STATE OF MAINE

MAINE BOARD OF ENVIRONMENTAL PROTECTION
AND
DEPARTMENT OF ENVIRONMENTAL PROTECTION

IN THE MATTER OF
NORDIC AQUAFARMS, INC.

APPLICATIONS FOR ATLANTIC SALMON LAND-BASED
AQUACULTURE FACILITY

HEARING - DAY 4
FRIDAY, FEBRUARY 14, 2020

PRESIDING OFFICER: ROBERT DUCHESNE

Reported by Robin J. Dostie, a Notary Public and court reporter in and for the State of Maine, on February 14, 2020, at the University of Maine Hutchinson Center, 80 Belmont Avenue, Belfast, Maine, commencing at 8:00 a.m.

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TRANSCRIPT OF PROCEEDINGS

MR. DUCHESNE: Good morning. I now call to order this session of the public hearing on Nordic Aquafarms applications for Site Location of Development, Natural Resources Protection Act, Air Emissions and Waste Discharge permits.

My name is Robert Duchesne. I am a member of the Board of Environmental Protection and I am the Presiding Officer for today's hearing. Members of the Board here today are James Parker of Veazie, Steve Pelletier of Yarmouth, Rob Sanford of Gorham and myself.

Other persons present, Peggy Bensinger and Laura Jensen, Assist Attorney General and Counsel the Board; Cindy Bertocci, the Board's Executive Analyst; Ruth Ann Burke, the Board's Administrative Assistant; Jerry Reid, the Commissioner of the Department; DEP staff which includes up here at the table anyway, Gregg Wood and Kevin Martin. Other members of the staff are sitting behind and may join us up at the table for certain topics later on. I can see Beth Callahan, Project Manager, in the back, for instance.

This is day four of the hearing. Today we'll begin with Nordic's witnesses on wastewater, effluent modeling and impacts. If there are members of the public here today that would like to ask a question of a witness that you believe was not covered you must submit your question to me in writing. Paper is available at the side table for this purpose. I will review the question, make a determination as to its relevance and ask the question as time permits. Speaking of time, we would love to be done by noon today. Done by lunch. We have no lunch plans. Nothing has been ordered, so if you feel a little bit pressured to finish this up before lunch, that's great. If that's not enough pressure, we'll lock the bathrooms.

(Laughter.)

MR. DUCHESNE: With that said, I will try to squeeze in whatever questions we can, that will include intervenors as necessary. I would offer that opportunity if we have time, as we've said before, to intervenors who did not previously request time. I know Ms. Daniels has been able to ask some questions before. I want to make sure The Fish Are Okay intervenors are also aware that they will have that privilege, but I will limit it probably to one or two questions depending on how much time is available.

At this time, I ask all of the persons testifying who have not to already been sworn in to stand and raise their right hand. There we go. Do you affirm the testimony you are about to give is the whole truth and nothing but the truth?

(Witnesses affirm.)

MR. DUCHESNE: Thank you. All right. We have another matter to tend to.

MS. BENSINGER: The parties may be aware that the Department of Marine Resources, I haven't seen it, but I understand has noticed that it is going to have a hearing on this and following that I believe the Department of Marine Resources will be providing further assessment to the Department on this proposed project. So we will be talking and we'll set up a -- some sort of a process for there to be an opportunity to submit written comments on that assessment. That -- we're trying to -- we'll be discussing whether that should change the deadlines for the -- the deadlines that we set up yesterday for DMR's other comments on coastal impacts and the memo provided to Gregg Wood. So we'll be thinking about that as the day goes on and we'll finalize that before the end of the hearing. Thanks.

MR. DUCHESNE: Great. And I would like to say that this proceeding is online if you wish to message friends at home who want to listen in. The address is maine.gov/dep/bep.html. At the bottom of that there is a link which is -- can be clicked on to get you into this proceeding.

With that said, we can go to our first panel.

NATHAN DILL: Good morning, Presiding Officer Duchesne, members of the Board, folks from DEP. My name is Nathan Dill. I am a Coastal Engineer for Ransom Consulting. I am a graduate of Bowdoin College. I hold a Master's of Science degree in Civil Engineering from the Louisiana State University where my studies focused on a combination of water resources engineering, oceanography and coastal science and numerical modeling. I have more than a dozen years experience as a consulting engineer working on a variety of projects that involve the application of numerical hydrodynamic modeling, coastal engineering analysis to solve problems in coastal and estuarian environments. This includes specific experience in the development and application of computer models to evaluate wastewater discharges in support of natural pollutant discharge elimination system permitting. I also previously worked for two years as a high school physics teacher. I am a licensed engineer in the State of

Maine, the Commonwealth of Massachusetts and the State of Rhode Island.

In 2018, I was asked on behalf of Nordic Aquafarms to evaluate the near-field mixing behavior of a proposed recirculating aquaculture system discharge into Belfast Bay. This evaluation is described in a memorandum I prepared to Nordic Aquafarms on September 27, 2018. That's included in the permit application.

The objective of this evaluation was to help identify an appropriate location or depth for the outfall and to aid in the outfall design so that it could maximize dilution of the discharge. I also understood that the evaluation would be provided to the MaineDEP to support the Maine Pollution Discharge Elimination System permitting.

This evaluation considered alternative locations with different water depths and as well as different configurations of the outfall in either sort of a single port outfall, which is just essentially an open -- the end of an open pipe or a multi-port outfall with a diffuser so the water is actually distributed and ejects from multi-ports at the outfall.

The CORnell MIXing zone expert system model, which is known as CORMIX as an the acronym was selected to model a near-field mixing process. This CORMIX model is an EPA supported model -- EPA supported. It has become a standard tool used to support regulatory mixing zone analysis for wastewater discharge permitting studies through the country. It's also used in other parts of the world.

So near-field, when I say near-field, I'm talking about the mixing that occurs within the immediate vicinity of the outfall, so when the water comes out of the end of the pipe we're talking about the mixing that is -- that's happening due to the velocity of that water entraining the water surrounding it and mixing it together. And it's, I think, important to understand that in this near-field that one of the more important things that you consider is that this is the -- this is the region where the design of that outfall configuration can have the most impact on that dilution, so, for example, if you make the port diameter smaller and you push the same amount of water out through it it's going to come out faster, it's going to create greater turbulence and it's going to mix more. And the -- these processes typically occur on a relatively short time and spacial scale, so within the order of minutes and seconds to minutes and, you know, within the order of meters, tens of meters to maybe get hundreds of meters from the outfall depending on what's going on with the current surrounding.

This initial mixing is also dependent on the physical conditions of the receiving waterbody, so what's going on in the -- in the bay that is receiving this water that's being ejected from the outfall. So in order to characterize what that looked like, I reviewed available literature that, you know, that -- where I was able to find -- anything I was able to find that told me about what the ambient conditions are like in the upper Penobscot Bay. Belfast Bay.

The CORMIX analysis that requires that you provide it with a depth average current speed and some -- it's in terms of the receiving waterbody, what's the -- what's the current speed that's going past that diffuser and we also need to provide some information on how the water column is stratified. So, you know, if the water is maybe colder and denser at the bottom more, saline colder at the bottom and it tends to get less dense and then potentially warmer as you rise towards the surface. I think anybody who has, you know, kind of swam in a natural waterbody may have experienced that where you feel warm water at the surface and then your feet may be dangling in colder water. So that has to be characterized to understand that as an input to the model.

So seasonal stratification observation profiles, what I -- what I found in the literature are there were many sources of data that provide information in the area. Seasonal stratification observations were taken at nearby locations in upper Penobscot Bay and in 1975 these were provided in a report in 1978, which provided -- which really gave us the most sort of comprehensive picture of what that area of the bay looked like. These observations were consistent with other information found in more recent literature sources, but they were more comprehensive because they included multiple measurements throughout multiple seasons and at locations near the proposed outfall in Belfast Bay. Because these provide the most comprehensive information they were used to use develop representative seasonal stratification profiles for this analysis that bracket the typical range of stratified conditions in the bay.

The observations show that stratification in upper Penobscot Bay is highly variable. In the spring season we see the strongest stratification due to a combination of thermal stratification so the warming of the surface of the water because the air temperature is getting warmer and also because warmer water is coming down the Penobscot River and from other streams that are -- that are flowing into the bay. The stratification then weakens into the summer as the water column overall warms and the fresh water input is reduced because there is less water coming out of the watersheds into the bay. Then as you transition into the winter season the air temperature drops below the water temperature and the water starts cooling from the surface and -- and you end up with a condition where you have nearly constant salinity going all the way down through the water column. Based on this information, which was -- came from multiple different literature sources which are referenced in the memorandum that are in the application we came up with representative stratification profiles for four different seasons. And it's also -- there is also a figure that was provided in the application that shows what those look like.

Observations of current speeds were available from multiple literature sources that were also listed in that same memorandum. Based on this review we selected representative current speeds of 5 centimeters per second representative of what you would see at a slack tide and 20 centimeters per second representative of what you would see during a mid-tide, you know, either on the flood or the ebb. Initially, I looked at outfall location of meters of depth of 15 meters of depth, sort of bracket the rage of the area where it was sort of feasible to look at. And we considered outfall configurations that had an open pipe that was a 30 inch diameter pipe that was just open at the end or a 30 inch diameter pipe that would have then had a reducer that would reduce that opening size down to a 15 inch diameter opening.

And then CORMIX runs were run to evaluate a combination of each season and current speed. Let me back up for a second. In addition to that, we also considered a diffuser outfall configuration that consists of, I can describe it, I guess, like you've got the -- going along the end of the pipe you've got a cap on the end, you've got 3 points that are, you know, spaced 50 feet apart that have a 12 inch riser pipe that comes up and a turn elbow that comes off and then -- and then a port opening that's 12 inches so now you've got three of those spaced 50 feet apart that have a 12 inch opening that are going to -- or where the water will convey from as it goes into the bay. They call that a multi-port diffuser.

So CORMIX simulations, a total of 48 different simulations were run to evaluate each combination of season and outfall configuration. CORMIX modeling results show that the mixing behavior of the discharge varies quite a bit as the tidal currents change so you get a different type of configuration of what that -- what that -- what it looks like, how that water is mixing when it's coming out depending on whether it's slack tide or whether it's mid-tide. There is also considerable variability in how that behaves throughout the different seasons, so it's a fairly -- it's a highly dynamic situation.

And so from those results we saw that the dilution is generally predicted to be greater during less stratified conditions when the ambient water -- the water in the bay is less stratified in the wintertime essentially as you get, you know, later into the fall and winter and even into the early spring. And the model results also showed that the smaller port size provides greater dilution, which makes sense because you're restricting the size of the port the water is coming out. It's coming out faster, it's creating more turbulence to mixing that water in. And the -- based on these results, the multi-port diffuser seemed to produce the best results so the dilution was similar to what we saw with just a single port with 15 inch diameter, but there was less variability in the behavior of that plume throughout the seasons and with changes in stratification, so the multi-port diffuser provided similar -- a similar level of dilution but it was also more consistent that -- similar level to dilutions in the smaller port diameter, but it was more consistent with changes in the ambient conditions.

The results of the analysis with the multi-port diffuser were provided after the -- were not provided in the original application, they were provided later to the MaineDEP in a letter to Kevin Martin from Elizabeth Ransom dated August 14, 2019, that's Nordic Exhibit 21. This was a -- in a response to questions regarding the dilution analysis. Okay. Results of the near-field analysis of this multi-port diffuser at the final selected location, this at the 11 1/2 meter depth, are qualitatively similar to the multi-port diffuser at other depths. The analysis predicts that the minimum dilution would occur during the spring season when strong ambient stratification reduces mixing during all phases of the tide. During these times the minimum dilution predicted at the height in the water column where the plume stops rising due to buoyancy effects is estimated to be 10.1 at slack tide and 15 at mid-tide. And this is -- those -- according to the Department rules Chapter 530 Section 4A(2)(a) those represent acute and chronic dilution factors for tide dominated estuaries.

I want to kind of digress for a second here and just provide sort of, I guess, if I can a better explanation of what that means. So in the spring season going into the spring you have -- you have got fresh water coming down the river and you have the water has been really cold because you're coming out of the winter so that fresh water is coming down the river, it's kind of floating on the surface of the bay because fresh water is less dense than salt water. That water is also warmer and it's being warmed by the air temperature because the air temperature is warmer than the water now, so the water starts -- body starts warming from the top and the water -- the fresh water tends to stay on the top and you have that colder, denser water sitting on the bottom. And so we have an outfall that is the -- the discharge -- the water that's coming out of the -- of the Nordic Aquafarms recirculatig aquaculture system is a -- is a brackish water so the salinity is less than the salinity at the bottom of the water column at this time. It's also -- it's also warmer, so that part in terms of salinity and temperature is more like the water that's on the surface during that season. And so as that water comes out it's ejected into the water column, the velocity of that water causes it to entrain the colder water around it that's nearer to the bottom. And so as it mixes with that colder, saltier water the salinity and the temperature it rises -- it rises up because it's initially less dense, but as it mixes in more saltier, colder water the density of that plume begins to match as it's going up. There is a point where that density matches the density in the layer -- in the layers of the -- change in density layers of being ambient and so it will stop rising at that point and just kind of spread out. And depending on how strong that stratification is, what the difference in density from the top to the bottom, it will -- and the -- and the difference in what the density of the discharge is it may stop at a different -- at a different layer.

Now, in some -- in some situations the flow can be strong enough compared to that stratification that that turbulence generated by the flow will actually cause the water to mix fully. But what we can -- what we see here from this analysis is that there will be times in the spring season when that -- when that stratification is strong enough that it's not going to let it mix fully all the way initially when it comes out. And so that's -- that's the situation that creates sort of the worst case scenario where the water hopefully initially mixes so much before it kind of stops and spreads out. So that's the -- that's the -- I guess the -- the biggest concern in terms of what -- what are going to be concentrations of constituents at this discharge after its impact or after it's mixed.

And I am going to -- I want to take a minute here too to talk about that a little bit more, I guess. So we heard a lot of testimony at this hearing regarding the temperature of the discharge and concerns about thermal impacts to Belfast Bay, more broadly within the larger Penobscot Bay. We've also heard multiple questions about thermal aspects of the discharge during cross-examinations that were really off-topic for prior panels and I think we -- when I came up here a couple days ago and so this is really the time, I think, to talk about that. So I took note of these concerns and questions and I wanted to talk about that a little bit now.

And so I think the first thing I want to be clear about is that the discharge water from the recirculating aquaculture type is going to be in the range of 15 degrees centigrade to 18 degrees centigrade and that's the temperature of the discharge. That's not how much the temperature is going to be increased by this system. So, again, so the temperature is going to be constantly within that range. It's not that it's putting in water at some temperature and then increasing it by that much, so I want to be really clear about that because I think there has been some confusion.

So I'm an American engineer and, you know, for the most part because of that I'm pretty comfortable talking about mixed -- weird mixtures of English and metric units like tenths of a foot. So and I've kind of got a sense of how long a meter is, but the one thing I cannot seem to develop a feel for is what a temperature and centigrade feels like. All right. So we can all figure this out, you take the temperature in centigrade and you multiply it by 9, divide it by 5, you add 32. So if I say something in centigrade just do that math in your head.

(Laughter.)

NATHAN DILL: I'm joking. I'm joking. So going forward, I'm going to talk -- I'm going try to make this as much as possible to try to talk about temperature in terms of Fahrenheit. So in Fahrenheit this temperature is -- the temperature of this discharge is going to be consistently between 59 degrees Fahrenheit and 64 degrees Fahrenheit, okay. Again, this is the temperature coming out of the pipe. This is not how much the temperature is going to be increased by this system. This is fundamentally different than a lot of what we think of as, you know, thermal discharges. This is -- the reason why the temperature is going to be consistently in this temperature is because this is the temperature that is required to raise healthy salmon. During times of the year when the water in the bay is colder it will tend to be more toward the colder end of that range, closer to 59 degrees.

During times of the year when the water in the bay is warmer it will be toward the warmer end of that range, more closer to 64 degrees Fahrenheit.

Based on multiple sources of information that I mentioned in my -- in my review of available literature the temperature of Penobscot Bay -- sort of reasonable range of the temperature in Penobscot bay is between 32 degrees Fahrenheit and 72 degrees Fahrenheit for the water that's at the surface. That's where you see the most variability. So that's largely because that's -- because the air temperature range is much greater than that and the temperature of the water surface is really driven by what the air temperature is. At greater depths once you get down to 20, 30 feet below the surface that range in temperature is smaller. It's -- it is reasonably between 36 degrees Fahrenheit and 54 degrees Fahrenheit. Now, so there is quite a bit of variability in what's going on in the bay.

So what does this mean as far as temperature impacts from the discharge? Well, there is a -- the DEP -- the Department has a rule established regarding temperatures into -- discharge any tidal waters, that's Chapter 582, section 5. This rule allows for a reasonable area in which the discharge is diluted by mixing with surrounding water from the bay, but then it restricts the increase in temperature outside this area of initial dilution to be no more than 1 1/2 degrees Fahrenheit between June 1 and September 1, so essentially in the summer, and no more than 4 degrees Fahrenheit during other times of the year.

So in order to evaluate what that impact is going to be I looked at a couple things and so I looked at the largest temperature differences largely to occur in the wintertime. This is when the -- when the discharge water is going to be about 59 degrees Fahrenheit and the bay water could be 32 degrees Fahrenheit. So you have a temperature difference right between the water that's coming down the pipe and the water in the bay surrounding it of 27 degrees Fahrenheit. So of course that means that if you put a thermometer right into the end of the pipe you're going to see water that is 27 degrees hotter than the water in the bay around it. But the rule allows for some reasonable initial mixing to occur before you actually -- before you decide where you're going to put that thermometer. So when I look at the CORMIX results for this situation during this winter time, the -- in order to -- in order to meet that 4 degree criteria you would have to dilute the water about four times. So to -- and so if I take, you know, roughly take 27 divided by 4, I'm less than 4 -- pardon me. If you take 27 divide it by 7 I'm less than -- I'm less than 4 degrees. So what that means is imagine if I have a bucket that holds 7 gallons of water and I put 1 gallon of water in that bucket that is from the discharge that is at a temperature of 59 degrees and then I fill that bucket the rest of the way up, I put 6 more gallons of water in it that are at 32 degrees and then mix it all together the temperature of that water is going to -- is going to end up being about 35.8 degrees Fahrenheit, so it's been diluted seven times and the temperature is going to be 35.8 degrees Fahrenheit, which is less than 4, greater than 32. I'm sorry, we have to -- I apologize for speaking about the math but that is actually important because that's what we're trying to establish here.

So then -- so then I look at the CORMIX results and I say, well, how far -- how far away from this outfall is this going to happen and during the winter scenario that we simulated the CORMIX results predicted that dilution is going to be more than 18, so that's more than double the dilution that we need within about 20 feet from the discharge. It's a fairly small area, so at that point we would just be maybe a degree Fahrenheit or two higher than what -- what the surrounding water is. As you get further away it dilutes even more. It pretty quickly goes up to -- dilution goes up to a couple hundred where it would be almost very difficult to even measure a temperature difference.

But I also need to look at the late spring because this is when the criteria is more strict, so we have a 1 1/2 degree criteria there and this is -- this is also when we expect to see the least amount of initial dilution because there is a high degree of stratification in the water column. During this time of the year the observed data show that the water temperature near the bottom could be as low as 45 degrees Fahrenheit. It's warmed up a little bit. We're talking about the month of June. And the temperature near the surface has also warmed up a bit, but it's still pretty cold. It's about 52 degrees Fahrenheit. The CORMIX results for the spring season shows that the plume will, and kind of as I discussed earlier this is sort of that worst case scenario, the plume is going to rise up in the water column until it becomes trapped in the stratification and for this situation that we model it's going to rise about one-third of the way between where it was discharged and the surface, so it will be about 20 feet or so below the surface depending on what the tide is doing. Then it's going to spread out in a relatively thin layer. Some of it is going to actually spread during the slack tide, some of it will actually spread upstream because it's -- it's somewhat less dense than the water around it. I -- when I -- when I think about it it sort of seems unusual that the plume would actually be traveling in the opposite direction, but I don't know if anybody has ever sort of experienced this, but if you're driving you car with a helium balloon next to you, you know, and you've also got say something set up on the dash and you accelerate that thing on the dash is going to want to fall back, you know, relative to what's going on in the car, but that balloon will go forward and that's because the helium in the balloon makes it less dense than and the air around it. The air around it kind of comes around and it comes around the back and pushes the balloon forward. So there is some aspect of the plume doing this. And at that point where it rises to that point the dilution is estimated to be about 10 to 1.

Now, so if we assume that the discharge is at 59 degrees Fahrenheit in entrained ambient water that was at 45 degrees Fahrenheit, so it's pulling in colder water as it's rising. It will -- at the point of where it reaches that point of rise about one-third of the way up it will have entrained enough cold water so that it will yield a temperature of 47 degrees Fahrenheit. And if I look at what the ambient temperature is at that level in the water column it's actually .3 degrees warmer than that. So we essentially have now this -- this plume is spreading out, it's actually slightly colder than the water around it at the same level and that's because as it's rising it's entraining that colder water around it and when it does -- when it does that, you know, it's making it more dense because it's colder, but that water is still less saline and so the -- so the salinity has an opposite effect on the temperature and so in order for that plume to sort of stop rising it's got to match the density in the surrounding water. Because it is a little bit less saline in order for it to match that density it actually has to be a little bit colder and so -- so then you have that -- that distance that it's -- that is kind of coming out and rising until it meets that point and that's -- I don't think I put that in my notes but that's a very small distance and, again, it's in the order of tens of feet.

All right. I hope I'm not taking up too much time.

MR. DUCHESNE: Well, to the extent that you may delay our lunch.

NATHAN DILL: I might have to -- I might have to stop and take a break to use the bathroom before you lock the doors.

MR. DUCHESNE: Before it's locked, yeah.

NATHAN DILL: So -- so after -- after commencing this analysis of the near-field dilution, I was -- I was asked by Nordic Aquafarms to -- to evaluate far-field dilution of the proposed discharge, so what's going on in the broader picture with longer time scales and farther distance scales. This request was in response to my recommendation that far-field dilution be evaluated dynamically using a different model than CORMIX model because the CORMIX model assumes steady state currents and steady state mixing and that means the model is limited for evaluating dilution at larger time and spacial scales. So it only gives us a snapshot of what's happening at say slack tide or a snapshot of what's happening at the mid-tide, but it can't tell us, you know, it assumes the current is just kind of moving constantly in one direction the whole time. It will give you results for three days out if you want, but in reality what happens in a tidal environment is that current comes back around and it turns the other way and actually tends to go move around sort of in an elongated ellipse just based on the tides. And so if you want to look at what's -- what's happening to that dilution, you know, outside of that initial mixing area it's not really going to give you the correct result.

So in my initial evaluation of the far-field dilution is described in a memorandum I prepared for Nordic Aquafarms dated October 2, 2018. It's included in the permit application and as attachment or, I'm sorry, as Nordic Exhibit 22. Responses -- the response to comments and questions on this analysis are provided in the August 14 letter to Mr. Kevin Martin as mentioned in Paragraph 8 in Exhibit 21. Additional supplemental information derived from this analysis in response to follow-up discussions with staff from the Maine DEP was provided in a memorandum I prepared for Nordic Aquafarms on November 23, October 2019, which is

Nordic Exhibit 23.

The approach I took far-field dilution was based on a combination of two-dimensional hydrodynamic modeling of tidal circulation and dynamic particle tracking to simulate transport and dispersion of the discharge plume over many tidal cycles and to evaluate long-term evolution of the discharge plume. A two-dimentional tidal hydrodynamic model using a model code known as ADCIRC, the advanced circulation, was used. And this -- this -- I -- this model was actually a model that was previously developed for a study that -- that we did to look at storm surge hazards in Islesboro and Vinalhaven and Penobscot Bay and so that model had previously been developed and validated by running many simulations of historic storm events and historic tidal conditions and then -- and then demonstrating that the model accurately reproduced the water levels during those historic events. That -- the report that describes the model developing validation was -- is included in Exhibit -- and I didn't make note of what exhibit that is, but it was not something that was initially done with the permit applications.

I have -- I have experience using similar hydrodynamic modeling and particle tracking methods to evaluate a variety of marine and estuary and mixing problems. Going back to work I did when I worked at the URS Corporation in 2006 and work I did on my Master's thesis at LSU where I evaluated proposed diversion of Mississippi River water into some of the swamps and wetlands surrounding the Mississippi River in southern Louisiana. As part of that effort I developed a computer program that I called Maureparticle because the initial application was for a river diversion into the Maurepas Swamp. And the -- this performs particle tracking analysis in two-dimensions based on results from this ADCIRC hydrodynamic model. Since that time this Maureparticle model has been applied by myself and others for a variety of applications including pollution, discharge, elimination, permitting studies and Maureparticle was the particle tracking model that applied to this analysis.

For this analysis the ADCIRC model was used to simulate time varying two-dimentional depth average to current velocity throughout Penobscot Bay including Belfast Bay. It gives results at a resolution of about -- compared to maybe 120 feet, so it gives us an output every -- on a grid maybe every

120 feet spacing. And then the current velocities, they're output, so you're getting -- you end up getting a result that shows you what the current is doing, you know, which direction and how fast the current is flowing over -- averaged over the depth at points spaced out 120 feet every 15 minutes for a 45 day long period of time, so I have these series of snapshots of what that current velocity field looks like. So that output then goes into this particle tracking model where the particle tracking is model is set up to continuously release particles just like the -- the discharge is continuously releasing water.

MR. DUCHESNE: Mr. Dill --

NATHAN DILL: Yes.

MR. DUCHESNE: -- I'm watching the clock --

NATHAN DILL: Okay.

MR. DUCHESNE: -- and I'm concerned that you're going to rob Mr. Parent of all of his time.

TYLER PARENT: I don't need much.

MR. DUCHESNE: Even better.

NATHAN DILL: All right. Thank you. I'll move on.

MR. DUCHESNE: The sooner it arrives, the better.

NATHAN DILL: Okay. I suppose you could ask questions for me to describe that better if you need, so I'll -- I'll speed it up a little bit.

So this continuous release consists of imaginary particles that represent small parcels of the discharge water that are released one at a time randomly along the distance of the diffuser then the model gives us a two-dimentional time history of where those particles are over that -- that long period of simulation. In this case, the particle tracking simulation went on for 30 days, so we see where those particles go over a 30 day period. And then by counting how many particles there are in a certain area you can calculate that -- and assessing how much volume of water is in there versus how many particles there are and you can estimate what the dilution of the -- of the effluent is at that point.

The results from this far-field dilution were also used to estimate nitrogen concentrations to show though that nitrogen would be diluted and would not be detectable of above background concentrations at nearby sensitive receptors and this was based the -- on some maps of locations for eel grass beds that were somewhat south of the discharge location.

In response to comments described in our October 14, 2019 letter to Mr. Kevin Martin, we provided an additional discussion on the potential impacts of near bottom dissolved oxygen in light of recent near bottom dissolved oxygen observations that are below SB waterbody classification criteria that had been observed currently before -- before there has been any discharge. Although the modeling and analysis we performed is not really capable of quantifying and assessing the complex processes that affect dissolved oxygen in the waterbody, we are able to induce that the positive buoyancy of the discharge particularly during times of the year when the stratification is strong, when -- which is when the --

MS. RACINE: I'm sorry. At this point, I would just note the time and I just want to make sure that we do have enough time for our subsequent panel.

MR. DUCHESNE: Yes. Thank you, Ms. Racine. I think he's on his last paragraph and if he isn't, he will be.

MS. RACINE: Understood. Thank you.

MR. DUCHESNE: Thank you.

NATHAN DILL: So -- so basically we didn't think that that was a concern because when the dissolved oxygen is low that's when the rising as I described is being trapped is not really interacting with the bottom. In fact, it's mixing the water -- pulling the water up from the bottom and mixing it.

And then in recent follow-up conversations with the DEP staff, we discussed a desire to develop a further understanding of how the far-field dilution is related to the age of the discharge water. This understanding is expected to be helpful in the assessment of the impacts of nutrients on the discharge water where those impacts depend on complex biochemical processes that do not occur immediately. In response to these discussions the far-field analysis was used to develop supplemental information based on the amount of time that elapsed since each particle was released in the water body. For the analysis, 48 hours was selected as a reasonable effluent age at which biochemical process may begin to take effect on nutrients of the discharge water. The particle tracking results were analyzed to define the region of the plume where the median age of the effluent was between 36 hours and 60 hours and the spacial distribution of the dilution within this area was determined. The results of this area analysis show a ring-shaped area that moves about the outfall location with the phase of the tide but overall remains relatively close to the outfall location.

MR. DUCHESNE: Well, good. Thank you.

NATHAN DILL: All right.

(Laughter.)

MR. DUCHESNE: And just for the audience, this is all pre-filed testimony so there has been an opportunity to read much of it, so a summary is useful and it has been useful, but it's a summary and we can move on to Mr. Parent.

TYLER PARENT: Good morning, Officer Duchesne, members of the Board and employees of the DEP. My name is Tyler Parent. I won't say any more about that as we spoke yesterday, but I am a fisheries biologist with Normadeau Associates.

First, I would like to state the Atlantic salmon is a native species to the Penobscot River. It's a cold water fish and the water inside this proposed facility would be tailored specifically to the needs of rearing that native species and so if the water coming out of that discharge pipe was bad it would not be conducive to raising these fish inside their facility. So that's just sort of a plain statement there.

The other thing I'd like to clear up it has been spoken about in previous testimony that temperature has not been considered as a potential impact for this study in the aquatic environment. That's not true. Temperature is included in water quality parameters most of the time and so although temperature might not have been specifically referenced it is included as a potential impact.

And then the other the other piece that has been touched on is that we weren't considering temperature as a permanent impact which is also not true. As the water quality parameters obviously will be happening every day as they come of the discharge facility and that is a permanent feature as long as this facilities stays open. And so for all of my considerations both water quality and including temperature have been considered as potential permanent impacts.

Third, we've also been talking a lot about where our water temperature data have come from and why some folks think that we don't have enough information. The big thing is the water quality and the water temperature in Belfast Bay and broader Penobscot Bay is no mystery. There is a lot of research that has been done and is continuing to be done in this waterbody including those buoys that Dr. Pettigrew mentioned and his buoys and others are available for inspection, the data that come from them that is. And so, for example, I have got pulled up on my computer right now as of 8 a.m. this morning the water temperature at one of the buoys is 39 degrees Fahrenheit and so it really is no mystery as to the temperature of this water. And so all of the various parameters that are fed into our modeling makes sense and we're not making them up. The temperature from the Normandeau Associates data collection in the '70s still holds true. And the purpose of taking those extra water quality parameters in 2018 specifically with temperature in mind was to confirm that those numbers are still holding true and are within reasonable estimates of what we would expect to find.

So throughout this process I focused heavily on the aquatic impacts because that is what Nordic asked me to do. Major potential for this project to impact the environment is really in the water and that would be in the -- in the way of this discharge pipe. And so we really looked at each of these various effluent parameters, compared them to background values and it is my assessment that based on the proposed aspect of this project it's not going to have a significant impact on the aquatic communities.

I'd also like to just focus a little bit on the Department of Marine Resources document that came out this month and I -- it's my understanding that there will be some discussion about how much we like this report and I know that DMR is going to be having their own the hearing, however, I'd like to focus on things that are basically indisputable facts in this and they're not opinions. The major piece is being that they compare the effluent filtration system to those of state and federal hatcheries in the state and otherwise and I'm just going to read out a couple of numbers betters that I think are important to remember here.

So currently the Department of Inland Fisheries and Wildlife and the Department of Marine Resources do not require effluent treatment from any aquaculture facility that obtains fish from a qualified source. So that means technically none of this has to happen, however, Nordic is really interested in being a steward of the environment and a good neighbor and ensuring the quality of the water in Belfast Bay for years to come. Let's see.

MS. RACINE: I have no objection to addressing them, I believe yesterday we discussed that Nordic wanted the ability for written comment. I know that we could have time at the hearing for oral testimony on the memo and we requested some additional time. I don't necessarily have objection, but I do just want to note that I want to ensure that the last panel has maybe some additional time given that we've gone over on this if that's not a problem.

MR. DUCHESNE: Absolutely.

MS. RACINE: Thank you.

MR. DUCHESNE: Yes, we're going to take the time necessary it just may be really uncomfortable.

(Laughter.)

TYLER PARENT: Almost done, I promise. So one more sentence here. It is worth mentioning that U.S. Fish and Wildlife Service Craig Brook National Fish Hatchery utilizes a 37 micron drum filter for solids followed by a UV dose of 45 millijoules per square centimeter on their effluent for the purposes of ISAV biocontainment. In contrast, Nordic Aquafarms biocontainment plan -- plan to filter solids to the 0.4 and that is the previous number and so we've all heard that it's been reduced to .04 micron level followed by UV disinfectant dose of 300 millijoules per centimeter squared. It is significantly over designed for biocontainment. And to put that in perspective, and mind you this is still based on the .4 micron level so it's only gotten smaller from there, their proposed effluent UV dose is 10 times the suggested level and the levels currently being used at a federal fish hatchery as well as their microfiltration is 200 times the minimum level and that's being used at the fish hatchery -- the U.S. Fish and Wildlife facility. And so I don't need to submit opinion on that. I don't need to tell you that the Department of Marine Resources thinks that that is more than necessary. I can leave those numbers right where they are because they can speak for themselves. That's it.

MR. DUCHESNE: Great. We can go to cross-examination. Ms. Tucker.

MS. TUCKER: Mr. Dill, you were present yesterday when I was asking questions regarding the temperatures. Isn't it true that Nordic has done absolutely no study on the ground at any depth independently of any data collection in Penobscot Bay for your modeling?

NATHAN DILL: No, that's not true.

MS. TUCKER: Really? Because you -- you just described that you were using a 1978 data and

Mr. Parent was talking about data from an old Normandeau study, so what -- what did you do that was independent collection at all depths in the area where you're proposing this pipeline?

NATHAN DILL: The -- the fact that we used data from a large survey of available literature and other sources does not preclude the fact that data were collected by Nordic.

TYLER PARENT: If I can add something. And the point is not about when the data were collected, it is about how representative they are of current conditions.

MS. TUCKER: How would you know what those are, sir, if you haven't collected them yourself independently of this time within the last two years that you've been in this area?

TYLER PARENT: Those values can be compared to those that are currently being taken by the various sources in the bay and as long as they hold true and are still within the same ranges they can be considered representative of today's values.

MS. TUCKER: Where were the temperatures and tests taken to come up with the 36 to 54 degrees at the bottom temperature that you referenced, Mr. Dill?

NATHAN DILL: Let's see. I would refer you to -- so I had submitted some rebuttal testimony. Let me see.

MS. TOURANGEAU: I'm handing you the rebuttal exhibits.

NATHAN DILL: Yeah, so this is Nordic Exhibit 34.

MS. TUCKER: Mmm Hmm.

NATHAN DILL: It shows a Figure 6-20, which was reproduced from that 1978 Normandeau report that shows some of the locations where data were collected that -- that that -- that this understanding of what the reasonable range of temperature and salinity and density conditions in the bay were taken from. This is just one of the sources. There are others -- you can look at -- in that same exhibit you can look at a figure that was reproduced from a report by Fandel, et al in 2016. It shows where some velocity measurements were taken. There is also in that same exhibit there are figures from a thesis by Bergund.

MS. TUCKER: What year?

NATHAN DILL: 1995. And a report by Xue in 2000 regarding the POM model that Dr. Pettigrew referenced in his testimony on Tuesday. That's -- that's model data. That was a validated model. All of these -- all of these observations are consistent with the data that we used in the analysis.

MS. TUCKER: So, again, you're relying on the work of other people, some of it decades old, to come up with what these temperatures are and your estimate is that the temperatures are between 36 and 54 degrees and I'm asking you at what depth along the proposed pipeline route would you find those temperatures based on your own independent study?

NATHAN DILL: The temperatures in the greater Penobscot Bay and Belfast Bay is highly dynamic. It is changing constantly. It changes depending on the depth, it changes depending on the season, it changes depending on the time of day. I would not be able to answer that question with any degree of certainty.

MS. TUCKER: And could you describe for me how the wastewater is going to be sent out of the facility through the pipe? Is it a continuous flow? Is it done in stages? Is it done -- at what tide? What -- what is the plan for that?

NATHAN DILL: You my understanding and my analysis is based on the assumption that the flow will be continuous at 7 -- at a rate of 7.7 million gallons per day.

MS. TUCKER: So that's roughly 90 gallons per second. What does that work out to be?

NATHAN DILL: I left my calculator in my backpack over there. I -- I don't want to do that conversion right now.

MS. TUCKER: So 365 days a year there is going to be a 7.7 million gallon flow continuously into the bay of water that is between 59 and 64.5 degrees and when that comes out especially in the winter months and spring that's going to be roughly 30 degrees warmer when it comes out of the pipe than the bottom temperature of the bay at that time.

NATHAN DILL: Yeah, I believe I just -- in my testimony just explained what that situation would -- would be like.

MS. TUCKER: Now, you said --

MR. DUCHESNE: Ms. Tucker, the audience in the back is asking you to move your mic over a little bit towards your mouth.

MS. TUCKER: Oh, sorry.

MR. DUCHESNE: Thank you.

MS. TUCKER: So you said roughly 27 degrees, so you've acknowledged at least 27 degrees higher temperature in the winter months that that's going to discharge at the bottom of the bay?

NATHAN DILL: Yes, that's what's I said. 27

degrees was the difference that my analysis was based upon.

MS. TUCKER: And I understood from Mr. Parent's prior testimony there has been no independent study done on what the impact of discharging water that warm on the adjacent lobster population in that area; is that correct?

TYLER PARENT: I would reference you to peer reviewed studies which suggests that that exact temperature range is actually suitable for lobster recruitment.

MS. TUCKER: You're saying that 27 degrees warmer than the current ambient temperature is suitable for a lobster?

TYLER PARENT: So the -- the 27 number isn't a very specific scenario, however, I can point you to a study from UNH that suggests that the 15 to 18 range is within the quoted 12 to 18 degrees and we're talking Celsius now, I apologize, that's from the report that I'm referencing, that that is suitable for lobster recruitment and actually preferred as the optimal temperature range.

NATHAN DILL: I'd like to just be a little bit more specific that we're not talking about water that is 27 degrees warmer. We're talking about water that is at 59 degrees Fahrenheit.

MS. TUCKER: Which is 27 degrees warmer than the ambient water temperature --

NATHAN DILL: That is also 1 degree warmer than 58 degrees Fahrenheit, so that -- describing it as being 27 degrees warmer does not really provide us very useful information.

MS. TUCKER: And isn't it true you've indicated that there is going to be within 20 feet of the outfall pipe the water will be 1 to 2 degrees warmer than the ambient temperatures in the bay, that's what you just testified to?

NATHAN DILL: Yeah, based on my analysis, yes.

MS. TUCKER: Okay. And isn't it true that lobsters will leave an area for a 1 to 2 degrees rise in temperature and have?

TYLER PARENT: I'm not sure where you got that. That's not necessarily true.

MS. TUCKER: And what do you base that on, Mr. Parent?

TYLER PARENT: The same study that I was just referencing in which controlled laboratory experiments were conducted and lobsters actually moved towards a source of just ever so slightly higher temperature and so I am not saying that that is always the case, however, I am saying that it is definitely not always the case that they would immediately leave an area due to a 1 to 2 degree temperature rise. And we have to remember that that 20 foot area just as we're talking about is not a significant portion of the potential lobster habitat in the area.

MS. TUCKER: Isn't it true that it is a significant portion of the lobster grounds fished by roughly 100 lobstermen in the upper Penobscot Bay, however?

TYLER PARENT: I would not say that a 20 foot circle, I guess, 40 foot diameter would be considered a significant portion of the lobster grounds in that area.

MS. TUCKER: But -- but it is the entire upper bay where this plume is going to be, isn't it?

TYLER PARENT: Well, we're talking about a 20 foot radius, am I right, radius there?

NATHAN DILL: It actually would be -- it's along the line of the diffuser so it would be roughly a rectangle that would be 20 feet by 100 feet.

TYLER PARENT: Understood. And so with that in mind, no, that is not a significant portion of the total area of the fishable water in Belfast Bay.

MS. TUCKER: But we are losing a significant amount of fishable water in Penobscot Bay because of the location of the pipeline?

TYLER PARENT: That would be -- significant in this conversation is really subjective. I would say that if you look at the total square footage or volume of water it really does not constitute a large portion of the bay. And the larger the area that we talk about the more this water has diffused and so every time we're talking about a 1 to 2 degree rise we are talking about that immediate area 20 feet from the diffuser.

MS. TUCKER: You're speaking about a stratification that changes radically from season to season and mixing behavior that varies quite a bit, your words, depending upon whether it's slack tide and it varies with the season and it's highly dynamic situation and despite these variables Nordic does not propose to have any variation in how and when it discharges this water into Penobscot Bay; is that correct?

NATHAN DILL: I -- I am not aware of any plans to sort of tailor the -- the discharge rate to conditions in the bay.

MS. TUCKER: And, Mr. Parent, you've mentioned that -- I'm going to use the exact words. I don't want to misquote you. Well, first of all, let me ask, did you consider the environmental assessment that was done by the Corps of Engineers for the Searsport dredge project when you did your evaluation?

TYLER PARENT: That's an independent project to this and so I was given the parameters that I -- I was given and I consulted with state agencies to get my species list of potential fish and shellfish to consider as well as adding three others that were not requested.

MS. TUCKER: And did you consider the environmental assessment from the Corps of Engineers which identifies that this is an area that has a high concentration of winter flounder?

TYLER PARENT: I did not specifically consider that assessment, however, as stated in my testimony two days ago, I absolutely do acknowledge that winter flounder have habitat that would be suitable in the project area.

MS. TUCKER: And are there any native salmon in the bay in Penobscot Bay year-round? Or did they migrate someplace else?

TYLER PARENT: They migrate someplace else. They are anadromous and so their life history has them return to their natal waters, in this case Penobscot River, to attempt to find their spawning grounds higher up in the watershed and then they head out to sea to eat and grow strong before hopefully coming back, so, no, they are not resident in the bay.

MS. TUCKER: And as you mentioned the temperatures that are being chosen for the water of this facility are intended to raise healthy salmon the 15 to 18 degrees Celsius or 59 degrees to 64.5 degrees Fahrenheit is -- is -- because of your choice of salmon to be raised.

TYLER PARENT: So that is the optimal temperature range for successfully rearing salmon in this aquaculture facility, yes, and this is based on Nordic's experience of doing it elsewhere.

MS. TUCKER: So Nordic is creating an artificial environment on land for the optimal temperature for salmon because they've chosen salmon as what they want to raise there, but that is not a temperature that is consistent with the ambient temperature in the bay year-round?

TYLER PARENT: It may not always match the temperature of the bay, that's correct.

MS. TUCKER: And, Mr. Dill, what is the temperature of the water coming from the bay into the facility when they suck the water out? What is that temperature?

NATHAN DILL: Well, that would vary during the year and I think the -- the range that -- reasonable range for that I mentioned that earlier. I have it written down here somewhere.

MS. TUCKER: And while you're looking I also want to ask you what the temperature of fresh water intake is.

NATHAN DILL: I had it. I know I said what that was.

MS. TUCKER: My question is are you sucking it in from sort of the bottom so it's 36 to 54 degrees Fahrenheit?

NATHAN DILL: Yeah, those are the numbers I was looking for.

MS. TUCKER: Okay. So when you're sucking water in it's 36 to 54 degrees Fahrenheit, but it's coming out 59 to 64.5 degrees Fahrenheit. Isn't it true that there is technology available that could chill this water before discharge so that it was consistent with the ambient temperature of the bay and would not have to be higher than the temperature of the bay?

NATHAN DILL: Yeah, I -- my -- my -- yeah, my -- I'm not really here to testify with respect to what happens to that water in the system and how it's managed within the system. My analysis really has to do with what happens to that water after it comes out of the diffuser.

MS. TUCKER: I'm asking you based on --

NATHAN DILL: I have a freezer that I can put water in and turn it into ice cubes, yes, there is technology available to cool water.

MS. TUCKER: But Nordic has chosen not to use chillers and is choosing to dump water into the bay that is higher than the temperature of that water when they sucked it out of the bay.

NATHAN DILL: I can't --

MS. TOURANGEAU: Objection.

NATHAN DILL: -- answer the question regarding what exactly Nordic is choosing to do with that water in that system.

MS. TUCKER: But your modeling is based on dumping water that is higher than the temperature that it came out of the bay at, so I'm asking you clearly that's a choice because it came out at one temperature and it's going back at a much higher temperature and that -- and there is technology available to make it the same temperature that has to be a choice.

MS. TOURANGEAU: I --

NATHAN DILL: Any temperature -- any technology available to cool water is --

MS. BENSINGER: Excuse me, Mr. Dill?

NATHAN DILL: Yes.

MS. BENSINGER: Is there an objection.

MS. TOURANGEAU: There is an objection. We've had now two or three questions that go outside the scope of Mr. Dill's testimony, which is on modeling and into Nordic's discussions about their water treatment.

MR. DUCHESNE: That is correct and I'll sustain the objection. Thanks.

MS. BENSINGER: When there is an objection, please stop talking --

NATHAN DILL: I wasn't -- yeah, sorry about that.

MS. BENSINGER: -- allow the objection to play out. Thank you.

MS. TUCKER: And I just want to touch on one thing. You said you did the modeling based on using, and this is your words, imaginary particles, quote, unquote, used to estimate the dilution including dilution of nitrogen, so all of this was done using estimates, imaginary particles and modeling but no actual collection of data within Penobscot Bay, correct?

NATHAN DILL: By -- by the very nature of the type of numerical modeling that I do it's all imaginary, so, yes, that's correct.

MS. TUCKER: I have no more questions.

MR. DUCHESNE: Thank you. Ms. Racine.

MS. BENSINGER: If I might remind all of the questioners we've got a request that you be careful to keep speaking into the mic so that the audio streaming people -- people listening online can hear. Thank you.

MS. RACINE: Okay. Hopefully this works. Good morning. Mr. Dill, in your October 2, 2018 memo to Nordic I believe it spans Pages 7 and 8, you recommended a field data collection program be designed and implemented at the water discharge site for further analysis and to check the accuracy of model results; is that correct?

NATHAN DILL: I am not -- I don't have that particular memo right in front of me at the moment.

It's somewhere in here. Yes, I believe I did make that recommendation, yes.

MS. RACINE: Would you support doing local field dye discharge studies to see how Belfast Bay diffuses discharge at the plant site?

NATHAN DILL: I'm sorry, I didn't quite catch that.

MS. RACINE: No, that's okay. I'll slow it down a bit. Would you support doing local field dye discharge studies to see how Belfast Bay diffuses discharges at the plant site?

NATHAN DILL: Yeah. Yes, I support -- I would support collecting data to -- yeah. I mean, I -- my -- I guess I would add to that that by the nature of the type of modeling work that I do it essentially requires observations to verify the models. The models are not very helpful if you can't demonstrate that they're accurate, so I support data collection efforts because, you know, because, first of all, it tells us about what's going on and, second of all, it is information that we need to validate and verify models.

MS. RACINE: And so field dye discharge studies would be included in that type of data collection that you would support?

NATHAN DILL: You -- yes.

MS. RACINE: And would Nordic collaborate with independent scientists to design such a data collection and analysis?

NATHAN DILL: I am not sure if I'm in a position to answer that question.

MS. RACINE: Okay. Do you -- do you agree that data collection and monitoring of oceanography data should include additional site surrounding the water discharge site not just at the discharge site?

NATHAN DILL: Well, yeah, I mean, you -- we're looking at phenomena that varies spatially, so having data collected in different locations so that you can make sure that your model and your understanding of the physical processes that are going on involves an understanding of that spacial variability, yes, I think -- I think -- I would agree with that.

MS. RACINE: And would you support that type of a data collection and monitoring on a year-long real time monitoring basis before building the system?

NATHAN DILL: I mean, you've asked me a number of questions about whether I -- whether or not I support data collection and I think that the more data the better.

MS. RACINE: Do you agree that the full three-dimentional numerical modeling of Belfast Bay circulation and mixing would be a key addition to the regional monitoring? I do understand you've explained to us that CORMIX modeling is three-dimentional in the near-field. My question is about three-dimentional modeling in the far-field.

NATHAN DILL: I think that the question is somewhat outside of the scope of what my testimony is in regard to, but.

MS. RACINE: If you know you can answer.

NATHAN DILL: Again, you know, I'm a -- I'm a modeler, so I love big models that accurately simulate large bays.

MS. RACINE: How long does equilibration take in your ADCIRC model? The point at wish things stop accumulating, did you calculate that?

NATHAN DILL: I'm not -- I guess I'm not sure what you mean by equilibration. We -- we run the model -- the ADCIRC model technically is the tidal model and these types of circulation models in general typically have to be due to issues with the -- the techniques, the mathematics, the matrix solvers that go into the software that actually simulates these things. Those mathematical techniques can produce spurious results and if you -- if you have a, you know, the models are driven by a boundary condition where you're saying this is what's happening on the boundary, this is what's happening on the surface. If you basically shock the model by changing that too quickly that can cause the model to, you know, we, you know, I guess we call it blowing up. But it can cause the model to give you completely unrealistic results and -- and so all of these -- the models for the most part start from a -- from a condition where the water is perfectly still and not moving at all and so in order to -- in order to get the model to actually simulate something like -- that you're actually observing like a full range of the tide going in and out of the bay you have to kind of start it slowly and fill up that boundary condition and so we call that a spin-up period and for this -- for this particular model, for the ADCIRC model we use a 14 day long tidal spin-up period and then the actual results that were used in the analysis were taken from the model simulation after that time period.

MS. RACINE: So I think maybe I'm referring to, and you can correct me if I'm wrong, but the equilibration I think you were describing earlier in your testimony when you were telling us about the different -- the various temperatures of the water and the salinity and you were explaining to us that it takes time for that discharge based on the temperature and based on the season and based on the salinity which would vary based on the fresh water discharge at that time into the bay and then what -- at what point those things -- does that make sense what I'm asking you?

NATHAN DILL: Yes. I think you're asking more along the lines of at what point do you reach sort of a -- it's not really a steady state but sort of a quasi steady state, which is when there is a balance between how quickly the -- that the diluted effluent is sort of diffusing away with the rate at which it's being ejected into the bay, right?

MS. RACINE: So does -- does your ADCIRC model address how long that takes?

NATHAN DILL: No, not -- the ADCIRC model doesn't specifically but the particle tracking model does and -- and so that simulation was run for 30 days and I think if I can...

MS. RACINE: Did that simulation include considering measured ambient flow?

NATHAN DILL: To the respect -- to the...
MS. RACINE: So I guess you were saying that the ADCIRC model didn't address the -- the coming to the steady state, but then you're saying that the particle tracking did and I guess my follow-up --
NATHAN DILL: Yes, the ADCIRC model --
MS. TOURANGEAU: I'm going to object and say that there have now been three questions and Mr. Dill hasn't been able to answer the first of the three yet. So can we...
MS. RACINE: Sure.
NATHAN DILL: It provided supplemental information to the DEP. I'm trying to find what letter or memo that was in, but where we looked at the age of the particles and then what the -- what the dilution would look like within an area where the average particle age was about, you know, on average about 48 hours and -- and I believe that -- that calculation was done starting from -- the simulation necessarily starts out with no particles in the bay and then it starts ejecting the particles and then you have a number of tidal cycles that go back and forth past the discharge. And I'm going to move my finger back and forth here and what I'm doing is I'm kind of drawing an ellipse repeatedly that represents

what the tidal current is doing, but then tidal current also moves with the mean current and which is the type of current that Dr. Pettigrew was talking about that can be influenced by wind, ocean currents, other features that for the most part were not accounted for in the ADCIRC model. And so what happens over a certain number of tidal cycles that -- that sort of drift of this sort of oscillating elliptical path will move away at a certain rate from the -- from the discharge and at that point if you look at what the concentrations are they kind of -- they kind of achieve sort of a -- it's not steady because it's constantly changing with the tide, but if you were to average things over a tidal cycle you achieve sort of a steady condition. And I can't -- I'll just -- I don't want to -- I don't want to be, you know, specifically precise about this, but it takes on the order of a week or two weeks or so for that to reach sort of a steady condition. So -- so I guess -- I'm not sure if I'm answering your question, but I think that the -- you wouldn't expect to see what the long-term impact of the, you know, what the long-term conditions are in, you know, the long-term influence of the discharge within, you know, a day or two from when it starts. You would want to wait, you know, a couple weeks, a month, but then once you've done that, you know, within that sort of order of magnitude of a few weeks the sort of average conditions aren't really going to change beyond that. You've kind of reached sort of a quasi steady condition where that continuous discharge is now -- you're not seeing that sort of ramp-up, I guess.

MS. RACINE: Okay. And I think that description about the ellipse and about the particle tracking, I guess when you were doing that, does that model consider current at different depths? I think you were describing the current, but is that also at different depths?

NATHAN DILL: The analysis that I did considers the current to be averaged over the depth, so it doesn't really consider the depth.

MS. RACINE: Can the ADCIRC model be parameterized by water measurement of water current or only validated?

NATHAN DILL: I'm sorry, I'm not sure if I understand your question.

MS. RACINE: Can the ADCIRC model be, I guess -- I guess manipulated by or designed by measurement of water current or can you only have model and then validate it?

NATHAN DILL: The purpose of the model is to solve the mathematical equations that estimate or predict what the currents are. If you knew what the currents were there would be no reason to use the model.

MS. RACINE: Have you ever -- have you made any hydrodynamic measurements to validate your model in the project area?

NATHAN DILL: No, personally I have not.

MS. RACINE: Are there other possible plume trajectories other than the ones that you have presented thus far?

NATHAN DILL: The analysis that I did was designed to be representative of sort of typical conditions and intentionally neglected influence of wind or, you know, we could -- we could also, you know, try to input a boundary condition to account for the type of non-tidal current maybe driven in by the eastern Maine coastal current that Dr. Pettigrew talked about. We did include the influence of not a maximum flow in the Penobscot River but an average annual flow, so what the average discharge is that comes down the river over an entire year. But we intentionally did not look at specific weather conditions because -- because if we had then we would have been modeling a specific weather condition. It's more useful to look at more general conditions and when you do add additional -- when you do add additional forcing to the model it creates additional non-tidal currents which only tend to increase the dispersion of that discharge. So by -- by excluding those -- those the forcings from the model we are providing a conservative estimate. We are likely overestimating what the concentration -- or underestimating what the dilution would be.

MS. RACINE: Are you saying that if we took those aspects into consideration there is no way that it would tell us that the concentration would actually be more based on those conditions?

NATHAN DILL: It's a very dynamic situation and so I -- I couldn't tell you unless you said specifically what those conditions were at a specific time and a specific location I wouldn't be able to answer that question.

MS. RACINE: I just -- you had said that it was conservative because we can only assume that if we took into consideration those other parameters that it would be only more diluted I guess is my -- that the inverse to that would be that are you saying that if we took those into consideration there is no way that the concentrations could be more than Nordic is considering?

NATHAN DILL: I would -- are we talking about concentrations in a specific location at a specific time or are we talking about overall generally within the region?

MS. RACINE: I was responding to your comment about it being conservative, I suppose.

NATHAN DILL: So my -- my comment about it being conservative is with respect to within the region over sort of general, you know, considering a generally reasonably long period of time and a general reasonably large area.

MS. RACINE: Do models CORMIX density, gradients reflect those measured at the site, if you know?

NATHAN DILL: The -- the ambient stratification conditions that were input to the CORMIX model are based on what I determine to be reasonable representations of what has been observed near, you know, in the upper Penobscot Bay in Belfast Bay near the location.

MS. RACINE: So at no point you -- you didn't measure the density gradient?

NATHAN DILL: I personally did not measure the density gradients.

MS. RACINE: And you may have already spoken to this, but based on your model what is the residence time of the discharge water in the body of water construes by Islesboro and the mainland? I think you had said something about one to two weeks, but perhaps this is a slightly different question.

NATHAN DILL: So residence time can take on different very specific definitions. And it's -- in a situation like this where we have a tidal environment it's very hard to define and depending on how it's defined you may calculate a different number. I do not believe I made any statements with respect to a residence time.

MS. RACINE: Would that --

NATHAN DILL: Other than -- other than to say I think there was in someone's -- the intervenor testimony mentioned that we had underpredicted flushing times or something like that, but that's not -- that's not true. We didn't mention a flushing time or estimated flushing time or predicted flushing time.

MS. RACINE: With residence time -- I know you said you didn't necessarily look at that, but would it be relative to the accumulation of effluent in this area?

NATHAN DILL: You'd have to define what you mean by residence time.

MS. RACINE: I guess how long would be the length of time for the first particle to leave the body of water if we defined it that way.

NATHAN DILL: What body of water? How big of an area are you talking about?

MS. RACINE: Or the last period of time for the last particles to leave the body of water.

NATHAN DILL: You'd have to define what area or body of water you're talking about.

MS. RACINE: The water entrained between Islesboro and the mainland.

NATHAN DILL: That's -- that's really not a specific enough of a definition of an area or body of water to be able to calculate a residence time.

MS. RACINE: Is the mean nutrient concentration that you model in CORMIX and the ADCIRC representative of instantaneous nutrient discharge concentrations or would you say it's an hourly or a daily or weekly or some other kind of average?

NATHAN DILL: The -- the models -- the CORMIX model gives you a dilution. It does not calculate the concentration. The ADCIRC model doesn't even calculate the dilution. It's the particle tracking model that -- that then allows us to calculate the dilution. Concentration once you've known the dilution, the concentration is a function of what the concentration of the effluent is and the concentration of the background. And so -- so we -- other than -- other than I think some example calculations that we did regarding nitrogen we're -- we're not able to calculate the concentration of anything without knowing what the, you know, what the -- what those other concentrations are.

MS. RACINE: Would you say that there could be activities that would result in higher than average concentration discharge from the facility on any given day?

NATHAN DILL: That's not really within the scope of my analysis.

MS. RACINE: How far from the discharge pipe does the CORMIX characterize concentrations; in other words, how are you defining the near-field?

NATHAN DILL: Really looking at the -- at the area where the initial mixing occurs due to momentum from the -- from the high velocity of the discharge water, so as the water comes out of the -- of the discharge port it's coming out very fast, but then as it mixes with the surrounding water it slows down and so that near-field region is essentially the region where the mixing is dominated by the turbulence of -- of that outfall and it also includes the area which is in many cases the same area where the plume is rapidly rising due to buoyancy. If -- if in that condition based on the density difference between the effluent and the ambient water quality you're getting a high rate of rise because of the velocity. That region it's really hard to define specifically where that is because it -- it depends on what the ambient conditions are. It depends on what the difference between the ambient conditions and the effluent are. But in a sort of general sense the transition from that near-field region to the far-field region happens where the dominant processes are no longer tied to the -- to the outfall itself but are more taken over by what's going on in the larger waterbody.

MS. RACINE: So if you recall, Ramboll, I think, was asked to evaluate some of Ransom's memos I believe on October 16, 2018. It was part of the MEPDES application.

NATHAN DILL: Yes, I have a memo here dated October 16, 2018 from Ramboll.

MS. RACINE: Okay. And in it would you agree that Ramboll agrees with your recommendation for field data collection to generate data to validate the model results. In addition, it would be reasonable to be conduct baseline monitoring of water quality and eel grass conditions at the two eel grass bed locations identified in the far-field dispersion memo. Did I read that correctly?

NATHAN DILL: I guess if you could refer me to a specific paragraph I can confirm whether or not this memo -- copy of the memo I have says the same thing.

MS. RACINE: Okay. I can find that, but I just --

NATHAN DILL: You know, I think it is in their conclusion --

MS. RACINE: It is, yeah. I think looking down at the end.

NATHAN DILL: -- it's the next to last paragraph. It says -- I can read it if you'd like.

MS. RACINE: Sure.

NATHAN DILL: Ramboll agrees with Ransom's recommendation for field data collection to generate -- to generate data to validate model results. In addition, it would be reasonable to conduct baseline monitoring of water quality and eel grass concentrations at the two eel grass bed locations identified in the far-field dispersion memo, Figure 6, after installation and operation of the outfall monitoring could continue periodically until the influence of the discharge water has been sufficiently characterized.

MS. RACINE: So I guess my --

NATHAN DILL: I think that the -- where they refer to Ransom's recommendation I think that's only applicable to the first sentence of that.

MS. RACINE: Okay. Yup, that's fair. To your field of data collection?

NATHAN DILL: Yeah.

MS. RACINE: Okay. And let me ask though, would it be reasonable to conduct baseline monitoring of water quality and surveys for eel grass present in areas affected by the far-field dispersion model? In your opinion.

NATHAN DILL: I don't know if that's absolutely necessary because I think that you would want to really focus that -- I mean, I think what we've seen is that you're not going -- you're not likely going to be able to detect any influence there.

MS. RACINE: So not likely to detect any influence, but I guess if we don't have a baseline we wouldn't know if any of the effects later were coming from the discharge or not, would that be accurate if we didn't have a baseline?

NATHAN DILL: I guess that really doesn't -- that's really sort of outside, I think, my scope of what I'm testifying about here.

MS. RACINE: I think you've already referenced this, but there was an August 14, 2019 response to Mr. Martin for some additional information about the temperature of the thermal component of the discharge to the receiving water. In that response you stated that the temperature of the effluent is expected to be a constant 13 degrees centigrade, ambient temperatures range from zero centigrade to 22 centigrade. I think you've testified here today as well as I believe on the actual discharge permit the figure we have consistently seen as 15 to 18 degrees; is that correct, for the effluent?

NATHAN DILL: Yes, that's correct.

MS. RACINE: On Page 2 of your September 27, 2018 initial dilution memo you also used a 13 degree Celsius figure and that was to assume for density purposes; is that right?

NATHAN DILL: The September 27 memo?

MS. RACINE: Correct. Page 2.

NATHAN DILL: Page 2. I thought you said Page 7.

MS. RACINE: Oh, sorry.

NATHAN DILL: Yes.

MS. RACINE: So even though you used 13 degrees centigrade that figure as I understand today is 15 to 18?

NATHAN DILL: Yes, at the time that this analysis was done I was working with an understanding that the discharge water would be 13 degrees centigrade.

MS. RACINE: The application was dated, I believe, in 2018 and said 15 to 18 and I believe your response to Mr. Martin was August 14, 2019.

NATHAN DILL: Yeah, I think we're discussing the same model results. So that -- if you look at that response to that letter you can look at the CORMIX runs that were submitted along with it were performed in July of 2018.

MS. RACINE: Okay. So that wasn't later updated?

NATHAN DILL: Yeah, so those CORMIX

simulations were performed at the same time as the ones described in this -- in this memo.

MS. RACINE: And you also in that response stated that the ambient temperatures could also range up to 22 centigrade, which would be 71.6 degrees Fahrenheit. I did the math this morning. Where did you get that figure from, the 0 to 22? 22 being the highest.

NATHAN DILL: You know what, I don't think it's included in one of the exhibits, but.

MS. RACINE: Would it be the Normandeau data from 1978?

NATHAN DILL: All right. So there is a report here. It's an oil pollution and prevention and abatement management study for Penobscot Bay. It was prepared by Normandeau for the State of Maine Department of Environmental Protection. Inside this document there is an extensive review of data collection within upper Penobscot Bay where they refer to numerous studies and measurements that were taken going back I think even into the early parts of the 20th century and they provide a -- a figure that shows maximum -- a maximum temperature of 22 degrees centigrade.

MR. DUCHESNE: May I interrupt?

NATHAN DILL: That's surface. Yes.

MR. DUCHESNE: I'm doing time management again. Of 25 minutes you've requested, we've now hit that point. I'm not going to crap the whip, but I'm also sitting here assessing how much I'm going to be able to allow other people and questions from the audience, so.

MS. RACINE: Absolutely. I have about two, maybe three questions.

MR. DUCHESNE: Terrific. Thank you.

MS. RACINE: Okay. I'm glad you referenced that report. Is that in your testimony earlier when you were -- you were speaking about where you got information about seasonal stratification, was that -- I believe you said it was a comprehensive picture of the bay.

NATHAN DILL: Yes. This report actually gives a very comprehensive picture of what's going on in the upper Penobscot Bay and it even includes the 40 year old Fortran model for simulating an oil spill within the upper Penobscot Bay.

MS. RACINE: And what was the frequency of those measurements during that time and was it at different depths?

NATHAN DILL: The information provided in the report is a summary of multiple observations and it provides a minute, maximum and mean value. It doesn't tell me exactly what the frequency of measurements was made, but I assumed it was a variety of different time series type measurements, spot measurements. It really doesn't get into the detail of exactly how those measurements were all done.

MS. RACINE: But we don't know if they were all daily or weekly or we -- we don't have any idea about the exact frequency?

MS. TOURANGEAU: So objection. At this point, we're going into the Normandeau report, which is not the modeling that Mr. Dill did.

MR. DUCHESNE: That would appear to be true to me, so I would sustain the objection.

MS. RACINE: I would just say that he specifically cited this 1978 report in attachments to his pre-filed testimony.

MS. TOURANGEAU: For temperature, not the underlying modeling.

MS. RACINE: I would just say that earlier he told us it was a comprehensive picture of the bay just a few moments ago.

MR. DUCHESNE: Okay. For the time being I will sustain the objection and move on.

MS. RACINE: Okay. So Normandeau actually took two readings for two days in August 2018, is that your understanding?

NATHAN DILL: Yes.

MS. RACINE: And part of that data collection were some temperature readings; is that correct?

NATHAN DILL: I have not -- I am not -- that really -- that measure -- those measurements are not really part of my testimony, so I'm not really sure if I can answer those questions correctly.

MS. RACINE: Well, a high recorded temperature on those readings on those days was on August 25, 2018 and that was a 19.26 centigrade reading which would be, again, I did this this morning, 66.7 degrees Fahrenheit. I guess did you ever take any of those measurements into consideration when you were doing your work?

NATHAN DILL: When were -- when were those measurements made?

MS. RACINE: On August, I believe, 23 and 25, 2018.

NATHAN DILL: So my analysis was done before that.

MS. RACINE: Okay. Thank you.

MR. DUCHESNE: Great. Thank you. I just want to double-check to see if other of our other intervenor groups have one single overriding question they've been dying to ask. And, if not, we're going to move on immediately to questions from the Board and the Department. Mr. Parker.

MR. PARKER: I have a simple question regarding the discharge configuration. You're talking about three 12 inch diffusers on the end of that pipe now?

NATHAN DILL: Yeah, yeah, diffuser with three 12 inch openings.

MR. PARKER: Okay. And they'll have a velocity -- exit velocity of about 6 1/2 feet per second for the water coming out?

NATHAN DILL: Is that -- is that based on a calculation of the cross-sectional area?

MR. PARKER: It is in the calculations.

NATHAN DILL: So, yeah, I think that's -- that would -- that's the velocity that would have -- that the CORMIX model would have also calculated. I would add to that that the design actually includes putting like a duckbill valve on the end of the -- those diffuser ports which will constrict the opening which will increase the velocity. That's pretty common for this type of diffuser although it's not something that the CORMIX model considers explicitly. So that will tend to increase the velocity so you likely will see greater initial dilution than what the modeling shows. And I don't know if for those who are not familiar with what -- what that is, it is essentially like a, you know, a section of a rubber tube that's crimped down at the end not too much unlike the -- the party favor things with the cardboard tube that you blow through and they open up and what that does is it helps to maintain higher velocity even if the discharge is lower than the -- than the 7.7 million gallon per day rate. So it allows the -- it allows the initial dilution or the diffuser to sort of perform better over a range of discharge velocities. It also -- it also has an added benefit of preventing intrusion of salt water up into the intake or keeping, you know, a critter or something out of there that might try to climb in there.

MR. PARKER: Okay. So that sort of follows-up --

NATHAN DILL: It's a one-way check valve.

MR. PARKER: Okay. Because I was going to say that pipe is going to fill up with water and that velocity with only three of those -- do you have ahead enough at the plant to drive that water in that pipe at that rate?

NATHAN DILL: You know, I'm not -- I'm not too familiar with exactly the -- the actual design of the pumping system or, you know, whether it will be gravity fed, but, yeah, that's -- that is something that is definitely considered, but it was not really part of my analysis. But you're correct and when you have a situation where you have brackish or fresh water discharging into a -- into a saline environment you get -- you get potential for an upstream -- an intrusion into the pipe. The other thing I would say is that -- is that it's very likely that when -- when the plant begins to operate and the discharge velocity is not at that full 7.7 million gallons per day rate that -- that maybe only one or two of those ports will be opened initially so it can maintain a high exit velocity.

MR. PARKER: Okay. And you think the duckbills will prevent backflow from filling pipe because the tide is going to go up the pipe just as well as it can go up the bay.

NATHAN DILL: Yeah, they -- they're a check valve. They -- they essentially clamp shut and so if they're -- when the pressure is coming -- pressure trying to drive upstream will actually cause them to clamp shut and prevent water from backing up. They're used very commonly to provide like a, you know, for drainage into tidal areas to prevent intrusion backup.

MR. PARKER: And when the plant first starts up when you have reduced flow because you have below your 7.7 million gallons is that going to have any impact on cooling the water before it gets to the discharge point?

NATHAN DILL: Impact on cooling the water?

MR. PARKER: Yeah, you've got -- if my numbers are right you've got 400,000, 500,000 gallons of storage in the pipe from the discharge to the plant. That's a lot of water.

NATHAN DILL: That -- and that would -- that would cool somewhat as it loses heat.

MR. PARKER: Go back to the ambient of the outflow?

NATHAN DILL: Yeah, I think that will happen. That's not something that we've accounted for, but, you know, it depends on what the rate -- I haven't -- I haven't actually done an analysis to say how much heat would be lost from the -- from the effluent into the bay as it's flowing through the pipe. You certainly would lose some, but I think that we've kind of assumed it all comes out at the end. It's all going -- all that heat is going into the water in the bay anyhow, so as far as what the sort of long-term overall impact of heat to the bay any heat lost when it's within the pipe is going to also be lost to the same...

MR. PARKER: Because I think it will gain heat and lose heat. I just -- it affects the mixing zone, that's all. That's enough. I'm all set.

NATHAN DILL: Yes. Yes.

MR. DUCHESNE: Yes. Mr. Sanford.

MR. SANFORD: Should this facility receive a permit or approval, would you be able to use isotopes or dyes or other markers to verify the far-field dilution predictions from your model?

NATHAN DILL: Yes.

MR. SANFORD: Have you used isotopes to examine such things as the previous Penobscot mathematical modeling to see how that was verified, how that came out in the field?

NATHAN DILL: I -- I don't have personal experience with that.

MR. SANFORD: Or dyes?

NATHAN DILL: No, I don't really have personal experience with that kind of study myself. I -- I do have experience, however, with situations where -- in other environments where the discharger was required to collect various different data of the constituents they were discharging because they were -- they were essentially exceeding what the -- what they were allowed in terms of -- I can think of one example was saline water being discharged into a fresh water lake and -- and using that information to verify the model results, so it was, you know, basically diverse collecting salinity data around the diffuser.

MR. SANFORD: Can any of the existing buoys collect data that contribute to this?

NATHAN DILL: I -- it depends on what -- if you were to use a dye or an isotope it would sort of depend on how detectable it would be, but, you know, at a certain distance away I would look at -- I would look at the model results to give me, you know, an idea of how far away you might be able to detect something based on what we already know and I would look inside that area when doing a study like that because I think if you get too far away and I think many were -- any of existing buoys are probably too far away from this site to be able to make that observation. I think that you'd find that the dye may very well be diluted too much to be measurable at that point.

MR. SANFORD: As an engineer, what would your recommendation be to your client for sampling particularly in the far-field?

NATHAN DILL: My recommendation would be to let me go back and look at the model results and come up with a plan for you.

MR. SANFORD: Okay. So is there some point for periodic assessment like year one, year two things like that, Phase 1?

NATHAN DILL: You know, I -- I fully suspect that that is going to -- we're going to see that coming down the road here that there will be development in consultation with the DEP, you know, that there will be a development of a plan to monitor what's going on and that will involve, you know, verifying, you know, use of the model to help design that plan and then also to -- the use of the data collected to verify that that's accurate so that we can go forward be more confident in the predictions we're making.

MR. SANFORD: Okay. Thank you.

MR. DUCHESNE: Mr. Wood.

MR. WOOD: Mr. Dill, thank you very much for your explanation of the temperature issues because there was a lot of confusion when it came to the difference in the temperature versus the temperature of the Delta T and the receiving water, so thank you for that. So all discharges by state law are given a reasonable opportunity for mixing with the receiving water before the receiving water surrounding the discharge will be tested for classification of the -- for violations. So you calculated some dilution factors, the acute chronic dilution factors consistent with the methodology in Chapter 530 and would you agree that the temperature is an acute effect?

NATHAN DILL: Yes.

MR. WOOD: So we would be looking at acute dilution factors, correct?

NATHAN DILL: Yes.

MR. WOOD: And we would call that the zone of initial dilution the reasonable opportunity for mixing and I thought I heard you say earlier that you -- the area that you would consider to be the zone of initial dilution was a 20 by 100 area; is that right?

NATHAN DILL: Yes. And I can -- that's what I said, yeah. And I think we could -- we could be more specific about that if we look at the CORMIX output. So there was a -- it's in the August 14 letter to Kevin Martin. We provided the prediction file output from CORMIX for the various different conditions and I think we would look at the -- we would look at the -- it's kind of -- it's kind of the way it went in the file, but it's intermediate depth, slow current winter condition and I think -- I should have dog-eared this page, but I found it here. So I was looking at -- at these results and based on that -- based on that -- the temperature differential that we looked at it was a dilution of 7 that would be required to meet that criteria and we have a dilution of -- the model shows a dilution of almost 14, 13.7, that is less than 3 meters away. I was being a little bit conservative in making that area a little bit larger and it's where the dilution is at roughly 6 meters, so roughly 20 feet or so is -- is 18.9, so it's conservative more than this 7.

MR. WOOD: Okay. Well, it got a little confusing as far as the Delta Ts and that kind of stuff, so I did some back of the neck calculations trying to simplify it using your 10 to 1 dilution factor.

NATHAN DILL: Yes.

MR. WOOD: So I thought I heard Mr. Cotter say last night that the temperatures in the bay range anywhere from 32 degrees to 72 degrees during the summertime.

NATHAN DILL: Yes.

MR. WOOD: And the salinities are between 20 and 25 parts per thousand both in the discharge and in the bay?

NATHAN DILL: I think the salinity in the bay can be as high as 30, 31.

MR. WOOD: Okay. Thank you. So if I took the worst case scenario what you're -- with you folks discharging at -- proposing to discharge at 18 degrees centigrade or 64 degrees, in the non-summer season, which is the Delta T and the rule in Chapter 582 is a Delta T of 4 degrees, we're looking at 64 degrees minus 32 degrees gives me a Delta of 32 degrees which I think has been -- has been drawn around here is around 30, 32 degrees --

NATHAN DILL: Yes.

MR. WOOD: -- and you use the 10 to 1 dilution factor we're talking about a Delta T in the receiving water of 3 degrees, correct?

NATHAN DILL: Yes.

MR. WOOD: Within the -- within the --

NATHAN DILL: Within that range, yes.

MR. WOOD: Within the zone of initial dilution of by 200 by 100 --

NATHAN DILL: Yes.

MR. WOOD: -- it's around 3 degrees. In the non- -- in the summer season, if you take the 72 degrees, worst case scenario, even though the rule does talk about not being able to change the mean of the daily mass I want to take the 72 as worst case scenario --

NATHAN DILL: Yup.

MR. WOOD: -- and if you're discharging at 64 that's a Delta T of 12 degrees divided by 10 as your dilution factor is 1.2 degrees Fahrenheit, would you agree with that? These are just -- these are just general calculations.

NATHAN DILL: Yes. Yes.

MR. WOOD: Okay. So let's go to salinity. Would the same dilution factors provide to salinity?

NATHAN DILL: Yes.

MR. WOOD: So if you have, I'm going to take worst case scenario, if you guys are -- folks are proposing to discharge at 20 parts per thousand into a receiving water of 30 parts per thousand that's a Delta of 10 parts per thousand divided by a 10 to 1 dilution factor would give me a decrease in salinity of 1 into receiving water after it's mixed; is that correct?

NATHAN DILL: Yes.

MR. WOOD: Okay.

NATHAN DILL: I would add to that too that during -- during a portion of the year the water of the surface is essentially the same salinity of the discharge water.

MR. WOOD: Okay. I think that you've already -- I think there was a question down here as far as gathering additional information because a lot of this stuff has been based on historic data and when Mr. Pettigrew was here I think you folks talked and that additional information in the bay locally and larger would be a good thing and would you be willing to -- if you were to if people were to collect that data, use that to refine your model when it comes to the far-field because that is a little less defined than in the rule where the far-field is -- I mean the near-field is pretty well defined in how you calculate that, so would you be open to refining your model if additional data is collected?

NATHAN DILL: Oh, yeah. Absolutely.

MR. WOOD: Okay. I think the next one might be for Mr. Parent. Mr. Dill talked about the effluent being trapped during times of stratification, probably the strongest in the spring.

TYLER PARENT: Mmm Hmm.

MR. WOOD: Would you expect effects to larval fish or larval invertebrates within the water column at that traveling level?

TYLER PARENT: From the discharge?

MR. WOOD: Yes.

TYLER PARENT: If there are larval fish in the area then there certainly could be an impact. With that area being so small, that additional mixing point, it doesn't represent a significant portion of the available potential larval habitat.

MR. WOOD: Okay. And also I want to stick on the water column stratification and this is probably for Mr. Dill. If the environmental conditions are favorable to phytoplankton blooms in that traveling level is there a potential risk of localized blooms in the vicinity of the outfall?

NATHAN DILL: You know, I would say that water that -- I guess I don't really know enough about the sort of biological processes of phytoplankton to be able to give you a really good answer on that.

MR. WOOD: Okay. That's all I have.

MR. DUCHESNE: Mr. Pelletier.

MR. PELLETIER: Good morning. I think we've come a long way over the last few days and there is quite a few conversations about the effect of this -- the effluent into the bay, the Belfast Bay, Penobscot Bay and on and just -- Mr. Wood just got deep into the math here a little bit with you, but I want to just make sure I keep this, you know, to a larger context. And a lot of your data that you created your model with was based on the best information you could find and a lot of that relies back on the Normandeau report that was collected 40 years ago and Mr. Parent essentially said it's still relevant. I want to make sure that -- that, you know, since that time too, you know, we've seen shrimp populations really decline in the Gulf of Maine, we know that the Gulf of Maine is one of the warming -- fastest warming waters and we see issues with lobsters already that just because of whether it's increased temperatures or increased acidity in the waters, there is a number of issues going on. We can expect those kind of conditions to probably maybe even continue. Mr. Parent suggested that the -- that that those data that you based your model on are still relevant. I would assume even if those numbers change up a little bit that the end results of your mixing area are still maybe in the order of tens of feet around the -- the outfalls and the outfalls go would you say like 100 feet and they're -- what did you say, three of them at 50 feet apart?

NATHAN DILL: Yes, about 100 foot, yeah, from between the first and last, yeah.

MR. PELLETIER: Okay. So around that -- that rectangle would be an order of tens of feet and not like some of the, you know, there's testimony that's been out there about one or two square or 700, 1500 football fields, that's -- is that correct?

NATHAN DILL: That's correct. And that, I think, gets back to that zone of initial dilution is much, much smaller than that 700 to 1,500 football field size. And I actually did a fairly quick back of the envelope calculation based on a thousand football fields, a football field is, you know, 360 feet by 160 feet, and if you -- if you were to calculate the volume of a typical tide, a 10 foot change in water level, so over an area of 1,000 football fields. So just in a day you've got two tides, you imagine a gigantic swimming pool that's a thousand football fields big and 10 feet deep that volume of water is more than a thousand times more water than would -- than would be discharged in a -- in a single day and that is essentially that area of water that moves back and forth past this area in a day.

MR. PELLETIER: Did your model, I wasn't sure if I got this right, but the influence of wind on the model, that's an outside force that is not part of your model.

NATHAN DILL: Yes.

MR. PELLETIER: If you have a strong easterly wind coming into Belfast Bay can we expect a change on that? Is that something we would need to include? Would that have a substantive effect on your model?

NATHAN DILL: If I were -- if I were trying with the model to demonstrate its accuracy by matching actual observations in the area I would include whatever the meteorological conditions were as forcing during that day and so, yeah, it would -- it would have an impact. I mean, it would -- it would change the model results.

MR. PELLETIER: And finally, how would we do a dye study? I mean, absent of having an actual structure out there that you could dump something out and see where it goes, is it possible to do kind of a preemptive dye test?

NATHAN DILL: In the -- in the literature that I reviewed there's been a couple different drifter type studies that were done by different people, I think, some of them using like a message in a bottle, you know, you write down a little note that says mail, you know, if you find this send it to, you know, send it back to me at this address and let me know where you found it and what day and time and you make a whole bunch of bottles and you just -- you put in a cork and you throw them in the -- and you wait for people to send them back to you. There was a study like that that was done. There was a study, I think it was Normandeau that -- where they dropped like card like -- that would float on the surface from a helicopter and then flew over with a helicopter and saw how they all distributed. There is a lot of different ways that you can do that.

MR. PELLETIER: There was actually a Normandeau -- not Normandeau -- there was a study in Merrymeeting Bay that used -- they collected the data with satellite tags so you could follow a number

of these things, so maybe that --
NATHAN DILL: Yeah. Yeah. Now, there are relatively inexpensive little GPS units --
MR. PELLETIER: Yeah.
NATHAN DILL: -- that you can get. I think they cost maybe a couple hundred bucks that you can create -- build a drifter and attach this thing to it and every hour or whatever you set it to it will say here's my coordinates, here's my coordinates, here's my coordinates.
MR. PELLETIER: Yup.
NATHAN DILL: And then, you know, with a dye or isotope or something like that you could release some of that and go out there and take water samples and then have the concentration of that measured and...
MR. PELLETIER: Okay. Thank you very much.
NATHAN DILL: You're welcome.
MR. DUCHESNE: Ms. Bertocci.
MS. BERTOCCI: I have a follow-up to Mr. Parker's question. When the -- assuming this were -- if this project is authorized and built and Phase 1 is operating, the discharge is not 7.7 million gallons per day, it's somewhat less than that, is it your testimony that the diffusers, et

cetera, could be configured in such a way that your model is going to be accurate for the mixing that will occur, that there will be sufficient head and sufficient mixing if it's, you know, just the Phase 1 operation?

NATHAN DILL: So we did -- and it's actually not included in what was submitted, but we ran the model with a discharge rate that was half of what the 7.7 million gallons a day were to look at that and -- and you do see with the -- with the lower velocity you don't get -- and this was when initially we were just looking at a single output port, you know, so you would basically get like an open pipe at the end, it would come out and kind of go up and, you know, you'd have one rise but one open pipe and you certainly don't get the same amount of initial dilution if you only have the water coming out at half the rate, but there is a couple of things in the design of the diffuser that are intended to mitigate that. One that, you know, just the fact that it's a diffuser with three ports would allow Nordic when it first -- when it first goes out there you basically have an end cap on two of the ports. And then you -- you would -- you would only put the duckbill nozzle on one of them so the other two are sealed off, so now you essentially have a port diameter with a duckbill on it that's even smaller than what we evaluated for half of the discharge and so that would give you a velocity that's higher than what we had analyzed and so that initial dilution would be more but then you also need to consider that anything that you're concerned about in the discharge is also going to be at half that quantity. So you don't -- you don't necessarily need the same dilution to get down to the same concentrations that you're looking at. So, you know, and so I think that, you know, I guess the mechanics of how that actually gets installed and operated is likely going to involve initially only having one or two of those ports open as the facility scales up, the divers go out there, they open up the other port.

MS. BERTOCCI: Okay.

MR. DUCHESNE: Great. Mr. Martin.

MR. MARTIN: Mr. Dill, so we heard a lot of questioning today on cross regarding sources of temperature readings. I think, and I might be wrong here, but I think where some of this is getting to is some of the public concerns and this may or may not be where the intervenors were going but I think the public has concerns about rising temperatures in the bay and just the general scientific consensus that's likely happening. Can you -- and obviously there is complex factors in this model, but could you speak to generally with what we could expect if the ambient temperatures are warmer?

NATHAN DILL: So I guess I'll try to maybe qualify my answer a little bit and then maybe try to give you sort of a simple answer. But based on the analysis that we've done considered a very large range of temperature relative to what you might expect to see for a change in the mean temperature, so I think when we're talking about climate change we're talking about a change in the average condition over a very long period of time, a relatively long period of time which may even be, you know, 30 years or more where you maybe see a few, you know, a degree or few degrees change. But this analysis is -- considers a much larger range of temperature because -- because, you know, the -- there is just -- there is a lot more variability and so the -- I don't think that the analysis is necessarily invalidated if there is a slight change in the mean because we're looking at this broader range so then you would ask yourself, okay, so what are you concerned about so now we're looking at what's going to happen at the higher end and the higher end of that range if the mean goes up the higher end is probably going to go up by about the same amount. I think that -- that in terms of thermal impacts it's going to be less of an impact because the ambient will -- have increased and we're kind of -- the discharge is already sort of above what the mean temperature is, so if the ambient temperature mean increases a little bit there is going to be less of an impact. Is that -- I mean that's...

MR. MARTIN: That makes sense. I guess my next follow-up question, and I'm not sure if this is a realistic scenario but more of a -- somewhat of a hypothetical is that let's say this is not a warming situation but more of extremes, so let's say that range broadens, do you -- do you have a sense of what kind of range there is because it sounds like the more severe impact would actually be in the winter season, so we have colder waters and it's actually getting colder and really can't get much colder than that, but how far would these have to get where you would find I guess real impacts under the 582 analysis?

NATHAN DILL: I guess how big of a difference between the -- I'm presuming your position is that it's not helping the position -- how big of a range between your discharge and the ambient temperature do you view as potentially being detrimental under 582.

NATHAN DILL: I think you'd be getting down to cold -- you'd have to get down to cold temperatures where it really may not even be physically realistic then you'd be looking at --

MR. MARTIN: Below the water.

NATHAN DILL: -- the water starting to, you know, freeze. They have a lot of ice on the surface and water can certainly go below 32, but maybe 28 or so, you know, and so it would be a couple degrees. I guess the result of that would be that it may take a little bit more -- a little bit more distance away to meet that dilution requirement. I think we're already -- you know, that number was already three or four times what the required dilution would be at 20 feet away, so I don't -- I don't think it would really make a difference.

MR. MARTIN: Okay. Thank you. Mr. Parent, and we touched on this a little bit yesterday and I'm going to touch on it again. I think your testimony kind of correctly analyzed in many ways the impact analysis -- under yesterday's or two day's ago analysis, which is NRPA, the discharge is not an activity under NRPA, so we're not analyzing permanent impacts in that matter, but we are analyzing the discharge under water quality classifications. You, I guess, speak to your analysis of this discharge relative to Mr. Dill's model and how you view that in reference to impacts to the standards of the SB water quality classification?

TYLER PARENT: Sure. I think it all comes down to how much habitat are we impacting because obviously the Penobscot River is at large an important migratory corridor for anadromous and catadromous fish and so the footprint of the project was physically and I suppose also physically from a temperature perspective, we have to look at how far that impact could possibly reach and that's sort of where the interplay between our analyses come into play and the end result being that very quickly the water coming out of the end of the discharge is diluting in such a way that it will not impact the behavior of the resident and migratory fish in a significant way that combined with those resident fish that could be in the area during any of the times of year they're not going to experience a significant loss in habitat even if that immediate area is unusable, which I don't think it will -- I don't think that will be the case. The 15 to 18 degrees Celsius number, 59 to 64 degrees Fahrenheit is not a prohibitive temperature for the majority of the fish if not all of the fish in the bay as we've learned that that -- the bay does refresh beyond those temperatures in both directions allowing aquatic life to continue using the area. It may within a small area alter behavior and so there is no denying that, however, the area is not large enough to create a significant impact on those aquatic species.

MR. MARTIN: Is that inclusive of all of the constituents in the effluent or just temperature that you're referring to?

TYLER PARENT: Oh, gotcha. So I'm talking about temperature specifically there, however, that testimony does apply to the rest because if you look at their filtration regimen that -- we're not filtering temperature. That's not going to happen through this physical or chemical filtration, but through their filtration regimen as we've spoke at length about it far exceeds standards that do or don't exist allowing those levels of nutrients and total suspended solids to be minimized to a point that almost immediately when it's entering the water column it will be nearly indetectible those nutrients and the other various constituents of that discharge water.

MR. MARTIN: Okay. And I think I heard you make reference to this in your prior testimony, but it is more specifically called out in SB classifications, but it is your opinion that this discharge would not lead to closure of open shellfish?

TYLER PARENT: That's correct. As stated before currently shellfishing is not permitted in the immediate area, however, I don't anticipate that this discharge will cause the closure of shellfishing anywhere in the area.

MR. MARTIN: Thank you.

MR. DUCHESNE: Great. I have a number of questions myself.

MS. BENSINGER: Lauren has a question.

MR. DUCHESNE: Oh, Lauren. Please do. I beg your pardon.

MS. JENSEN: Mr. Dill, you mentioned in response to Ms. Bertocci's question that there was modeling that you did with regard to Phase 1 of the project that hasn't been submitted --

NATHAN DILL: Yes.

MS. JENSEN: -- to the Department. Is that something you'd be able to submit to the Department?

NATHAN DILL: Yes.

MS. JENSEN: Okay. That's it.

MR. DUCHESNE: Thank you. Although I understand shellfish harvesting isn't permitted, we did hear from aquafarmers in the area who are perhaps in an impact zone. Are they affected?

TYLER PARENT: Are you referencing the lobster fishermen?

MR. DUCHESNE: No, those who are doing scallops or mussels or oysters that we heard from -- on Tuesday night from the public we heard some local folks who are doing it.

TYLER PARENT: Yup, understood. My understanding is they're not doing it in the immediate project area and with that combined with the impacted area immediately in the mixing zone being so small I do not anticipate impacts to shellfishermen that are outside that immediate project area and even if it was open to shellfishing I don't think that you would see a significant impact within the relatively immediate area.

MR. DUCHESNE: Okay. What I'm actually

going to try to do here is dumb this way down so that I can understand it. Because what we talked about a lot is how we're going to prevent the harm, we haven't really talked about what is the harm that we're trying to prevent. So I would like to -- what the people here told us they want to do is catch lobsters, swim the bay, they don't want phytoplankton blooms on the beach, they don't want to see any impacts at all and I want to know what those potential impacts could be. So if I understand correctly, discharge components that are different than the receiving waters are what we're looking at and I heard salinity difference, temperature difference, total suspended solids, biological oxygen demand, nitrogen in the form of nitrates and I think I heard phosphorous. So those are all constituents that are going to be different than the receiving waters. Now, in order for me to understand this I'm saying, all right, what's already happening in the bay. All of these are going into the bay naturally, there is rivers, Little River is -- is discharging three times the amount of water if I understood the math correctly, the Passagassawakeag -- yeah, that river. You know, I could say that this morning, but I'm a long way away from the coffee. The

Passagassawakeag roughly the same. The difference would be that those are coming in from the edge, the pipeline is coming out from the middle, the rivers ebb and flow a lot depending on what the season is and what the rain has been so they have major flushing events and then they may not be at all. So there are differences, but in the meantime a lot is going into the bay besides this, how do I compare what the rivers are doing versus what you're doing? And I guess I'll send that to Mr. Parent in terms of how it effects the fish.

TYLER PARENT: Sure. I think if we were to compare it to a river, and correct me if I'm wrong here, the point of getting a discharge out far from shore is to minimize that impact because if that outfall is happening let's say right next to the lowermost dam on the Little River it's not going to have as much chance to be caught by current allowing for that dilution to happen and so that's one major method that, you know, is just a given. I don't think there was ever a time when they were trying to just have it flow out right from shore. And so I really think it comes down to the overall engineering design of this and the placement of each of the components and so the fact that they have placed it at a desired location and a desired depth and then engineered those discharges so that dilution can be maximized via those check valves and the various other design features of the discharge. And I'm having trouble remembering the very end of your question, but I think that the answer is you're not going to be able to tell.

MR. DUCHESNE: Yup. Okay. Salinity, there is a difference in salinity as it comes out. If there is too much fresh water in the plume and things don't work the way we want them to, what gets affected?

TYLER PARENT: So are you saying if --

MR. DUCHESNE: Fish die or --

TYLER PARENT: Yeah.

MR. DUCHESNE: -- an area of lobsters can't -- won't be in, what is the harm if there is too much fresh water coming out of that plume?

TYLER PARENT: So too much fresh water added has to be qualified here.

MR. DUCHESNE: Yeah.

TYLER PARENT: 20 to 25 parts per thousand is not too much fresh water because there are times of the year, times of the day depending on the tides where the ambient water is at 25 to 25 parts per thousand and so you do not stand a chance of, you know, in this case the salinity being the osmotic pressures on the cellular life, you know, out in the bay it's not going to have an impact because it's not a great enough difference from the ambient water to make it unlivable for any of the resident or migratory species.

MR. DUCHESNE: Well, I think rainfall across the entire bay is going dump a whole lot of water too and all fresh.

TYLER PARENT: Right. And the estuaries and the mouths of these rivers are an inherently changing environment and so the species that are, you know, Belfast Bay is really more marine than anything, however, if you look further up in the estuary there are species that are adapted for a more changing environment, but down in this area where we really have marine species and some that are able to come in further than others, but the salinity is all within range of normal background.

MR. DUCHESNE: Okay. I think you covered temperature already, so not to be redundant on that, but total suspended solids, what is that stuff and if there is too much of it what goes wrong?

TYLER PARENT: So I'll first point out that the projected effluent total suspended solids is lower than that of the background water and so in that parameter it is cleaner than -- than what is coming out of the facility. Total suspended solids if increased to an extreme level can cause a fish to not be able to breathe, not be able to see, you know, there are fish who are adapted to a high turbidity and, you know, sort of the measure of total suspended solids also being called turbidity in this case, but there are fish that are adapted to that environment. I'll say Belfast Bay is a -- it's not a tropical vacation spot for scuba diving because the visibility like anywhere in the Gulf of Maine is not huge. That said, this water that's coming out will be clearer in that particular parameter and so there is not a threat of impact from total suspended solids.

MR. DUCHESNE: How about biological oxygen demand? Do I understand that when stuff goes in it's going to use some of the oxygen that would have otherwise been available for aquatic life, what's the impact?

TYLER PARENT: So even if the oxygen were depleted to a point that was not conducive to aquatic life, which is not the case. You're -- it's not enough water to impact an area large enough where you would have an anoxic zone.

MR. DUCHESNE: Okay. 80 percent of the air we breathe is nitrogen, so what is the impact of having too much nitrogen or nitrates in a plume locally?

TYLER PARENT: So it all comes down to ammonia would be a bad version of nitrogen --

MR. DUCHESNE: Right.

TYLER PARENT: -- to be coming out of a pipe, however, through their biological filtration with the various communities of good bacteria that they have in their filtration system and I'll also say those bacteria exist in the bay because that's how all of these nutrients are being broken down in the ambient water every day because all of these organisms are eating and excreting their various -- they're eating and pooping and -- and that -- that needs to be broken down and there is no manmade filtration system in the bay and so those bacteria already exist and so after those nutrients do enter the water, in this case nitrogen in the form of nitrates, it's already gone through the process of becoming biologically available and able to be broken down by plant life and so you would have to have very high concentrations in order to have too much which would then promote the idea of these blooms, however, their concentration is -- because they're removing such a high volume of a high percentage of those nitrates prior to -- prior to the outfall it's not going to be after mixing nearly enough to create a noticeable difference.

MR. DUCHESNE: Now lastly, of course, phosphorous, you do that in a lake and you get an algae bloom. If you do get phosphorous in the ocean what happens?

TYLER PARENT: Not the same thing. It's very different, but, again, in this case the phosphorous that is in the effluent is not high enough to cause a noticeable impact.

MR. DUCHESNE: Great. Any last minute questions? Yes, Mr. Sanford.

MR. SANFORD: Mr. Dill, can you summarize what type of sensors would be at the outflow pipe, things like -- that would -- flow monitors, temperature monitors, biosecurity, things like that?

NATHAN DILL: Are you -- I guess you're referring to like permanently or to, you know, do like a periodic monitoring?

MR. SANFORD: Permanently.

NATHAN DILL: I guess I don't -- I'm not

personally that familiar with what -- what types of instruments there will be and where exactly they'll be. My understanding is it will most likely be water samples that would be taken before they go off land, but, you know, there is certainly a lot of different types of instruments and things that you can deploy to measure currents, to measure salinity, to measure --

MR. SANFORD: I'm thinking specifically of the discharge. Like let's say, for example, there is some clogging and you mentioned divers having to come in and unplug or take a port cover off or something like that and I'm wondering -- I know something like the discharge rate you can predict because it will -- you'll -- you'll know at the start of it, but there could be some variables that could happen at the discharge that you might want to know such as, you know, temperature differential or something like that. Do you have recommendations or are such things commonly employed?

NATHAN DILL: Yeah, so -- yeah, so there is a, you know, one device is commonly CTD, it's -- that's a, you know, it collects conductivity which is sort of a surrogate for the salinity, temperature and also the pressure so you can calculate the depth. If you take one of these and you lower it off the side of a boat and it records as it's going down and you pull it back up.

MR. SANFORD: Right.

NATHAN DILL: And then it will give you a profile of what the salinity and temperature are. Those can be -- that type of device can be, you know, outfitted with numerous different instruments to measure things like the turbidity to the -- I don't know, other potential constituents that you might be interested in. You can -- you can put a buoy out there that has instruments like that set at different elevations, the different depths, and leave them out there for a long period of time to record a time series at different locations.

MR. SANFORD: Might you want something right there at that discharge point so that you could tell let's say if someone came along and messed with it or marine life clogged it up and you needed to know that you would have to come in and unclog it or something?

NATHAN DILL: I think you'd -- you'd want to be kind of a certain distance away so that you're not directly interfering with the -- with the discharge, whatever that is. I mean, I can -- I can kind of tell you a little bit of experience I have not personally going out and collecting data around a diffuser like this, but where I have -- where others have done it and they've given me the data to look at and they're looking at things like measuring the temperature where you've gone out there and you've dropped that sort of device down and measured the temperature or even in some cases have had divers out with special little bottles to take samples of the water and bring them back. That more -- more often than not you don't necessarily find what you're predicting, you find -- you've predicted that there is going to be a temperature change here but you can't find it, you can't measure it and it's because right in the immediate vicinity of the outfall it's such a sort of chaotic turbulent environment that because turbulence is very much a, you know, it's turbulence that's driving this mixing and that's what you want and that turbulence is very unpredictable. It can actually be very difficult to -- if you don't -- if you have, you know, a little ribbon of water that comes off of it, you know, a few seconds that might, you know, have the concentration of whatever the discharge is coming out of the -- out of the outfall but then it very quickly mixes and if -- if you just happened to take a sample right from that ribbon you might be able to detect it, but if that ribbon of water went past and you missed it then you might actually be entraining -- you might be getting a little bit of the ambient water.

MR. SANFORD: But that's actually making an argument for what you want to have something constant --

NATHAN DILL: Continuously.

MR. SANFORD: -- in real time as opposed to particular sampling, so.

NATHAN DILL: I mean, I guess to answer your question, I'm not real familiar with devices being deployed like right at the outfall to do -- to provide continuous measurements. I think more what I'm used to seeing data from is samples that are being taken before it actually goes -- comes out of the pipe and then -- and then cases where you've done a -- not a long-term -- not necessarily a long-term deployment of an instrument or a permanent deployment of an instrument to try to measure what's going on the bottom outside of the diffuser, but that type of -- if you're -- if you're looking at trying to get data from what's going on outside of the diffuser that may be something that you do at a specific time and it involves, you know, deploying some instrument, you know, physically, you know, using somebody's, you know, hands to either lower it there or a diver or some other means to do that, but not necessarily a long-term deployment.

TYLER PARENT: Are you -- are you hoping to find a method though which they can prove that they are meeting the standards that are in their permit?

MR. SANFORD: I'm not hoping to find anything. I'm just curious if there is continuous data collection or recording similar to the way a -- the Portland Water District produces or -- and is monitoring continuously their outflow of what they're sending in or a wastewater treatment plant.

TYLER PARENT: Yeah. There would definitely be ways to which you can assess each of those water quality parameters downstream of their filtration system, but prior to it going out the pipe at which you would know that it has not yet entered the ambient water and you could then confirm that all those parameters are being met.

MR. SANFORD: Like you would -- you have something that's right at the start before it enters the tank because you know what's outputting from your wastewater treatment, right?

NATHAN DILL: Yeah. So I guess I would -- I would say there are -- I think there -- it would be feasible to put an instrument out on, you know, on the -- essentially on the diffuser that could measure some of the physical parameters like the temperature, the salinity, maybe even the turbidity, but if you were to look at things like the, you know, say you wanted to look at the nitrogen concentration or some of the other constituents you'd really have to take a sample of the water, schedule the lab, and so that -- my understanding with the wastewater treatment plant that's typically done after it's been treated but before it's discharged into the waterbody.

MR. SANFORD: And is -- do you have a concern about the physical security of that discharge site?

NATHAN DILL: My understanding is that it will be -- I mean, there is certainly, you know, potential that, you know, an anchor or something like that could hit it, so my understanding is that it will be marked and it will be indicated on nautical charts. I mean, there are -- there are numerous discharge pipes in, you know, marine coastal waters all over the country that have the same types of concerns and this would be treated similarly.

MR. SANFORD: Okay.

MR. DUCHESNE: Okay. I believe we're ready for redirect.

MS. TOURANGEAU: Waive.

MR. DUCHESNE: Oh, God bless you. I believe then we are done. And we can move on to -- actually, I think we will take a 10 minute break while we reset for the last panel. This will be your last opportunity to use the restroom before we lock it up, so I would recommend you take advantage of it.

(Break.)

MR. DUCHESNE: Ladies and gentlemen, as I gaze around the room it appears that most of the key parties are back in the room, so we can take our places for our next and final panel. We have now reached that portion of the morning where Upstream will make its presentation on open -- on wastewater. So who would like to start? Ms. Racine.

MS. RACINE: I just would like to introduce the panel. With us today is Dr. Kyle Aveni-Deforge, Gary Gulezian, John Krueger and Dr. Bill Bryden -- Mr. Bill Bryden, excuse me, and they've prepared a statement so I'm going to let them go ahead, but I just wanted to introduce them.

JOHN KRUEGER: You can all hear me? Great. Well, my name is John Krueger. I live in Northport.

I have an MS and BS from MIT in Chemical Engineering. I at one time directed the Licensing and Enforcement Division at the DEP and also the Field Services Division at the MaineDEP. I directed the Department of Human Services Health and Environmental Testing Lab. And I've been a consultant for the association of public health laboratories and I did biomonitoring and laboratory data interoperability. And I am a retired consultant from EPA's Emergency Response Laboratory network. Thank you all. This has been one heck of a week, hasn't it? I have been doing 12 hour days here. I am looking forward to this afternoon, I can only tell you that.

I think we can all agree that if a permit is to be granted we want it to be a good one. Few gain if the Nordic project goes forward and fails. Some examples of a good permit in my opinion would be a permit that sets limits on specific pollutants at levels that ensure that specified water quality standards are defined and met, a permit that requires necessary and appropriate monitoring of the effluent as well as a comprehensive program to monitor the chemical, physical and biological water quality of the bay, and a permit that requires implementation of some sort of a contingency plan to ensure that any unexpected problems are dealt with quickly and effectively.

The topic of my presentation is pretty awfully boring, I guess, it's about water quality based effluent standards, but the key here is trying to understand, you know, what are -- what kind of standards, you know, can we apply to a large operation like this. One way to assure these goals is to seek a permitting requirement that are not limited to the use of a technology based effluent standard. In my presentation today technology based effluent standards are being compared with water quality based effluent standards. In this case, technology based effluence standards would be RAS. It's -- it's an operation, you can think of it as a machine that you depend on its capability to define, you know, the effluent and the environmental impacts. Water-quality based effluent standards instead are based upon the environment -- what the environment can assimilate and without harm. Now, regulatory authorities have the authority to accept a best available technology in-lieu of setting specific standards such as say a nitrogen level that would be in the receiving bay or cove and have the permitting authority also utilize water quality based effluent standards. When water based effluent standards have not been defined, technology based effluent standards are typically applied typically using the so-called best available technology. And if the underlining goals in my opinion and objectives of the Clean Water Act are to be met it may require the permitting authority to exercise its discretion to develop national additional -- I mean, to develop additional standards, limits and requirements.

Now, Nordic has chosen a pristine greenfield as a site and if permitted it may be the second largest land-based salmon farm in the world. This is large for our small community. As I said before, you know, size matters. The sensitivity of the area suggests that the water quality based standards also be considered in addition to defining the technology as being sufficient to protect the discharge site. To set a water quality standard one needs to understand the environment that will accept the discharge so that means no new inventory of fauna and flora on the environment that may be sensitive to specific effluent parameters and understand exactly where currents, tides and secondary circulation will carry the effluent. The problem is that Maine has few, if any, water based -- water quality based standards. The Legislature has suggested that there is a need to create effluent standards, this might be a good time to be begin to process. Lacking these standards is why there is so much interest now in evaluating the Nordic version of the RAS and determining if it is really the best available technology. Recirculating tank aquaculture is a great choice, but the choice of what type of RAS to use can make a difference of the those who chose closed RAS. Those that chose --

MR. DUCHESNE: Mr. Krueger, can you back up just a little bit from the mic --

JOHN KRUEGER: Sure.

MR. DUCHESNE: -- as so reminded. Thank you.

JOHN KRUEGER: You mean you want me to slow down a little bit?

MR. DUCHESNE: Nope, just a back up from the mic just a bit.

JOHN KRUEGER: Oh, oh, okay.

MR. DUCHESNE: It's splattering on the internet.

JOHN KRUEGER: My counsel has advised screaming into the microphone. I guess I've overstated --

(Laughter.)

MR. DUCHESNE: Without swallowing it.

JOHN KRUEGER: Yeah, there you go. Thank you. All right. How is this?

MR. DUCHESNE: Good.

JOHN KRUEGER: So those that chose a closed RAS meaning no effluent out to the river or bay yields all the benefits of growing finish on land without the environmental risks. Those risks can be significant, again, as we've been talking about this last week, and I appreciated the way -- directing questions at the end of the last session is, you know, understanding what the worst case scenarios might be.

Partially open RAS such as what Nordic is proposing allows a discharge of a considerable amount of effluent every day. There are concerns as we've been talking about of nutrients, pathogens, viruses, pharmaceuticals, et cetera, being released. A fully closed RAS is now in various stages of development in the U.S., Canada, Europe and the Mid East. These are often referred to as minimum liquid discharge and zero discharge systems. Aquifer based, water supplies and hydroponic outputs to utilize nutrients are examples of ways these companies are assuring sustainability. And a good example is Sustainable Blue up in Nova Scotia. Examples of companies, I mentioned them and others, AquaMaof, they're developing a technology. Superior Fresh is another one in Wisconsin. Many in the scientific community are behind the use of these because of the benefits.

On a large finfish aquaculture is in its infancy in Maine and it's like the wild west, you know, come to Maine, we've got a lot of water and we've got a lot of ocean. If closed RAS are where the industry and investors are headed it's important to focus on the details to make sure that Maine gets it right, you know, right from the start.

One way to assure that the Nordic RAS system meets its environmental concerns would be to perform a checkpoint review of its small sister RAS system in Fredrikstad and review third-party reviews of the facility using industry groups such as INFILTEC. It would be in my hope that this might be something that the DEP might explore. How is it working. I -- there is a lot of questions I've written down, but I think that's a good way to start.

Now, we talked about water quality issues, but one issue that's come up a lot has been temperature and interestingly enough temperature is really the only water quality based effluent standard there is on the books as far as I can see. I appreciated the comment from the DEP in seeing how close using approximate concentrations of temperature how close it comes to meeting the standard. And I did want to add on the record that the CORMIX model is listed as being plus or minus 50 percent, which in my mind puts some of the information that we've been hearing from DEP staff very close to the -- to the limits that are in Chapter 582 of the regulations.

But temperature, however, is kind of a unique kind of pollutant and I just want to go a little bit into temperature here because there has been so much talk about it. It's actually considered a non-conservative pollutant. It's not measured as a concentration and instead it's a property of the water. So its thermal energy basically is not in the water in the same sense like copper atoms and ammonium ions are in the water. Thermal energy is absorbed by water molecules which is manifested as temperature in a property of the water. In testimony offered by Mr. Dill in his August 14, 2019 response, concerns of temperature and the author used lower temperatures for their effluent, which we've gone over, and I think maybe some higher extremes even for the bay temperature. When I'm looking to get a temperature, I have been using -- I've been using the Northeastern Regional Association of Coastal Ocean Observing Systems, they're called NRACOOS. They have buoys and they collect data. In a typical year it would be over 8,000 measurements and they provide high and low values, but it's on a daily, many times a day measurements. And I don't want to get really picky on numbers, but, you know, for 2018, for instance, where they had a full year the temperature range was a high of 64.3 in -- generally in our area. And how that can -- and it might just be the depth. These are measured at I think 3.9 feet, so, you know, the depth makes a lot of difference. But my point isn't so much to get into the picky here on the temperatures, but the issue is that the picture that was drawn by Mr. Dill that was it's going to be a very small increase like .2 degrees centigrade or something, which seems to make, jeez, this thing is sort of fluffy, isn't it. And maybe we're being picky, you know, in talking about such a small change, but one way to look at this, and I have another way of trying to understand this temperature, is looking at the heat that's being transferred to the bay by the discharge, hey, I get to apply my chemical engineering thermo dynamics, hey, I'm excited about this.

So let's look at the heat capacity of the water. Water has a very high heat capacity meaning that it absorbs a lot of heat before it gets to get hot. In fact, water has the highest heat capacity of all liquids as far as can I tell from looking at it on Google. As an example, oceans cool slower to the land due to this high heat capacity. So one way to look at the effect of a discharge of an effluent into a generally lower temperature body of water is to calculate the amount of thermal energy that's transferred from the Nordic discharge to the bay. So the thermal -- and this energy can actually be calculated. And look at the specific heat of water, which is defined, I know this isn't a term that people think of, it's called joules, but it's, you know, we're going to go actually into some European systems, they like to use centigrade and kilograms, so I have to do all of my conversions. You Nordic folks will like this. I've had to go the other way.

And anyway, so the heat capacity of water is like 4,179 joules per kilogram per degree centigrade. So first a few figures. As established in the previous testimony, we know the estimated temperature of the Nordic effluent and I'm going to use their high value, 15 to 18, and I'll use 18 degrees centigrade. And then I'm going to go to these intracoastal buoys and pick one and where they had over 8,000 measurements and rather than get into what was the highest and the lowest, they did a nice thing, they provided a mean, an average, of the bay temperature over the year and they came up with 7.9 degrees centigrade as the average temperature. So now I've got 7.7 million gallons of water and I can calculate -- I can multiply and convert those to kilograms. I have a temperature, a Delta T of in this case it would be 10.1 and taken 7.9 from the 18 and -- and I know the specific heat of water. So I multiply this all out and it comes up with this number of like 1.2 times 10 to the 12 joules, okay, well, that doesn't do me much good. I converted that to kilowatt hours and it's like 340 kilowatt hours and then into BTUs, it's like 1 trillion BTUs.

So put these in perspective, you know, this is where, you know, I'm just trying to be practical here, this thermal loss of the bay is equivalent in one day of burning 10,000 gallons of gasoline. That's 10,000. And also in one day this amount of heat, this energy, is the same as what's used by

10,000 homes in a day. Now, I -- this heat, you know, would be absorbed in the sediments, some of it could be radiated in the air and I'm not prepared to tell you what the temperature is going to be in the bay from this, but we're at the mercy of models again. And I hate to get into quoting the George Bachs and talking about how so many models aren't very accurate, you know, and sometimes they're even useful, but we are in a situation now where I'd like to believe that Nordic is right and it's going to be 9.2 degrees centigrade, but if it's not, you know, again, is it right to be having fears like this. It's a lot of heat. It's a lot of heat that's -- that's being brought in to the bay that isn't -- isn't there normally and it's going to be on all of the time, so it's a continual source of heat.

So, again, we are back to this modeling issue how important it is. It concerned me when I know that Ramboll almost a year-and-a-half ago, it in October of 2018, recommended to Nordic that additional data be collected. You know, we could be sitting here today and have that data. We could have a verified model, but the decision was made not to collect the data. That concerns me. I want to get this resolved. You know, I think our community is so divided at this point over whether -- trying to understand which way to go. I'm also concerned too with the modeling, these 2-D models. They don't take into -- in my mind, in my opinion they don't take into account the opportunities for secondary circulation. And think about it, you know, the times for sure there is going to be a rising of the effluent to the surface and what about the strong winds in Maine and the opportunity certainly exists for a wind blown force to move a plume into a cove. I look at Brown's Point here, I look at Saturday Cove, we've got areas where there could easily be pockets of secondary circulation. Can these occur? Can we be looking at little pockets for nitrates, temperature, other nutrients to collect and that's why we need to get -- we really can't use 2-D average models that assume we're going to use an average -- temperature average gradient by taking what is at the surface and what's at the base. So I want to -- I just wanted to get that point in.

We need to better define the so-called mixing zone. All our rules are based on this. Well, what is this mixing zone? It's not easy to calculate. I have been working on that and I wasn't even going to begin to try to explain that here.

I've got to use differential equations and I'm getting too old for that. But the heat transfer is like nutrients and can be exacerbated by stratification or heated effluence can be entrained in distinct layers in the water column and subject to different forces such as wind and weather. We've learned from previous presenters the need to also take into consideration these secondary circulations. That's what Dr. Pettigrew was talking about when he was here and what he suggests is you have to multiple buoys. You really -- I mean, there's a lot going on in our small bay here.

MS. TOURANGEAU: So I'm going to object. Since we started talking about heat transfer five or six minutes ago this has been outside of scope of the pre-filed testimony.

MR. DUCHESNE: Yes. And I appreciate it, counsel, because I don't actually have the pre-filed testimony open. Yes, I'm sorry, Ms. Racine, would you like to respond?

MS. RACINE: Just that I am -- we could, I think, move on if that's...

JOHN KRUEGER: I can just move on. I'll just move on. Okay. It was in my testimony, but that's quite all right. Let's go to a new topic on standards. Let's just -- we'll drop that for a while.

Let's go to standards. I think there is a need for enforceable concentration based standard as well. That was in my testimony. Okay. The application provides maximum daily amounts for, you know, all these total nitrates and phosphorous, ammonia, et cetera, but also average daily barriers and, finally, concentrations. We've seen that, I think Nordic provided in their application, I don't know if I can pronounce this but, Sashimi Royal facility, I was looking at their nitrates or nitrogen values on a daily basis coming out of that facility and they vary over just a span of maybe seven different times in factors of three. So to me that needs to be brought into this. We talked about it a little bit earlier, will the flow rate always be a constant 7.7 million gallons a day. Well, in the same way will the nitrogen compounds always be coming out at the same concentration in this flow, so I think it's important to decide how we're going to monitor this. Is it going to -- are we going to put a daily average? I mean, we were talking a little bit earlier about, you know, some sort of a monitoring. Are we going to monitor the outflow? I saw in the application we were looking at biweekly analyses of waste in the effluent and then with -- with the request that it become monthly because, you know, I'm a chemist, you know, I'd like to see -- I'd like to see some expanded testing besides these simple nutrients that would to me set myself free of worrying about pharmaceuticals and other cleaning solutions if I knew we were occasionally testing for them on some sort of a random basis. There should be a monitoring program, third-party, you know, collect samples, you know, the whole -- there is a whole science, believe me, you know, getting involved with quality controls associated with sampling, but I've seen nothing in the application to talk about a way that we can monitor this effluent in a way that we can put any sort of a standard in regards to enforcement. And the same thing with water, if that's our sole -- if that's -- the temperature is our total water quality based standard we don't want to develop a permit that has any possibility of failing. I mean, that's our obligation is to preserve our standards.

So in closing, okay, I have prepared my comments in writing on this -- a lot of calculations, which I don't want you to take my word for on this

10,000 gallons worth of heat -- of gasoline burning every day. I have it available. I've been told I'm not allowed to share with you any of my comments or any of my discussions without your permission, so I'll -- I'll leave that for our good legal people to decide, but I have written this up in a way that I thought would be useful if I were going to review my information and I'll make it available if you so choose and I thank you very much for listening to me from an old chemical engineer.

MR. DUCHESNE: Great. And just for clarification, we're confined to what's been introduced into the public record, especially the pre-filed testimony, so thank you.

GARY GULEZIAN: Good morning, Presiding Officer Duchesne, Commissioner Reid, members of the Board of Environmental Protection and staff from the DEP. I am Gary Gulezian and I am a volunteer working with Upstream Watch. I hold a Bachelor's degree in Biology with emphasis in Aquatic Biology from Dartmouth College and a Master's degree from the Harvard University School of Public Health in Environmental Health Sciences and Management. For 33 years prior to my retirement I worked at the United States Environmental Protection Agency as an

Environmental Scientist and Manager on a number of programs including air and water pollution, contaminated sites, radiation protection, enforcement, permitting and rulemaking. During the last 15 years of my career, I served as the Director of the Agency Great Lakes National Program Office. And the Great Lakes National Program Office has responsibility for the open water monitoring of the -- of the lake -- of the lakes, the Great Lakes, and identifying problems and issues and the response to those problems and coordinating with the Great Lakes states and with the Canadians and other federal agencies to address those issues and problems.

My oral testimony today will focus on several key issues, not all of the ones that were included in our pre-filed testimony but ones that I think are the -- are the most salient and this would include water monitoring and modeling. And I am going to more or less limit myself to issues that were in the permit itself either in the response to the questions or attachments to the -- to the permits. And the -- the reason that I think that this is important is that it -- we really need to sufficiently characterize the area, this particular site, given the very, very large size of this facility and its potential for discharge and understand what the impacts are of Nordic's discharge. There was only a very limited amount of site specific water quality monitoring data that was submitted with Nordic's application, so it's impossible to reach firm conclusions but what is there raises checkered flags or yellow flags of concern and I really want to highlight those because I really think that needs to be taken into consideration.

First, I will discuss the monitoring report, which is Attachment 14 of the -- of the permit application. It's entitled Maine Aquaculture Water Quality Summary, Belfast Bay, Belfast, Maine. This report was prepared by Normandeau and Associates but it's not the Normandeau report that we've been talking about from several decades ago and that report is dated October 16, 2018 and to the best of my understanding of the application this report presents the only water quality sampling results that were contained in the application for the discharge and intake locations at the site. The monitoring was conducted on three days, two days in late August and one in early September. And what that monitoring did is it looked at the discharge sites along two of the pipeline routes and this was, I think, to help make a decision as to which route to use and also two sites -- two at the intake locations and at high tide and low tide. So there are sort of eight depth profiles that were over on those -- on those three different days.

This monitoring suggests that there may be existing water quality issues near the discharge location. For example, the depth averaged total nitrogen concentration at high tide at the original discharge site location was 0.51 when you average the several depths that were -- that were sampled. This value is potentially very significant for several reasons. First of all, it exceeds guideline levels that were actually identified in Nordic's application for the protection of eel grass beds. The application states total -- median total nitrogen begin should be less than .34 to .38 milligrams to liter to prevent replacement of eel grass habitat with macro algae growth. And note that that says median levels. We really can't look at median levels with just one sample, but we have a level monitor here of .51 versus a range that would be acceptable of .34 to .38. So the question is is the one day that they went out and found levels like that representative? Maybe it was too high, maybe it was too low, but for me, and I've looked at a lot of monitoring data in my career, this is a real red flag that -- that needs to be -- that needs to be investigated and it kind of goes along with a lot of the recommendations that we've heard from Dr. Pettigrew and from the Ramboll recommendations and from the Ransom recommendations. There is a lot at stake here if we have levels that can potentially destroy eel grass beds.

There are also potential implications for oxygen levels at the site. The application identifies an additional total nitrogen concentration guidelines with respect to preventing low levels of oxygen. The report itself states, and this is within their application, total nitrogen should be less than or equal to .45 milligrams per liter to prevent hypoxic conditions with dissolved oxygen concentrations less than 5 milligrams per liter. It's instructive to note that of the eight profiles that they -- they looked at six of them contained at least some values of oxygen saturation below 85 percent and the oxygen saturation for Class SB waters is to keep levels above 85 percent. So on these one or two days where they or I guess in this case would be on the three days where they looked at things most of the profiles had levels that exceeded -- exceeded those guidelines.

Another consideration is the way in which the monitored nitrogen values affect the modeling that was done for the discharge. The modeling and use a background level of .17 milligrams per liter of nitrogen and that just added to the amounts that would be put out by the facility itself, but if it turns out that this .51 milligram per liter level, which is what's out there now without the facility in place is a better representation of background then that would mean that you'd need to potentially increase some of the outputs from the model that you've been talking about by several milligrams per liter. Now, I'm not saying that these numbers represent precisely what's happening or what's the appropriate background to use, but they're a real caution to me and looking at this that there is the real potential here maybe these numbers are even low compared to what you would find if you did continuous monitoring over a seasonal -- over a seasonal time frame.

So I would just make the recommendation that we look very closely at what the baseline levels are there now. I think it would be irresponsible to -- to not do that knowing that we already have potentially a compromised situation here before we go forward and permit a concentration limit for Nordic. I think I'll end my presentation here and turn it over to Kyle.

DR. KYLE AVENI-DEFORGE: Hello. Great. Happy Valentine's Day. It's great to spend it with you all.

(Laughter.)

DR. KYLE AVENI-DEFORGE: Thank you for hearing my testimony, the Board and staff. I'd like to start with I actually grew up in Belfast. I may have spent more time on-site than anyone else here to date. I spent a lot of time at Little River, under over, through, collecting leaches in the upper dam with permission of course passing the dams, in and over the bay of the Little River. So I spent a lot of time here and that was when I was quite young, also putting hay up in Perkins' field. So a lot of time on-site, but since then I spent a little bit of time at school. I have a Bachelor's from with Swarthmore College in Biological Sciences and a Ph.D. from the University of South Carolina also in Biology where I studied generally biomechanics and the disturbance dynamics of mussel beds due to hydrodynamic forces and also genetic hybridization in New England and Old England. Later on, I did a post doctoral fellowship at the University of Hawaii in Hawaii in pursuit of marine biology where we studied nutrient dynamics, hydrodynamic forcing of water column nutrients into submerged aquatic canopies that happen to be located in Florida about seagrass beds and their communities associated with them. A little bit later I did some work at North Carolina State University where we used flow-through systems to measure water quality characteristics in streams adjacent to hog farms. So real time monitoring of nitrogen, which are only semi-relevant in this case, but an interesting technology nonetheless. And more recent work, probably a little bit more prosaic, I've been working on sand loss systems in Hawaii, water quality monitoring, benthic habitat analysis and establish baseline environmental analysis, so somewhat relevant to this project here.

I've come to talk a little bit about potential biological concerns and our job is to sort of evaluate what types of biological risks exists so it -- if you were to choose to issue a permit you'd understand sort of what parameters you were looking at for environmental degradation. So to evaluate the consequences of proposed Nordic Aquafarm effluent, human uses and functions and services, so what humans are doing in the area and what types of services the animals are extracting from this area of the bay. You need to consider existing conditions and the receiving waters as well as characteristics of the plume and where the plume could possibly go.

So far the modeling has suggested that the highest concentrations of any effluent from the project will be constrained to the near shore between Islesboro and the mainland. I think we've talked a little bit back and forth about what the receiving body actually is and some people have characterized it as Penobscot Bay, larger Penobscot Bay. In general what it looks like is the water that's coming from this plant -- this treatment facility will end up being in the near shore here and it will be somewhat constrained in how it moves throughout the bay by the presence of Islesboro and the ambient current. So it's probably not going into Penobscot Bay directly, but as it is part of the Penobscot Bay that's definitely the case. Any environmental consequences of the discharge will likely follow where the plume goes, so wherever we model or find that the plume is going that's probably where we need to look for environmental responses.

I provided testimony to DEP through Upstream Watch stating my concerns about the proposed farm in Little River Cove. These concerns covered three areas. First, the characterization of the receiving waters; second, the model conducted to describe the plume dynamics; and third, uncertainty over the dynamics of pollutant discharge. I'll go into each one of them a little bit. The present uncertainty of plume dynamics makes evaluating environmental impacts difficult in my opinion. Gary and John had talked about some of these things, so I'll be a little bit brief on those elements of my testimony.

So in order to evaluate the impacts of an action the existing conditions must be well understood. The proposed action will take place continuously for 20 to 50 years which is colloquially in perpetuity for some of us. Given the duration of the activity it's necessary to understand your starting conditions. For real those monitoring efforts began when Normandeau and Associates began water quality monitoring in September and October as Gary has discussed. The levels monitored there are of some concern because they're close to levels that could be damaging to environmental -- to seagrass beds or to low oxygen level could be an impaired system. And as he mentioned this sort of makes you want to see a little bit more monitoring there to understand whether that's an uncommon situation or a common situation and I would imagine that Nordic would be interested in that too because it affects their risk levels from releasing new entities into this environment whether or not it would be damaging in the sense that it's additive. But without a little bit more baseline information on the characteristics of the receiving waters future analysis and environmental effects is difficult and especially if monitoring for something like this it isn't begun until the project begins, so perhaps before permitting or during construction monitoring for sure.

I have uncertainty about the use of the two-dimensional ADCIRC model for evaluating the far-field plume dynamics. It's a concern that the 2-D model won't capture enough detail from the near shore ocean dynamics to make reliable predictions of the plume dynamics in the far-field. So we know the currents around Islesboro are variable and that the residual flow may progress clockwise or counter-clockwise around the island, so there are large scale currents that exist that aren't involved in the model. It's also documented that current directions and velocity at different depths in the water column can be variable. It's documented that wind can exert effect on upper water column currents and we know in Belfast Bay that there can be strong onshore winds at various times of the year and those can affect currents that are driving interactions with the plume. It has also been shown by CORMIX that discharge can reach different heights in the water column during different flow tide and density regimes. Dr. Pettigrew has also suggested that there can be other localized flow regimes such as in the Little River Cove where an eddy forms and there is secondary circulation and then that could actually entrap effluent that reached that site. So these three-dimentional features of the near shore hydrodynamics could affect the plume dynamics and are not represented in the two-dimensional model. Without on-site measurements or model validation of hydrodynamics it's difficult to know whether or not the assumptions that those variables are not important is correct.

So to make a conclusion based on our current projection of how the plume might move that there won't be an interaction with the shoreline or that the concentration gradients at the suggested -- exists as they suggest it's difficult to have with confidence. Given the uncertainty and that we don't have any on-site validation today -- I think I just said that. I will say it anyway because it's written. We do not have enough information about how the plume will move through the near shore area to look for the consequences for the intensive communities or the seagrass beds that are known to exist nearby. Without the ability to evaluate baseline characteristics of the affected area or the area likely to have effects from the project. It will be difficult to identify project related effects in a timely manner, so the model probably needs to be validated and parameterized ideally with local conditions to describe what's going on in the area that we're looking at.

I have some concerns about the characteristics of the discharge, some of them have been spoken to in the past sessions, but I'm not confident that I understand the answers. So my concerns about the discharge revolve around the discussion of mean discharge concentrations throughout the model -- modeling and discharge process and we'll talked about daily caps on certain types of things and that's sort of a daily average of a discharge. Instantaneous discharges could be very different from the mean that's described for a day, so if you have a process in our facility that -- such as fish feeding it creates a pulse of nutrient release and there are other times in the day where there is lower levels. The pulsatile nature of nutrient release if it doesn't -- or if it deviates from that median concentration or mean concentration that we've seen modeled could have biological effects in the environment.

The proposed filtration rates for nutrients are admirable and ambitious and they set up a concern of their own. For example, if the efficiency of a system is 99 percent, when its efficiency drops only 1 percent the concentration of that constituent in the effluent will double. So the lifetime of process equipment is really important to consider in deciding how stable those effluence could possibly be in the outfall. So parameterize the instantaneous discharge, so having ideas of what those instantaneous discharges might be if they're different from the median discharge might be very important in also considering any effects and how those would promulgate through the models.

So you asked a question a little bit ago about the context why should this matter to the environment and because we can't really be sure where the plume is going to go, I think, and right now we've got -- also, we can't be entirely certain what the dilution will be in that plume as it moves away from the CORMIX area because we've used vertically averaged concentration in the -- in the cells of the 2-D abstract model, but we know that flow -- that concentrations can be trapped at different levels so there could be concentrations in the water column that are different and if the water moves from the shallow area to the deep area it's not instantaneously dispersed in that, so it could be captured in areas. There could be areas and I think somebody asked a question about it earlier about whether or not you could have localized phytoplankton blooms in the strata of the water column. We can't answer questions about what environmental consequences could be in specific locations. We can look at the process and what it's likely going to result in. So nutrient release in the shallow near shore water, which can be strongly photosynthetic from the top to the bottom means that you could have phytoplankton blooms in a lot of different areas. Phytoplankton blooms have been correlated, positively correlated, with elevated nutrient concentrations. Elevated nutrient concentrations have also been correlated with increased risk of dinoflagellate blooms, which can lead to toxic red tide and nutrient bioaccumulation in the food chain. Elevated nutrient concentration in coastal water can lead to nuisance ephemeral algal blooms which can wash up on shore. They can also be captured and also benthos and their biodegradation can lead to further loss of O2 from those levels and we already know we have a semi-impaired system. Seagrasses can also be affected by these processes either increase in turbidity in the water column from phytoplankton or from turbidity itself, reduces the light incidence on the leaves and that can reduce the photosynthetic rates of those plants and their growth. It can also increase the rate of the growth of the epiphytes and epibionts that live on their leaves and that can also shade them functionally and so another loss of photosynthetic activity for those organisms and they can have environmental consequences for them. Those are important because those are refugia for small fish and invertebrates. And the habitat itself is forage as we know for fish and wildlife in this area, so it has ecosystem functions in that regard. Human uses in the area could also be impaired by many of those processes, so in general that's eutrophication and by introducing extra nitrogen into the system increases the chance of localized eutrophication within the area where the plume will be reaching. So the area that will have these impacts is not clear. If there -- there are impacts they're likely to be on the bounds of the Little River Cove, so that plume is not going to be kept in that area and we need to start thinking about where the bounds of those impacts might be from a model that considers all of the important factors and certainly looking at those systems before we start looking for responses from the permitted activity should it be permitted.

So it's impossible to eliminate this uncertainty prior to permitting. It's a permanent change -- this is a permanent change to the environment so understanding the plume dynamics and existing conditions in the receiving water is critical to evaluate any project related changes in the water column in near-field communities and to evaluate the environmental consequences of the project. If our goal is to mitigate those or minimize those, we need to start with understanding what we're minimizing and mitigating. That's it.

BILL BRYDEN: Hello. My name is Bill Bryden. I'm coming to you from the Great White North. I finally got to take the skis off my luggage and put those little wheel things on. I'd like to thank the Board.

MR. DUCHESNE: If you could pull the microphone in just a little closer for the people up back.

BILL BRYDEN: Yeah, that's people in BC and Norway and Canada, everybody is listening to this, I think. I'd like to thank the Board and the poor civil servants that have to make this crucial decision that will impact the lives of Mainers in this region for decades to come. For this opportunity, I'd like to thank the Maine public and of course my friends here that I've just recently met at Upstream.

My name is Bill Bryden. I was educated at Memorial University and I won't bother you with my CV. It's in my testimony. It's getting late for lunch.

MR. DUCHESNE: I'm still getting the high sign that you need to pull the microphone a little closer or speak up.

BILL BRYDEN: Sorry. Is that better?

MR. DUCHESNE: We'll find out.

BILL BRYDEN: For the last 15 years in my part of the world if you had to ask the major conservation groups ranging from New Brunswick through Nova Scotia into Newfoundland who has been the biggest proponent of land-based aquaculture you'd probably hear my name. I've launched most of the recent supreme court lawsuits in my part of the world involving environmental impacts and assessments of all of the major aquaculture projects in my region. I also have been involved in an in-depth review of all of the major aquaculture projects in my region for more than a decade, involved at some -- lately I've been involved in so many EIS reviews and environment assessment registrations that I can't recall them all at this point.

I have reviewed this proposal. I did submit a rather sketchy submission because I didn't have much time to do it and I understand that a lot of my testimony was stricken because I didn't understand the rules and my literature cited was an error, which was a good thing because I know by the time I put in

100 scientific papers here today, it's just not possible.

We've seen the goal posts move, I think, yesterday on order of magnitude. I think that was a good thing. Like I said, I am one of the biggest proponents of land-based aquaculture in my part of the world and I was pleased to see that happen. Yeah, so the goal post was we went from a .4 micron filter that everybody wanted to tell you filtered bacteria and we come to find that maybe it wasn't, but now a .04 will. There is one little problem with that. I have a lot of experience in this -- this field. That big report that you've seen all over the national news in Canada, the 2.6 million dead fish, it was me and a another for weeks setting that up and all international media flew in to meet with me. So I have been really intimately involved in this for quite a long time. So I've seen instances where people have promised the world through filtration and jumping from .4 to .04 and I don't even think we've got the .04 in writing, do we? Maybe hopefully in the permit somewhere.

But I've seen where these blood filters -- as a matter of fact the reason why Newfoundland has blood filters now in its processing plants, I think if you talk to Tom Granter you'd think -- he'd probably tell you it's because of me. So I think this filtration is really important, but I've seen instances even in processing facilities in Newfoundland where it's as simple as doing this, you just turn the filter and you pull it in and you save a fortune and blood goes out in the bay and that's behind a closed door. So through -- I think I -- they tell me from the policy and compliance people that I have the Newfoundland and Labrador record for the most freedom of information request from anybody in the last 10 years, so I'm kind of keen on this. And so unless you have somebody on the end of the pipe watching what's going out how are you going to know what's going on inside of the factory when these filters are very expensive, plug up and get damaged very quickly and we just heard they're going to use 10 times more of them, so that's -- that's one point.

I am going to throw out my testimony. I've been here all week. I've listened to all kinds of people testify. Some of them I didn't like their testimony. The chap from Denmark, Dunn, I found him excellent. So I'm going to jump right into -- I've had so many cross hairs at me -- come at me and -- and I'm not even sure what I'm allowed to talk about, only that if it's in the record I think I'm allowed to, but I'm going to focus on a chap that I'd really like to thank, a chap named Gregg Wood and Dr. David Russell, your local fish pathologist. Just so you understand, Dr. Fred Kibenge is the guy that trains fish pathologists. There's five of them up in Canada. He wrote the book Aquaculture Virology in 2016, the benchmark book for this industry. The -- it was one of only two OIE, so these are the UN labs that protect our food supplies. Only one of two OIE labs in the world to be certified to test for ISA virus. Doctor Alexandra Morton is probably the world's most famous virus hunter in salmon. Dr. Alexandra Morton recently asked me to accept funding from her to design a study and co-author with her and Dr. Grydeland. Dr. Grydeland then went after the federal government to get permits that I couldn't get so I could test for some of the deadliest fish viruses known to man and ship it to my place to his lab in PEI. That's not in my CV, but I just thought I'd mention it in case anybody wondered if I really knew what I was talking about.

I'd like to also correct a couple of things that were said by Dr. Bricknell. He said that a 3 log reduction was a 99.9, or sorry, that it was a 2 log reduction of 99.9 reduction, but I'm going to call a friend. I don't know if he needs to be sworn in or not. He's got a Ph.D., I think, and...

MR. DUCHESNE: Afraid not.

BILL BRYDEN: Dr. Google. You all know Dr. Google, right?

MR. DUCHESNE: No.

MS. TOURANGEAU: Objection. This is outside the scope of any of the pre-filed testimony.

MR. DUCHESNE: Yes. That is correct.

BILL BRYDEN: All right. I did -- I did file log reductions in my pre-filed testimony. I think it's -- it's how we get less viruses into the ocean and there is -- there is a point to this. So Dr. Bricknell also didn't want to discuss IPN. That's what's -- it's right at the threshold for the UV sanitation of the effluent. It -- it's -- it's very close as Mr. Noyes pointed out to the 250 microjoules per second per centimeter squared, so it's an important virus.

But I'd like to get into Dr., or sorry, Mr. Parent's testimony, who I didn't see a whole lot of permanent features talked about in his -- in his testimony. And if we have a permanent plume of ideal water going out into this bay with your last endangered salmon stocks, which I think are down to 1,100, you've done such a great job managing them, you know, you're down to 1,100 fish and we're going to dump effluent from by my calculations somewhere around 14 million salmon in those tanks. Then if they're shedding a lot of viruses -- there was an interesting paper that just came out, one small net pen site in BC, it just came out last week, one small net pen site was shedding 65 billion viruses an hour. Now, that's a big number. That's a really big number and if we take a log reduction, you know, that these filters are going to supply of 99 percent or 99.9 percent or 99.99, if we go 6 log reduction, we keep moving the decimal places, but we start with 65 billion and we start moving it, it's still -- you're still left with an enormous number.

So I have some concerns because Mr. Noyes has told us that there is something like 270 plus contagions that salmon carry. The OIE requires testing for five viruses. So I think you should put something on the end of the pipe. If you're -- if you're ever going to let them discharge, which I think the industry is going to zero discharge and that, by the way, I'm not sure what perjury is or impeachment or whatever and it's just probably an error, but Dr. Carrie Byron testified that that wasn't scalable to 33,000 metric tons, but, again --

MS. TOURANGEAU: So I'm going to object because we're going outside again the scope of your pre-filed direct testimony.

BILL BRYDEN: This --

MR. DUCHESNE: Excuse me a second.

MS. BENSINGER: When there is an objection please stop talking.

BILL BRYDEN: Sorry. I heard you say that so many times.

(Laughter.)

MS. BENSINGER: Allow the -- the lawyer to respond to the objection and the Presiding Officer will rule on the objection. Thank you.

BILL BRYDEN: Thank you.

MS. RACINE: Thank you. Yes, understood. And I think we had some additional time for Mr. Bryden to respond specifically to the DMR memo and perhaps -- perhaps he could do that and if the Board had additional questions about that topic during their time they could do so.

MR. DUCHESNE: And would that be acceptable?

MS. TOURANGEAU: Of course, but I don't think that Dr. Byron -- Byron -- now I'm confusing their names.

MR. DUCHESNE: I know.

MS. TOURANGEAU: I don't think UNE's representative didn't talk about the DMR memo.

MR. DUCHESNE: Yes.

MS. RACINE: No, no, I understand.

MS. TOURANGEAU: Okay.

MR. DUCHESNE: And if it's any constellation, Mr. Bryden, this is new to me too.

BILL BRYDEN: Okay. So, yeah, as in my testimony, stated testimony, that there are zero effluent systems out there because I have found systems out there and this is where the industry, I think, is headed. So when they say it's best in class, is it really best in class if there is a system out there that has zero effluence that's scalable to 33,000 metric tons? And if you're going to let them put effluent out there maybe you should have something on the end of the pipe 24/7 online so the entire public can see what's happening there. And if you do that, I would suggest you look at something like high put-through quantitative genetic testing. This is what Dr. Kristi Miller-Saunders lab is doing in BC. She's Canada's top federal virus hunter. She runs a $10 million project looking for new viruses. In fact, she just discovered three brand new viruses that were killing salmon for decades in BC that we had no clue even existed.

So Dr. Bricknell testified that the Williamsburg Treaty was for specific salmon. Again, I'll refer you to Dr. Google that will bring up the Williamsburg Treaty and that was signed by all members including the United States. And I think you'll find that if you type in Atlantic salmon you're going to get a lot of information in that treaty. In fact, it was specifically designed for Atlantic salmon and it was designed to prevent pathogens from being imported from one region to another because the industry has a history of importing viruses and eggs and letting them loose in the ocean. This has been a supreme court challenge, a federal supreme court challenge in my country three times now where the supreme court had to tell the minister of fisheries -- federal minister of fisheries to stop putting piscine virus infected fish into net pens. The first judgement came back in 2015.

So we're not very good at -- at following the rules it seems because now Nordic wants to bring in Icelandic non-native strains of salmon from a hatchery that repeatedly has been caught shipping virally loaded eggs, most recently just a year ago, less than a year ago, months ago into Washington. The foreign virus that's now in the Pacific ocean that was never there before. So you guys -- I don't -- people don't want to be responsible for doing those sorts of things, so I would suggest that you uphold the Williamsburg Treaty that the United States signed that was developed by the top salmon biologists in the world to make sure that foreign eggs don't ever come in here. So that's -- that's my first set of goal posts that I'd like to move.

So I'd like to see St. John's River strains only fish here. I'd like to see only aquifer water used. There is a reason why almost all of the RAS facilities that have been approved recently globally are using aquifer water only. And the reason is exactly as Mr. Heim suggested, Mr. Noyes suggested, Mr. Bricknell suggested, Mr. Merrill suggested and that is if you use surface water you're going to introduce every pathogen that's in the region into the tanks and you're going to have to use lots and lots of antibiotics as shown by the antibiotics quoted for every single RAS hatchery in all of Canada that shows horrendous amounts of antibiotic use.

I've done some calculations on this facility and it's going to blow your mind how many hundreds and thousands of kilos of antibiotics are going to be dumped in that bay. Now, they have half lives and it won't the be the exact number that they put in the tanks, so there is going to be a problem with antibiotics.

And my second request to put into the permit would be public reporting, a cap on antibiotic use is another one. And I'd just ask you to up your anti and if you can test for more pathogens other than the few that you're testing for now, why not? And this goes to a simple fact of aquaculture and aquaculture fish are in a protected tank being spoon fed is a lot different than the salmon that are going to be, you know, exposed to that effluent. They have to avoid predators, they have to jump waterfalls, run rapids, they have to find a mate, they have to survive. The ones in the tank they've just got to go to market. They can go to market and grow and still be sick. Most of them are. Most them are pure -- if -- if you've done a random sample you'd find lots of viruses in those grocery store fish. You'd find lots of bacteria and you don't want that dumped onto the last 1,100 salmon you have in the last stronghold you have in all of the United States. That's the point was I was trying it make. I could go into all kinds of more stuff, but I think everyone is getting ready for lunch, so.

MS. RACINE: And I would just -- yeah, I would say that I think that would be a good end. In terms of the DMR, we'll have an opportunity for written comment and we'll go ahead and waive that opportunity to do a presentation on that now and I think we can move on to cross.

MR. DUCHESNE: Very good. We will go to cross. Yes, cross by Nordic.

MS. TOURANGEAU: I just have one question, but it's for all of you. Are you aware that if Nordic released fish in our ocean there would not be a wastewater treatment system of this caliber and that the discharge would be addressed by a MEPDES permit and not by the individual permit that we're discussing here today?

GARY GULEZIAN: Yes, I am aware of that.

MS. TOURANGEAU: Thank you. Can you each answer?

JOHN KRUEGER: Oh, each answer?

MS. TOURANGEAU: Yes, please.

DR. KYLE AVENI-DEFORGE: This is Kyle, yes, I am aware.

JOHN KRUEGER: Can you repeat that question? I'm sorry, I was moving the microphone and I got confused.

MS. TOURANGEAU: I flipped away from my question. Are you aware that if Nordic grew these fish in our ocean there would not be a wastewater treatment system of this caliber nor -- and that the discharge would be addressed through a MEPDES general permit and not through the individual permit that we're discussing here today?

JOHN KRUEGER: Yeah. Yeah.

BILL BRYDEN: My name is Bill Bryden and, yes, I am aware of that.

MS. TOURANGEAU: Thank you.

MR. DUCHESNE: Great. I believe we can go to DEP and Board questions. Mr. Parker.

MR. PARKER: I don't have much for questions, but I've got one for Mr. Krueger. And I'll like to say I didn't like thermodynamics either.

(Laughter.)

MR. PARKER: One thing that you talk about is the temperature of the discharge, but in your discussion and I haven't heard much yet about the temperature of the incoming water, and if the temperature of the discharge becomes a concern, is there any logical reason that they couldn't draw water from deeper in the water column to bring cooler water in because I've heard them say that the salmon liked the temperature range that's there and that could help offset that.

JOHN KRUEGER: Yes. Thank you for clarifying it. My understanding -- oh, my God, I'm eating the mic here. I have a loud voice. So the process of growing fish and pumping water and circulating creates heat. I think in my understanding and the goal of course is to get as cool a water as you can get and therefore the temperatures that the fish like to be at is 13 centigrade, but the process of them feeding and pushing water with these pumps and this filtration that we're continuously doing adds heat. So at some point it's to every -- to the advantage of the industry to try to get the heat out of the plant so optimum growth can occur. But I think, yes, that's why the intake pipe is way out further than the exhaust pipe in cooler water is my understanding.

MR. PARKER: I was just getting to the point that it seems to me that you had to pump all that heat, but if you start out with cooler water you end up with cooler water.

JOHN KRUEGER: Yes.

MR. PARKER: Logic. I follow logic, I guess somewhat. Mr. Gulezian.

GARY GULEZIAN: Gulezian, yes.

MR. PARKER: All right. Okay. I saw you talk about the nutrient impact on those three probably grab samples in August and September, which were very limited testing and I don't question what you found, but what you're reporting in there is a heavier background nutrient load than the discharge from the plant is proposed to put into the water. If that's the case, it seems to me that the incoming water from the plant would help offset possibly an existing problem with nutrients. Am I way off base with that?

GARY GULEZIAN: I think that when you're talking about nitrogen and in this case we were talking about total nitrogen, the concentration coming out of the discharge would be 23 milligrams per liter whereas the ambient conditions that the Normandeau report that's also included in the permit at that point was .5. So as a matter of fact what they're putting in would be 50 times higher than what was there at the point that it's leaving the discharge pipe.

MR. PARKER: Okay. That's not how I understood it, but I won't argue with you over that. And one more comment I'd like to make and I'll agree with Mr. Krueger on that one is we absolutely should be using water quality standards supported by the best technology, but we should be using best technology standards. I think we have to set the water quality standard and then use what's necessary to meet them in the best position available. Is that what I think you were saying?

JOHN KRUEGER: Yes. Yes. I mean, it's come up at the Legislature. The question has come up do we have a standard. I mean, all of these companies are coming here to perform, you know, land-based salmon. What is -- what is the standard? I -- it's going to be very more difficult as we start comparing technologies than it's going to be to start putting some standards, so I think it has to be -- personally it needs to be a combination of the two. If the area is a very sensitive area, I mean, I think this is a pretty pristine area. I think you've gotten that sense. There might be more need to have an established say a nitrogen standard than it would be say in an area where there really wasn't much for environmental life to begin with. And so that's why I think it's within the permitting authority here for you folks to set that standard. I think that's the expectation under the Clean Water Act.

MR. PARKER: Thank you.

MR. DUCHESNE: Yes, Mr. Pelletier.

MR. PELLETIER: Thank you. Mr. Bryden. Sorry, the name tag is moved over there. Last night there was a question of Mr. Noyes about the efficacy and how well the filtering system would work down at .040 and there was a specific question to him about whether or not such a -- such a low -- that such a tight type of filter, a low floor filter might be prone to a lot of maintenance issues that might not work and the response was, well, it seemed to be a fairly dynamic system, it kind of cleans itself in some respects and I didn't fully understand it, but I got the sense that this was -- there was a number of backups, the number of cassettes that they were talking about, the number of use that is a fairly kind of a dynamic process that -- that they had a lot of confidence in. I didn't get that same sense from you. Your testimony -- what's your testimony about how well that system could work over time?

BILL BRYDEN: Well, first of all, there

is -- they're graded, so they're graded on a percentage, so it doesn't matter what the figure is if it's 4 or .04 or 4, they're going to be graded at a percentage of log reduction, so its 99.9, 99.99 and when you're talking about the volumes of water that we are and the potential for big numbers of pathogens whether you move the decimal place two or three places is kind of a knowledge. There is going to be an amount of plugging. There is going to be some -- some physical damage if they're rubbing back and forth. So they leave the factory we hope compliant what's on the sticker. How they're going to react and what sort of monitoring plan you'd have in place to make sure that that 99.99, which is already going to let an awful lot of stuff through would be affected over time would be anybody's guess.

MR. PELLETIER: Thanks. Mr. Krueger, one of the comments you made earlier was you talk about the number of closed RAS systems that are around I would think mostly maybe in North America, I don't know, maybe in other places, but do any of them besides the one, which I don't think is close in Norway, do any of them support salmon aquaculture?

JOHN KRUEGER: Yes. It is a -- it is a growing and new technology, but the three that I reference are all working in this direction scaling up mentioned are Sustainable Blue, Superior Fresh and AquaMaof, they are all looking at salmon and they're at different stages of development. I think perhaps the one that's closest here is Sustainable Blue and, yes, they are growing salmon.

MR. PELLETIER: But there are no operating closed systems for salmon?

JOHN KRUEGER: Those -- those are closed, yeah, the three that I mentioned.

MR. PELLETIER: They are?

JOHN KRUEGER: Well, they're -- it's either a question of minimal, it's like the discharge going towards fully closed, the sustainable is fully closed.

GARY GULEZIAN: He asked if they are operating now.

JOHN KRUEGER: Yes, they are operating now. Yes. They're apparently doubling in size, you know, they're -- they're building, you know, they're not going to the largest size where they think the profits are first, you know, they're starting small and growing. And, you know, obviously they're attempting to build a market. They have tastes -- you know, people that taste salmon for a living, I guess, but my understanding is it was a 3,000 to 5,000 metric tons a year for some of the pilot studies. And I've kept you long enough. I'm sure the folks from Norway could tell you more about this than me, but, yeah, it's growing and my understanding is it it's looking very successful.

MR. PELLETIER: Thank you.

MR. DUCHESNE: Mr. Sanford.

MR. SANFORD: Dr. Aveni-Deforge, on Page 2 of your pre-filed you -- do you expect that this project is subject to an EA or an EIS under NEPA?

DR. KYLE AVENI-DEFORGE: I don't necessarily expect that it would be. It is not unprecedented and so in the -- in the system where I work more commonly which is the Pacific, we see environmental assessments and environmental impact statements triggered by federal involvement on a number of these different issues any time -- any time you have a federal agency involved. I wouldn't -- I can't speak to what happens typically here and so I can't say what I would expect to see it here. I understand that it's not unheard of to have it involved in something like this.

MR. SANFORD: Have you reviewed EISs or EAs for projects of this type?

DR. KYLE AVENI-DEFORGE: I have never reviewed an EIS for a fish farm program. I've reviewed EISs for a variety of deep restoration projects, harbor dredge projects and other stuff. There was a nuclear aircraft carrier project in Guam, I think, that I reviewed one for also.

MR. SANFORD: Do you -- do you share the views that closed systems are the most desirable from a risk and impact perspective?

DR. KYLE AVENI-DEFORGE: I'm not a fisheries biologist. Inasmuch it reduces your interaction with the environment and reduces your risk of discharge in exchange for potential pathogens in either direction, I can understand how that's a strong argument to be made. And so on its face value I'd say probably, yes. If I can just take a tiny step back to the EIS question and the reason I sort of expressed the opinion with the EIS project system is that it takes sort of the impacts of a project and it sort of puts them under one umbrella. And there's been a lot of sort of different directions whether it's a traffic study or water quality impact during construction, this, that or the other thing, it's sort of -- they sort of work their way out through a variety of different permitting structures from the local to the state level. When you have a project that's brought underneath the umbrella of an environmental impact statement, all of that stuff is brought together at one place and so there is an analysis in one place where you can look at all of the impacts and you can evaluate the whole thing in one picture.

MR. SANFORD: Okay. Thank you.

MR. DUCHESNE: I have two questions from the audience for Mr. Bryden. Are there RAS systems using surface water?

BILL BRYDEN: So that's a relative question. You have to look at the age of the facility, do they exist, have they been around and around for a long time. I think what might be interesting to look at is what's happening currently on the planet in terms of surface water use in RAS facilities and I think you'll find that recently Nova Scotia banned surface water use because of the excessive antibiotic use and the pathogens that end up in the fish that were then transferred around all over back Canada in the net pen sites including ISA virus. So I think if you look and you'll see regions of China that have banned surface water use in RAS -- RAS facilities. You'd find that Newfoundland hasn't built a RAS facility in quite a long time that has allowed surface water use and, in fact, one that is proposed to be built and permitted was just -- it just vanished. It fizzled out and I don't know what ever happened to it. I can't even find it, but it died.

MR. DUCHESNE: Great. And second question from the audience and I'll paraphrase quickly. There is a risk to salmon from these viruses, can you specify any risk to human health on the same viruses?

BILL BRYDEN: As far as we know the viruses from fish can't be transmitted to terrestrial vertebrates, but there was some interesting research that's been published in peer review journals by some pretty sharp virologists that suggest that when we started feeding the chickens to the salmon in cages, I mean, a lot of companies claim all natural food, but a lot of times it's pork scraps and beef scraps and whatever and salmon and ends up as a sausage and with a salmon skin on it. But so when we started feeding chickens to it there was quite a few virologists that notices a virus was found that was for the first time in human history as far as we know an orthoreovirus which is a terrestrial vertebrate virus and then all of a sudden it was found in fish and that's the only orthoreovirus that we know of that we exist in fish as far as I know. So or, you know, maybe a monkey with things and mixing things up that maybe we shouldn't be.

MR. DUCHESNE: I see no further questions from the Board. This was our last panel. I am going to close the hearing. So with that, we have concluded the testimony and cross-examination of --

MR. DUCHESNE: No, actually we have not done that, have we?

MS. RACINE: No, but we're going to waive cross.

MR. DUCHESNE: I don't want to seem over anxious.

(Laughter.)

MR. DUCHESNE: Now, we're going to close the hearing and I do have some closing statements and the first one is brief. Thank you for all your participation in this hearing. We do need to take a five minute break and hash out a few things before I make some announcements about what happens next. There are some records that may need to remain open for additional input and we need to flush that out for a few minute, so I would recommend everybody just take a moment and stay comfortable.

(Break.)

MR. DUCHESNE: Okay. Once again, we do have some housekeeping to attend to and some schedule items so that you will know what to expect going forward and for that I will turn it over to Ms. Bensinger.

MS. BENSINGER: Thank you. As you know, the record -- the hearing is concluded and the record will be closed to all public comments on the 18th of February. There are a few matters as there often are at the end of these hearings that the record will be -- will remain open for in this very limited sense and I'm going to run through them at this time.

First, the Department has to do with air, air modeling, the Department is planning to conduct further dispersion modeling to estimate air concentrations that would result from the project as proposed based on all of the evidence in the record. The results of that modeling will be shared with the parties and the parties will have an opportunity to submit comments on that. I don't know the timing of that. I haven't had a chance to consult with the air bureau folks, but that is planned to happen.

Second, Mr. Hopeck's memo of January 27, 2020, we discussed this earlier. I'm just reiterating it. Nordic has requested until February 18 as an opportunity to submit a written response to that and the other parties have requested until February 25 to respond to the memo and taking into consideration Nordic's response.

Third, it was discussed in the hearing that there are boring logs of sediment in the coastal wetlands and the applicant was going to check and see if those are currently in the record. Have you been able to do that?

MS. TOURANGEAU: Yes. They are not in the record, but I believe I have them. Yes, via email, not in hard copy, but I can circulate them.

MS. BENSINGER: Okay. If you can submit those by the close of business by email today or do you need some time?

MS. TOURANGEAU: I can probably do it today.

MS. BENSINGER: Okay.

MS. TOURANGEAU: I can just forward it to the service list but not in hard copy because I...

MS. BENSINGER: If you could submit those by Tuesday the 18th that would be great. Monday is a holiday. And the parties will be given an opportunity to submit written comments on those and any indication from the parties how much time they would need to submit written comments on those boring logs?

MS. RACINE: So if we're going to get them today...

MS. BENSINGER: Tuesday.

MS. RACINE: By Tuesday.

MS. BENSINGER: Tuesday.

MS. RACINE: I guess a week?

MS. BENSINGER: A week.

MS. RACINE: I don't know -- I don't know how extensive it is.

MS. BENSINGER: A week, ten days?

ELIZABETH RANSOM: It's like two pages.

MS. RACINE: Okay. A week.

MS. BENSINGER: A week.

MS. RACINE: Yes.

MS. TUCKER: I think a week -- if it was longer than a week I would let people know once I saw them. It's hard for me to gauge that without --

ELIZABETH RANSOM: I can describe them. It's like a page with photographs and then the logs themselves are like a depth with a description, a one or two word description next to it that says the soil type.

MS. TOURANGEAU: I'll shoot electronic copies around to the service list today. I have them in my email.

MS. BENSINGER: Okay. We'll say the 25th since that's a week from Tuesday for a response from the parties. Mr. Dill in response to a question from Ms. Jensen, he had mentioned a Phase 1 water model or water modeling done with just Phase 1 in operation. He indicated that such a model was in existence and could be submitted. When could that be submitted?

MS. TOURANGEAU: So Mr. Dill just informed me that those were submitted to the Department in digital format in late 2018, early 2019.

MS. BENSINGER: So that's already in the record.

MS. TOURANGEAU: Yup.

MS. BENSINGER: Okay. Never mind. And lastly, the DMR February 25 memo to Gregg Wood regarding fish pathogens the inner -- Nordic had indicated it didn't need time to respond to that any further. The party -- the other parties, the intervenors have requested until the 21st. And we'll put this all in writing. I'm just reiterating what we said the other day and until the 21st to submit written comments on that.

And lastly, with regard to DMR, DMR has apparently as I mentioned earlier noticed that it will have a hearing on March 2. At some point subsequent to that hearing the Department expects to receive an assessment from DMR and the parties will have 10 days from receipt of that assessment. We don't know when that date will be. Or, no, the applicant will have 10 days from receipt of that assessment to file a response and the parties, the intervenors would have 10 days after the applicant's response. That's a lot of dates. I'll put it all in -- we'll put it all --

MS. TOURANGEAU: We'd be willing to waive and respond in five days.

MS. BENSINGER: Well, okay, then the parties will have five days -- 10 days from the date of the applicant's response. The transcript -- so other than those things the record is closed. Ms. Tucker?

MS. TUCKER: I just have a question about --

MR. DUCHESNE: If you can move towards --

MS. BENSINGER: If you can get near a mic for the transcriptionist and the record, please.

MS. TUCKER: I'm asking a DMR question to you and that's unfair probably, but did you know if that hearing is going to be here or --

MS. BENSINGER: I have no idea. I don't know any of the details.

MS. TUCKER: Just asking for clarification.

MS. BENSINGER: Sorry.

MS. TUCKER: Thank you.

MS. BENSINGER: So the record will be closed other than that and I'd like to remind Board members and the parties, people have been fairly respectful of this, but I just want to remind you the ex-parte -- the rule against ex-parte communications continues as the Board is the decision-maker and parties should not have conversations with Board members during this period. Thank you for that.

The transcript, I understand the goal is to have it ready within a month. And after we receive the transcript we'll set a deadline for the submission of post hearing briefs. And that's all I have. I'm going to turn it back over to the Presiding Officer. Thanks.

Oh, yes, there was one other thing. Ms. Tucker sent an email today asking that the email be distributed to Board members and put in the record regarding comments from a gentleman at NOAA regarding winter flounder and the Presiding Officer is going to rule on that.

MS. TOURANGEAU: Before we go on to that, could Nordic work with the transcriptionist to expedite completion of that process?

MS. DOSTIE: Can we talk about it after?

MS. TOURANGEAU: Mmm Hmm.

MS. BENSINGER: That's between Nordic and the transcriptionist.

MS. TOURANGEAU: Yup.

MS. RACINE: And one point of clarification and the closing of the record just, again, for the February 18 at 5 p.m. deadline that intervenors are still permitted to submit comments on non-hearing topics until that date?

MS. BENSINGER: That is correct.

MS. RACINE: Thank you.

MS. DUCHESNE: Yes, I have a request from Ms. Tucker that I need to hear, I believe. And, again, back to the mic.

MS. TUCKER: I had sent a note after the question I think it was yesterday, it might have been the day before, but I think it was yesterday on winter flounder because I saw in the EA on the Searsport dredge that there was an extensive discussion from NOAA on that, so I sent a note to Mike Johnson at NOAA who sent back a note about there is an extensive designation of Belfast Bay in the upper bay as essential fish habitat, so I just sent his note in and I was questioning if that can be shared with the Board.

MR. DUCHESNE: Okay. At this point, I believe the record is going to be closed on that. We've agreed on what it's going to stay open on. This information would have been available earlier I think if it was online especially from NOAA, so I don't believe it's appropriate to include it in the record now because we've now closed the proceedings and there is no chance for any of the parties to react to it, so I believe we've gone past that point and I'll have to deny the opportunity.

MS. TUCKER: Okay. We'll just present it to -- at the hearing DMR has. Thank you.

MR. DUCHESNE: That would be wonderful. Written public comments, that's written public comments will be accepted until Tuesday, February 18 at 5 p.m. Written comments should be sent to nordicaquafarms.dep@maine.gov. That's nordicaquafarms.dep@maine.gov.

And I would just like to add for the audience that during our Tuesday night testimony you noticed we were paying a lot of attention, I think, to just about every public comment made. A lot of those comments dealt with issues that we did not deal with during the hearing. The hearing process itself was decided between the parties and with the Presiding Officer earlier about what are the most important topics that are going to take a lot of hearing time and that doesn't mean other topics aren't just as important or has -- it needed to be dealt with. A lot of those had to do with the recreational use of the area, scenic impacts and that sort of thing. That's still part of the process that the Board goes through as part of it's application of Development Law, for instance, fitting harmoniously in the environment. So those issues are not dead. It's still up for the Board to consider, it's just they were not part of the major part of the hearing testimony that we were hearing in this process. So I definitely appreciate the input from everybody on those issues and they are still very much alive.

At this point, does anyone else have any questions? If not -- yes, ma'am.

AUDIENCE MEMBER: Can you repeat the email address?

MR. DUCHESNE: Yes. Nordicaquafarms.dep@maine.gov.

And with that, I will officially close the hearing. Thank you.

(Hearing concluded at 12:34 p.m.)

C E R T I F I C A T E

I, Robin J. Dostie, a Court Reporter and Notary Public within and for the State of Maine, do hereby certify that the foregoing is a true and accurate transcript of the proceedings as taken by me by means of stenograph,

and I have signed:

____

Court Reporter/Notary Public

My Commission Expires: February 6, 2026

DATED: March 8, 2020

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