plant was designed at Crandon.

12 A I was involved with the project starting in the start of  
13 1998.

14 Q Was it designed already by the time you got there?

15 A A portion of it was. The metals removal it went  
16 extensively, the reverse osmosis process. The evaporation  
17 process was added after I was there.

18 Q Well, one of the things that I wanted to ask you about --  
19 and this has sort of stimulated my interest. The wastewater  
20 treatment plant at Crandon -- okay? -- that had lime  
21 precipitation, didn't it?

22 A Yes.

23 Q Just like we have here.

24 A Yes.

25 Q It had a clarification system, didn't it?

1 A Yes.

2 Q Just like we have here; right?

3 A Yes.

4 Q The reverse osmosis, first stage.

5 A Correct.

6 Q Just like we have here; is that right?

7 A Correct.

8 Q It had a second-stage reverse osmosis system, didn't it?

9 A Yes, it did.

10 Q Just like we have here.

11 A Correct.

12 Q Likewise, it had a pH adjustment process that was  
13 incorporated?

14 A Yes.

15 Q More or less like we have here?

16 A I believe so, yes.

17 Q Now, at Crandon you had been provided with a predicted  
18 inflow there too, hadn't you?

19 MR. BRACKEN: Your Honor, I'm going to object to  
20 the line of questioning. I don't know where we're going  
21 with this.

22 MR. EGGAN: Well, I think we're going to see in a  
23 moment where I'm going.

24 MR. BRACKEN: Well, that may be, but the question  
25 is whether it's relevant to Kennecott Eagle Mine which is

1           why we're here. It seems to me that we didn't raise this in  
2           our -- we didn't raise this in our direct testimony in this  
3           regard. And he can talk about it as to his qualifications,  
4           but if he's going to start saying -- start making -- trying  
5           to say there's similarities and therefore something happened  
6           that somehow impacts the decision here, I think that's  
7           irrelevant. He hasn't laid foundation why it would be  
8           relevant.

9                       MR. EGGAN: Well, your Honor, frankly, --

10                      MR. BRACKEN: Otherwise we're going to go --

11                      JUDGE PATTERSON: Let him finish.

12                      MR. BRACKEN: Otherwise we're going to go off into  
13           a -- I assume we could go off into any other mine without  
14           establishing a foundation that it's similar and it has  
15           relevance to the design of this plant. And we already know  
16           that the design of this plant that -- it hasn't been built  
17           yet and it hasn't been operated yet, and he's answered that  
18           he's never seen it before. So I don't know where we're  
19           going. I think we're wasting our time this afternoon.

20                      MR. EGGAN: Well, I don't want to waste time, your  
21           Honor, however, I would like a little bit of leeway to ask a  
22           few more questions, and I think the relevance on this issue  
23           will become clear. But I would note that this witness in  
24           direct examination testified that the Crandon situation was  
25           very similar to this one. And so, in my view, they opened

1 the door on this issue.

2 JUDGE PATTERSON: I agree. You can go ahead.

3 MR. EGGAN: Thank you.

4 JUDGE PATTERSON: I think I know how you're going  
5 to make it relevant too.

6 Q Your initial inflows at Crandon, they were based on  
7 recommendations by hydrologists just like they are here;  
8 isn't that right?

9 A I believe so. That was -- it was ten years ago.

10 Q Okay. Well, as I understand it, the inflow rate there at  
11 Crandon was 600 gallons per minute, wasn't it?

12 A I can't recall. That was ten years ago. I would have to --  
13 I can't recall.

14 Q All right. Let's refresh your recollection then. I'm going  
15 to show you a document from the Nicolet Minerals Company and  
16 see if this refreshes your recollection as to inflows at the  
17 Crandon Mine. "Selected an average inflow rate of 600  
18 gallons per minute as the design basis for construction and  
19 operation of the wastewater treatment facilities."

20 A Yes. My only comment is -- that's what it says, "600  
21 gallons per minute," but I know there are a lot of changes  
22 and a lot of revisions, so I don't know if that was the  
23 current or the early one or the final. I just can't recall.

24 Q Well, the basis of the -- this document suggests that the  
25 basis of design --

1                   MR. BRACKEN: Wait a minute. Wait minute. I  
2                   object, your Honor. The question was, "Can I refresh this  
3                   witness' recollection?" He said, "It was ten years ago.  
4                   I'm not sure." Now he said, "It doesn't refresh my  
5                   recollection, and the problem is that there were changes."  
6                   So he can't read into the record a hearsay document if this  
7                   person doesn't have any --

8                   MR. EGGAN: Good point. I'll withdraw that part  
9                   of it.

10            Q     Is your recollection refreshed? Was it 600 gallons per  
11            minute?

12            A     I really can't recall.

13            Q     All right. Well, let's see if you can recall that the  
14            Wisconsin Department of Environmental Quality told Foth &  
15            Van Dyke that they had to increase the inflow rate up to  
16            1200 gallons per minute? Do you remember that?

17            A     No, I don't.

18            Q     You have no recollection of that at Crandon?

19            A     No, I don't.

20            Q     It wasn't important to you that --

21                   MR. BRACKEN: Objection to that characterization.

22                   JUDGE PATTERSON: That's argumentative.

23            Q     Was it important to you that they had increased the inflow  
24            from 600 to 1200?

25            A     I can't recall that specific recommendation.

1 Q Do you recall that Crandon was told it needed to go back and  
2 what I should say is the Nicolet Minerals Company was told  
3 to go back to the drawing board and redesign the system to  
4 accommodate an additional inflow rate?

5 A I was involved with the project as a wastewater engineer. I  
6 was involved in a certain portion of the project. There  
7 were other people that had interfaces with the Wisconsin DNR  
8 and with the communications with the company. I had a  
9 specific part and it was not to deal with -- not to -- it  
10 was to treat the water.

11 Q I thought your -- I'm going by your resume and what you told  
12 me. I thought your resume said you were the lead process  
13 engineer for permitting activities pertaining to wastewater  
14 was a proposed metallic mine. "Participated in preliminary  
15 wastewater treatment facility design."

16 MR. BRACKEN: Are you talking about the reference  
17 to the Nicolet Mine or to this mine?

18 MR. EGGAN: Well, I asked him that, and he thought  
19 it related to Crandon.

20 A Is there a question?

21 Q Yeah. Were you the lead process engineer for that mine?

22 A Yes, I was.

23 Q Okay. And one of the responsibilities that a lead process  
24 engineer has is participation in the preliminary wastewater  
25 treatment facility design.

1 A I believe what you're getting at was the flows changed. The  
2 process engineer receives the flows, you know, such as from  
3 the hydrologist or any change from a regulatory agency, and  
4 I would implement that into a design change.

5 Q And you're suggesting that you have no recollection  
6 whatsoever of the Wisconsin Department of Environmental  
7 Quality requiring the Nicolet Mine Company to increase the  
8 size of the design of the wastewater treatment plan based on  
9 adjusted inflows?

10 A I don't recall that.

11 Q Do you have any reason to think that it didn't happen?

12 MR. BRACKEN: Objection, your Honor. I think  
13 that's an improper question. He has no recollection of it.  
14 He doesn't have any recollection. He doesn't have any  
15 recollection and what Mr. Egan is trying to do is now  
16 testify as to something that happened that he has no  
17 recollection of. I hope he can get around that problem he  
18 has in that way.

19 MR. EGGAN: I don't think it's -- frankly I don't  
20 think it's a problem at all.

21 Q But if you don't recall, we'll move on. At Crandon what did  
22 they call the treated water infiltration system at Crandon?  
23 Was it called an SAS, a surface absorption system?

24 A That sounds familiar. I'm not sure that's the -- it sounds  
25 familiar. I can't be sure.

1 Q At Crandon as water left the wastewater treatment plant it  
2 went into a treatment lagoon, didn't it, before it went into  
3 the land application system?

4 A I would have to refresh myself with the documents. I've  
5 worked on a lot of treatment systems and that was, like I  
6 say, ten years ago.

7 Q Well, let me show you, and maybe this will refresh your  
8 recollection and maybe it won't. This says, "Nicolet  
9 Minerals Company."

10 A This was -- yes.

11 Q Okay. Now, do you see -- do you see something that's called  
12 a discharge lagoon?

13 A If -- there's a document that's dated May of '95 before I  
14 was involved with the project with a discharge lagoon stated  
15 there.

16 Q Okay. And that was prior to going into the soil absorption  
17 system, the SAS?

18 A On this document.

19 MR. BRACKEN: Objection, your Honor. I'm going to  
20 object to him asking him questions now about -- from a  
21 document from three years before he even worked on the  
22 project which is his testimony. Ten years ago puts him at  
23 1998. Now he's asking him about what a document in 1995  
24 says about another mine. I mean, we're getting so  
25 attenuated, there's no foundation that he knows anything

1           about this, so how can he answer questions about it? Now  
2           he's going to answer questions about documents that were  
3           prepared before he was involved in the process.

4       Q     Do you recall it?

5       A     I don't recall the specifics of the project. I recall the  
6           generalities of the project.

7       Q     Well, do you recall that --

8       A     It looks familiar, but that document was created three years  
9           before I started with Foth.

10      Q     But you recalled all of the various elements of the  
11           wastewater treatment plant.

12      A     I was intimately involved with those elements of the  
13           wastewater treatment plant.

14      Q     I see. As inflows increase in a wastewater facility like  
15           the one that you've created or as -- let's use this as an  
16           example: As inflows increase into the Kennecott Eagle  
17           wastewater treatment plant, as inflows increase, there is an  
18           expectation there will be a need for additional maintenance  
19           of the system.

20      A     Could you restate the question?

21      Q     Sure. As inflows increase, there will be a need for  
22           additional maintenance of that system to assure that it's  
23           working properly; am I right?

24      A     Not necessarily. You know, some equipment is based on hours  
25           of operation. Some equipment is based on time duration.

1 Q Okay. Well, reverse osmosis and the membranes that are  
2 involved, as use increases, as flow increases, there will be  
3 a need to clean those membranes more frequently, won't  
4 there?

5 A Not necessarily.

6 Q Well, what are those membranes -- what is the maintenance  
7 schedule for membranes in a reverse osmosis system?

8 A Well, with regards to -- I don't have precise knowledge with  
9 regards to that, but there may also be a factor with mass  
10 loadings as flows increase the mass loading may not increase  
11 because they get diluted. The maintenance schedule for  
12 reverse osmosis system may be mass related also as much as  
13 flow related. I don't have specific detailed knowledge of  
14 that.

15 Q What if the mass loading was increased? Would there be an  
16 additional need to clean or to even replace the membrane  
17 system?

18 A I would be speculating. I would anticipate that there -- as  
19 you have higher flows and masses that there would be some  
20 level of increased maintenance. It's not a given though.

21 Q You're not sure?

22 A That's correct.

23 Q I don't know that you could tell me the brand or the  
24 specific manufacturer that would provide the membranes for  
25 this particular system, but could you tell me the kind of

1 membrane that is going to be used?

2 A I can't offhand.

3 Q Who would you have to talk to about it?

4 A I would have to consult with a --

5 Q Manufacturer's representative?

6 A I would have to consult with the manufacturer of the RO

7 system.

8 Q And if a membrane fouled and needed to be replaced, how

9 quickly do you think you could get a replacement membrane?

10 A I would have to consult a -- I don't know offhand.

11 Q How large are the membranes that we're talking about here?

12 Are there varying sizes?

13 A There are varying sizes. I'm trying to recall. I've seen

14 some documents with regards to the sizes of the membranes on

15 the order of their -- let's say a couple tables put together

16 for each one. I'm not sure. I really would have to look at

17 some additional data to give you a firm answer on that.

18 Q Okay. So you don't know?

19 A I've seen it. I just don't recall it.

20 Q What kind of biotics are you going to use in the system?

21 Have you made that determination?

22 A Not the precise BIOX or biotics or --

23 Q All right. And who do you have to talk to about identifying

24 the biotics for that system?

25 A Well, typically a system such as a reverse osmosis system is

1 a fairly specialized system, and the expertise, you know,  
2 for a detailed selection of components like that would like  
3 with the reverse osmosis system vendor. Upon final  
4 selection of the reverse osmosis system vendor, he would  
5 give a recommendation for that.

6 Q Okay. It's a complex system, isn't it?

7 A It's a system that's been used in hundreds of --

8 Q Okay. I think you just -- I think you just said, "It's a  
9 very detailed system."

10 A The selection of a particular bioxide is very detailed --  
11 it's a detailed -- detail. Excuse me.

12 Q Anybody from MDEQ ever ask you about which bioxide you're  
13 going to use?

14 A I don't recall.

15 Q Anybody from MDEQ ever ask you about what type of membrane  
16 you're going to use?

17 A I don't recall.

18 Q Don't you think the kind of membrane is important in terms  
19 of this detailed reverse osmosis system?

20 A We will be submitting the final plans and specs to the MDEQ  
21 for their approval.

22 Q And you have not developed those yet?

23 A Correct.

24 Q Let me ask you a question or two about the orientation of  
25 the TWIS. Would you have been the person who decided the

1 orientation of the TWIS, what direction it's going to be  
2 placed in?

3 A I was not.

4 Q You were not. And would you be the person that would be  
5 able to offer guidance on that issue?

6 A I am not. I'm not a hydrologist.

7 Q Okay. So you don't know anything about mounding or the  
8 impact of mounding or the flow directions of the water at  
9 that site?

10 A I've been involved with discussions with the experts in  
11 that, but I'm not an expert in that field.

12 Q So you wouldn't have an expert opinion on that issue?

13 A Correct.

14 Q If the director of the MDEQ were to tell Kennecott that it  
15 needed to go back to the drawing board and redesign the  
16 wastewater treatment plant, the plant, that's doable, isn't  
17 it?

18 A A redesign of a treatment plant?

19 Q Yes.

20 A Yes, it is. It's always possible.

21 Q And you've been involved, I'm sure, in projects where an  
22 agency has said, "Look. You need to go back to the drawing  
23 board, and you need to redesign this plant"?

24 A I can't say that I have.

25 Q Okay. With respect to the selection of this particular

1 wastewater treatment system, wastewater treatment plant and  
2 all the various components, whose idea was it to use this  
3 particular system?

4 A The major selection of the metal hydroxide filtration,  
5 reverse osmosis and evaporation was predominantly on my  
6 charge.

7 Q Okay. And Foth & Van Dyke, I take it?

8 A Correct.

9 Q And my guess is that since you had been involved with  
10 Crandon, you thought, "Well, here's an opportunity to use a  
11 system that we thought was going to work at Crandon."

12 A That's not correct.

13 Q It's not. So it's just coincidental that the two systems  
14 look a lot alike?

15 A The RO for the Kennecott Project was driven by the presence  
16 of chlorides. Without an RO system you cannot effectively  
17 remove chloride. So the chlorides necessitated reverse  
18 osmosis. There was an option to not have an up-front metals  
19 precipitation process on this project. If you look at  
20 average flows on the metals, there is a possibility that you  
21 could get by with reverse osmosis alone. The addition of  
22 the metal hydroxide process adds a robustness to the overall  
23 process and allows us to treat very large concentrations of  
24 metals. That was one decision process in the matrix for the  
25 process design. It was -- RO was necessary, and we added

1 the metal hydroxide process. Once we have RO, that  
2 necessitated the treatment of the concentrate. Out West  
3 they can put the concentrate in a brine and solar evaporate  
4 it. In the Midwest in the UP we cannot do that. We have to  
5 use an evaporator. So it was a fairly clean process design.  
6 It was not, "Let's take the other project and use it over  
7 again."

8 Q So it wasn't a desire to recycle the project that had  
9 already been designed?

10 A Correct.

11 Q Okay. And it's just coincidental that the two projects are  
12 pretty much the same?

13 A I would have to go back to the process design for the  
14 Crandon project which was ten years ago. My recollection is  
15 that the Crandon project had elevated levels of sulfates,  
16 not chlorides. Sulfates are also difficult to treat with  
17 any other process other than reverse osmosis. The Crandon  
18 process also had metals which necessitated the use of an  
19 up-front metals removal process.

20 Q Without reverse osmosis, you're not going to be able to  
21 remove that chloride, are you?

22 A Correct.

23 MR. EGGAN: I don't think I have any other  
24 questions.

25 MR. HAYNES: I don't have any questions.

1 JUDGE PATTERSON: Mr. Wallace?

2 MR. WALLACE: I just have a couple.

3 CROSS-EXAMINATION

4 BY MR. WALLACE:

5 Q You talked about a simulation you had done in Ohio; correct?

6 Was it Ohio?

7 A I believe it was --

8 JUDGE PATTERSON: Pennsylvania?

9 Q Pennsylvania?

10 A -- Warrendale, Pennsylvania.

11 Q Warrendale, Pennsylvania. And some components of the  
12 proposed system were simulated and some were not; is that  
13 correct?

14 A The evaporator was not simulated.

15 Q Okay. And I think your testimony was, you didn't seem to  
16 like the evaporated crystalizer because there weren't any  
17 issues with that; right?

18 A That's correct.

19 Q What were the issues with the reverse osmosis that you were  
20 simulating to clean up or correct?

21 A The reverse osmosis process is more subject to change in the  
22 incoming concentrations of materials. The evaporator, it  
23 just brings everything to distilled water. So it's really  
24 not subject to change for different situations, different  
25 mine sites or different projects. There were not issue per

1 se, but the evaporator is a very clean process.

2 Q And the way you simulated this it wasn't bench scale with  
3 test tubes, but it was small scale; correct?

4 A There were containers of, I would say, you know, five foot  
5 diameter by five foot high, several hundred gallons of  
6 wastewater that would run through systems for extended  
7 durations.

8 Q Did you construct a small wastewater treatment plant, or was  
9 it basically --

10 A The facility was owned by Siemens US Filter, a very large  
11 treatment facility operator. They had existing equipment.  
12 They added some equipment for this test.

13 Q And with the issues that you had with reverse osmosis, were  
14 they resolved in the course of this simulation?

15 A I'm not sure I said I had issues with reverse osmosis. I  
16 don't recall that.

17 Q Well, I'm just taking your own testimony, what you said.  
18 You didn't have any issues with the evaporator crystalizers,  
19 so you didn't simulate it, but you did simulate reverse  
20 osmosis to determine things that you didn't know about;  
21 correct?

22 A We simulated the reverse osmosis process.

23 Q And did you resolve the questions that you had if you had  
24 questions?

25 A The output of the treatability study verified the process

1 design as selected in the groundwater discharge permit  
2 application.

3 Q What are some of the ways that wastewater treatment plants  
4 typically fail? I mean, they do fail; correct? We read in  
5 the newspaper about sewage going into rivers and, I mean,  
6 this is -- they fail various ways.

7 A I would have to look at specific examples. The sewage going  
8 into the river is a flow capacity issue.

9 Q Are there other failure modes that you've studied in  
10 connection with this design that are typical that occur with  
11 wastewater treatment plants?

12 A You know, we use prudent engineering practices in the design  
13 of the system.

14 Q But these plants do fail, and they allow unclean effluent to  
15 be released from time to time. I mean, you're in a roomful  
16 of lawyers that -- some of us have made a living off of  
17 releases, discharges, contaminants getting into the  
18 environment because of failure of devices. And I'm  
19 wondering what are the typical failures of wastewater  
20 treatment plants? 'Cause they fail too.

21 A This plant is not permitted to discharge any wastewater  
22 which does not meet the permit or the limits.

23 Q Well, that would be a violation, but should it occur, you  
24 know, the results could be irreversible, couldn't they, on  
25 the environment?

1 A That's not my area of expertise. I deal with the treatment  
2 system.

3 Q Okay. I'm trying to reconcile a couple things you said. I  
4 understand that you have some patents. Are they in your  
5 name?

6 A They are in my previous employer's name.

7 Q And these patents are being used in the design of this  
8 plant?

9 A No, they are not.

10 Q Have they been exploited commercially?

11 A Yes, they have.

12 Q But they have nothing to do with this kind of design?

13 A It has to do with very similar processes of metal hydroxide  
14 precipitation and the use of solids contact clarifiers.

15 Q But your patents don't have any application to the plant  
16 that's been designed for this site?

17 A Correct.

18 Q And I understand that you're saying that the technology  
19 behind this kind of design even though it's a novel design,  
20 the technology's been around for decades I think you said;  
21 is that right?

22 A Yes. The technologies for the metal hydroxides has probably  
23 been around for 50 or 100 years. The technology for the RO  
24 has been around for over decades as has been the evaporation  
25 processes.

1 Q Okay. And you understand that acid mine drainage is a  
2 problem with sulfide mining; correct?

3 A I understand that I've been given a range of concentrations

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25 Q I mean, do you know one way or the other whether acid mine

1 drainage has been the consequence of hard-rock mining in  
2 hundreds of instances?

3 A My expertise is in wastewater treatment.

4 Q Well, I guess, you know, the lesson is, never ask a "why"  
5 question in a trial, but I'm going to take a chance here.  
6 Do you have any idea why the problem of acid mine drainage  
7 has never been attacked in the way you're attacking it here?

8 A The processes selected for this site were specific to the  
9 site. It's specific that we had chlorides in the metals.  
10 If a mine was Out West, it would have different  
11 characteristics and different methods of treating that  
12 water.

13 Q Is the anticipated acid mine drainage at this mine unique?

14 A That's not my area of expertise.

15 Q So part of your design didn't involve looking at designs of  
16 wastewater treatment plants in sulfide mining at all?

17 A There was a review of -- a general review of the options for  
18 treating. It was fairly straight forward what unit  
19 operations were required to treat this wastewater.

20 Q An I guess what I'm asking is, was there something unique  
21 about this proposed mine that in your mind required  
22 designing a novel system that will be unique if it's built  
23 here?

24 A I don't believe it's a novel system. The presence of  
25 chlorides drove the need for reverse osmosis on this

1 project.

2 Q Is there a reason that you could not provide to the DEQ in  
3 connection with this application quite detailed  
4 specifications for your design? Why are you not at that  
5 stage yet?

6 A The permit requires the detailed plan and specifications to  
7 be provided, you know, after the permit is given and prior  
8 to construction.

9 Q I know that. But is there some practical reason why you  
10 couldn't provide the specs now?

11 A If there were a change to the permit conditions, we would  
12 have to redo some work.

13 Q I mean, do you have these specifications, the detailed  
14 specifications?

15 A No.

16 Q Do you know how this is going to be built in detail?

17 A We do not have detailed plans or specifications.

18 Q Do you know how this is going to be operated in detail?

19 A I know how the facility will be operated, not in detail.  
20 There is not an operations manual.

21 Q Do you know how it will be maintained in any detail?

22 A Not in detail.

23 Q And is there a reason why you couldn't be at that stage now  
24 so we could review detailed specs, detailed operation plan,  
25 detailed maintenance plan and have our experts review it?

1 Is there a practical reason?

2 A It would be unusual at the current review phase to have that  
3 level of detail completed.

4 Q Okay. But this is an unusual statute and an unusual mine,  
5 and I'm wondering if there's any practical reason why that  
6 information couldn't be made available now in connection  
7 with the application.

8 A The information -- I don't know. I don't know. It could be  
9 made available, but it seems it would be highly unusual that  
10 you would go through that level of detail at this phase of a  
11 process. It just to me would be unprecedented.

12 MR. WALLACE: I have nothing further.

13 MR. REICHEL: My name is Bob Reichel, sir. I  
14 represent the DEQ. I just wanted to follow up on a couple  
15 of points that Mr. Egan asked you about on  
16 cross-examination.

17 CROSS-EXAMINATION

18 BY MR. REICHEL:

19 Q He asked you a whole series of question intended to make the  
20 point that you conceded that you hadn't seen this particular  
21 treatment train in use in another hard-rock mine. Do you  
22 recall that line of questioning?

23 A Yes.

24 Q But I believe you also testified that you have seen the  
25 individual technologies and some combination of these

1 technologies in use in other industrial applications; is  
2 that correct?

3 A Yes.

4 Q In these other industrial applications that you're familiar  
5 with through your training and experience as an engineer,  
6 have any of them involved some of the metals that are at  
7 issue here as things that need to be treated?

8 A Yes, they have.

9 Q Could you give us examples of those kinds of things?

10 A There's a process called zero liquid discharge where a power  
11 plant or a facility such as a petrochemical facility will  
12 use metal hydroxide precipitation or some sort of metals  
13 removal process up front of RO. The metals, hydroxide takes  
14 out the metals. It's similar to our project. The RO will  
15 take out other soluble materials such as chlorides or  
16 sulfites similar to our project, and then they place the  
17 concentrate over to an evaporator crystalizer similar to our  
18 project. There are hundreds of those installations. The  
19 difference there is a lot of times they don't go to  
20 discharge. They reuse that water internally in the plant.  
21 They clean it up to very high standards and reuse it so they  
22 don't have to use additional water. Here we're discharging  
23 it because of the nature of a mine.

24 Q Can you give us other industrial applications that you're  
25 familiar with that would involved similar metals and -- I

1 don't how to ask this. Let's -- for example, have you been  
2 in -- are you familiar with the use of these metal hydroxide  
3 precipitation systems to remove metals such as copper or to  
4 treat those?

5 A Very familiar.

6 Q Okay. Is there -- in an industrial setting other than  
7 mining?

8 A Yes, absolutely.

9 Q Based upon your training and experience in engineering and  
10 wastewater treatment, is there any reason to believe that  
11 the copper that might be present in the influent to the  
12 wastewater treatment plant at this mine is somehow less  
13 amenable to treatment than copper from some other industrial  
14 source?

15 A No. The copper would be subject to the same chemistry and  
16 solubility as other sources.

17 Q And I just chose that as an example. Are you aware of  
18 any -- looking at the contaminants that have been addressed  
19 in the permit here, are you aware of anything unique about  
20 these contaminants related to the fact that they're coming  
21 from a mine that makes them somehow less amenable to  
22 treatment than have been used in other industrial  
23 applications?

24 A No, there's nothing unique.

25 Q Mr. Eggan also asked you a whole series of questions about

1 notes in a document where you identifying the bases upon  
2 which you were describing or projecting certain removal  
3 efficiencies. Do you recall that?

4 A Yes, I do.

5 Q And he pointed out that the document referenced equipment  
6 manufacturer's recommendation. Do you recall that?

7 A Yes, I do.

8 Q Just so the record is clear on this, in noting that were you  
9 stating or concluding that that was the sole basis upon  
10 which your analysis of the potential effectiveness of these  
11 treatment systems was based?

12 A No, I wasn't.

13 Q And again, how would you describe or summarize the bases for  
14 your judgment within that regard?

15 A The bases is that I've had 25 years, almost 25 years of  
16 engineering experience. I've dealt with a lot of equipment  
17 suppliers. I've dealt with similar processes over the  
18 years, and, you know, have experience with handling the  
19 engineering behind these type of processes.

20 Q And more specifically with regard to the manufacturer's  
21 recommendations -- I think one of them was an example on --  
22 I think in the first RO pass there was a note about a 75  
23 percent recovery rate. Do you recall that?

24 A Yes, I do.

25 Q And again the reference -- or the document referenced

1 "equipment manufacturer's recommendation." In your  
2 professional experience as a wastewater engineer, was that  
3 75 percent realistic or unrealistic?

4 A Oh, it was realistic, absolutely.

5 Q Would that be true with respect -- is that true or not true  
6 with respect to the other instances where you noted that you  
7 were referring to equipment manufacturer's recommendations?

8 A That's correct.

9 MR. REICHEL: That's all I have at this time.  
10 Thank you, sir.

11 MR. BRACKEN: I just have one or two follow-ups,  
12 your Honor.

13 REDIRECT EXAMINATION

14 BY MR. BRACKEN:

15 Q Mr. Egan talked to you about use of biocides. Is that an  
16 additive under the permit?

17 A I believe it is. I would have to -- I believe it's listed  
18 on the flow schematic. I would have to check that to be  
19 sure, but I believe we had mentioned that a biocide would be  
20 added. It's typical.

21 Q And did your selection of a biocide before use have to be  
22 approved by the DEQ under the permit?

23 A I believe it does.

24 Q Do the results you obtained from the treatability test  
25 confirm your calculations under G-1 as to the ability of

1 your wastewater treatment as designed to effectively treat  
2 the influent to standards it needs to have under the permit?

3 A Yes, it does.

4 MR. BRACKEN: I don't have anything further.

5 MR. HAYNES: Your Honor, I have a question that  
6 arose from Mr. Reichel's redirect, if I may.

7 CROSS-EXAMINATION

8 BY MR. HAYNES:

9 Q Mr. Fassbender, in the RO process there's going to be a  
10 sludge coming out of the -- a permeate coming out of the RO  
11 process; correct?

12 A Correct.

13 Q And that's going to be -- that then goes to the evaporator;  
14 correct?

15 A No, the permeate -- the concentrate will go the evaporator.

16 Q And where does the permeate go?

17 A The permeate from the first-pass RO goes to the second-pass  
18 RO. The permeate from the second-pass RO goes -- it  
19 eventually goes to discharge at the TWIS. It may even have  
20 pH adjustment, if necessary.

21 Q I see. And then the concentrate goes where?

22 A To the evaporator.

23 Q And then from the evaporator we have -- what's the result of  
24 the evaporator? That's sludge; right?

25 A The evaporator crystalizer process which reduces the volume

1 of that concentrate to much smaller volumes which can be  
2 handled at an offsite location.

3 Q Or put into the mine backfill; correct?

4 A I don't believe so. I believe the permit has been written  
5 such that it cannot be put into the mine backfill.

6 Q And what do you expect the constituents of the evaporator  
7 process to be?

8 A The constituents will be largely the salts that come into  
9 the process such as the predominant will be the sodium  
10 chloride which is common table salt. There will also be  
11 trace constituents of other metals. There will be quite a  
12 bit of sulfate in there.

13 MR. HAYNES: All right. Thank you.

14 MR. EGGAN: Just one quick follow-up.

15 RE-CROSS-EXAMINATION

16 BY MR. EGGAN:

17 Q When Mr. Reichel asked you about the recovery rate, 75  
18 percent based on the equipment manufacturer's  
19 recommendation, he said, "Is that realistic?"

20 A Yes.

21 Q And my question to you, sir, is based on your experience in  
22 the mining industry is it realistic at a sulfide mine with  
23 the constituents were talking about here, at a sulfide mine?  
24 You probably can't answer that question because you've  
25 not -- you've not had that kind of experience, have you?

1 A The unique properties of a sulfide mine is their ability to  
2 release metals --

3 Q And acid.

4 A -- and acid. We have a pre-treatment step ahead of the RO  
5 which will treat those metals -- those same metals and acids  
6 ahead of the RO system so the fluctuation of metals going to  
7 the RO system is very much mitigated.

8 Q Have you had experience at a sulfide mine in your career  
9 with an RO system actually up and operating?

10 A No.

11 Q You have not?

12 A No.

13 Q Okay. So your prediction as to the reality, the realistic  
14 nature of that -- of 75 percent recovery isn't really based  
15 on your experience with mining, is it?

16 A It's based on my knowledge of reverse osmosis.

17 MR. EGGAN: Okay.

18 RE-CROSS-EXAMINATION

19 BY MR. WALLACE:

20 Q Mr. Reichel asked you a few questions about similarities  
21 between other industries and mining for this wastewater  
22 treatment process. I have a question about a distinction  
23 between other industries and mining, and that is, to what  
24 extent did your design of this plant take into account that  
25 the plant would be built in an area where heavy blasting was

1 going to be occurring? What features did you incorporate  
2 to -- if any, to consider the blasting environment?

3 A I don't know of specific features that were incorporated for  
4 the blasting.

5 Q Were there probably none specifically addressed to the  
6 environment in which this is going to be doing the mining  
7 involving blasting?

8 A I'm sorry. Could you restate that?

9 Q Are you telling us, in effect, that you did not incorporate  
10 into the design of this plant the fact that it would be  
11 built in an environment where heavy blasting was occurring  
12 in a mining operation. Does that effect --

13 A The effects of blasting are beyond my area of expertise.

14 Q So the answer is "no"?

15 A No specific changes at this point.

16 MR. WALLACE: Thank you.

17 MR. BRACKEN: Your Honor, because of the last  
18 question Mr. Eggan asked, I have one more question.

19 FURTHER DIRECT EXAMINATION

20 BY MR. BRACKEN:

21 Q If I can approach, Mr. Fassbender, do you recall prior to  
22 your testimony I provided you with some papers that Dr.  
23 Miller had written, authored, including one called "The  
24 Reduction of Sulfate Concentrations in Neutral Mine  
25 Effluent," which was referred to when Dr. Miller testified

1 in this case?

2 A Yes.

3 Q Do you remember that?

4 A Yes, I do recall.

5 Q I provided you a copy of that?

6 A Yes.

7 Q And this is an issue of reduction sulfate concentrations.

8 And doesn't Dr. Miller in this paper --

9 MR. EGGAN: Is this a document that's been  
10 admitted, Counsel?

11 MR. BRACKEN: I have provided you a copy.

12 MR. EGGAN: Actually, I think I have a copy. My  
13 question is, has it been admitted?

14 MR. BRACKEN: I had not been admitted.

15 MR. EGGAN: Okay.

16 Q On page 2, number paragraph 2, "Reverse Osmosis and Membrane  
17 Methods" suggested by Dr. Miller that that could be used in  
18 a sulfate mine with sulfate mine concentrations; is that  
19 correct?

20 A Yes.

21 Q Page 2.

22 A It's "Reverse Osmosis and Membrane Methods. Unlike the  
23 methods above, reserve osmosis" --

24 MR. EGGAN: Your Honor, if this has not been  
25 offered or admitted as an exhibit, I would object to the

1 witness reading from it.

2 MR. BRACKEN: Well your Honor, it's -- he has --  
3 with one of his own, he has attacked this witness'  
4 credibility in effect by saying this has never been used. I  
5 think it's appropriate at this point --

6 MR. EGGAN: No, I don't think I did say that. I  
7 this that it's never been used 24/7 which is what Dr. Miller  
8 said.

9 MR. BRACKEN: I thought what you recently said,  
10 last couple questions you asked, you didn't know of any use  
11 for reverse osmosis in a sulfide mine situation. I may have  
12 misheard you.

13 MR. EGGAN: You misinterpreted. I was suggesting  
14 that he doesn't have the expertise to answer a question.

15 MR. BRACKEN: He does not have that expertise,  
16 that's true. But Dr. Miller clearly has opined about it in  
17 public, and that's the point of the -- asking the question.

18 Q You reviewed this paper, and that's what the paper says?

19 A Yes.

20 MR. BRACKEN: I have no further questions.

21 MR. EGGAN: Nothing else, your Honor.

22 JUDGE PATTERSON: Last chance.

23 MR. EGGAN: Thank you, your Honor.

24 (Proceedings concluded at 5:01 p.m.)

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