MANITOBA CLEAN ENVIRONMENT COMMISSION

LAKE WINNIPEG REGULATION REVIEW

UNDER THE WATER POWER ACT

VOLUME 14

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INDEX OF PROCEEDINGS

INDEX OF EXHIBITS

Thursday, April 9, 2015

Upon commencing at 9:30 a.m.

THE CHAIRMAN: Good morning. We'll resume the hearings. We have one presenter today, Manitoba Wildlands. So I guess we'll need to swear in the two of you as well as the person on Skype. So I'll turn it over to the Commission secretary for a moment.

MS. JOHNSON: If you can each state your name for the record.

MR. BECKWITH: I'm Paul Beckwith.

Paul Beckwith: Sworn

Gaile Whelan Enns: Sworn

MS. WHELAN ENNS: Good morning, I'm Gaile Whelan Enns, director for Manitoba Wildlands and as a participant in this hearing. We are going to hear from Paul Beckwith from the University of Ottawa regarding climate change with respect to regulation of Lake Winnipeg. I think probably it is best for Mr. Beckwith to introduce himself. You have some previous information in terms of his CV.

And we'll go to you, Paul.

MR. BECKWITH: Okay. The first slide isn't up, is that correct?

MR. WHELAN: No, not yet, we're just watching you.

MR. BECKWITH: Okay. Good morning everybody, I'm Paul Beckwith. I'm in the Geography Department at the University of Ottawa. I'm a part-time professor. I teach climatology and meteorology, second year introductory course. I have done that three times. I also teach geographical approaches to environmental issues. That's an ongoing course at the moment. I also will be teaching global ocean changes.

So, as well as being a part-time professor teaching these courses, I am working on my Ph.D. research. My topic is abrupt climate change. So I look at changes in the past and I look at the present contemporary climate system to try to determine how quickly, what's changing now, how quickly, and where we might be heading to.

I am an engineer. I went to McMaster for engineering physics, and then I specialized in laser physics, laser optics, and did a Master of Science degree in laser physics. And I have had a lot of work experience, including working at Rockwell International Science Center in California on nonlinear optics. I have been following climate change for many years, and then decided to go back to university to pursue study in that field. So I look at the overall global climate system, trying to make connections between the different pieces that are changing, the different elements that are changing, to come up with an overall big picture of how the system is rapidly changing.

MS. WHELAN ENNS: Thank you, Mr. Beckwith.

MR. WHELAN: Paul, we've got your presentation up now.

MR. BECKWITH: Okay. So I'll get started. Let me just bring it up myself.

Okay. So I'll be talking today about climate system change from the global to the local, the local being the Lake Winnipeg watershed and the water levels and regulation. I'm in the laboratory for paleoclimatology and climatology in the Department of Geography. My supervisor is Konrad Gajewski and he has been working for years on pollen studies.

I am representing Gaile and Manitoba Wildlands. I have done work with the Sierra Club of Canada, logs for them, and also volunteer work assessing intergovernmental panel on climate change reports. And so if you could please go to slide 2, and I'll get started.

Okay. So a big question for these, for the Lake Winnipeg Regulation hearings (inaudible - technical difficulty) over this century, especially during extreme drought and flood intervals. So during the really dry periods, really wet periods. Really wet periods, we're in a fairly wet period over the last 15 years or so.

So, generally the approach is to analyze the climate history of the last hundred years, and then use climate models to generate projections for the next hundred years or so. So the question is, how good are the models?

So these climate models work well for linear climate changes. So the climate is changing slowly, incrementally, temperatures slowly rising, and basically the statistics of weather are invariant. And we assume that they are invariant, because when we say something like the likelihood of a flood is one in a hundred years or one in a thousand years, we are assuming that not much has changed to the climate system and those statistics are still valid going back to that period of time.

So, in this presentation I'll discuss how global climate system changes, high level changes underway presently now change the heat balance between the equator and the Arctic. And that's the key. This has changed the atmospheric circulation patterns, like the jet stream behaviour and locations, ocean currents have slowed, and there's also change. Therefore, there's changes to the climate background that the weather occurs under. So the weather statistics have changed and are continuing to change. So the system is more nonlinear than linear.

So if you could go to slide 3, please? So I show here the local, the Lake Winnipeg basin including the five watersheds. So our focus today is mostly on the Lake Winnipeg watershed and the regulation of water levels.

So if you could go to the next slide, slide 4? So some of the presentations that you have seen already are the International Institute of Sustainable Development, the IISD, Henry David Venema talked about strategic large basin management for multiple benefit. So my take on this presentation, based on the report, is it emphasizes how to achieve health and balance in the overall system. So not looking to just Lake Winnipeg and water levels, but looking at the inflows and the outflows and the entire interactions of the whole basin, so the overall system. So I'm doing a similar thing with the overall climate system.

Gregory McCullough presented on climate in the Lake Winnipeg watershed and the level. So he looked at the climate history over the last century or so of climate patterns, rainfall, temperature changes, and inflow history to Lake Winnipeg. And then he went on to describe climate pattern predictions for this century based on the global climate models, and then drilling down to the regional models or downscaling the global models. So he looked at, related climate trends and variability to the water levels. And this was also done in great detail by Manitoba Hydro, very similar approach by the water resources engineering department, the power planning division, in their study, Lake Winnipeg Watershed Hydro Climate Study. So, again, he looked the historic climate, temperature, precipitation, and wind specifically, to look at stream flow trends, variability, and then they made projections this century using global and regional climate models.

So moving on to slide 5, this is the outline of what I'm trying to get across today. I'm looking at the global climate system changes, and then bringing them down to the local level of Lake Winnipeg. So in the global sense, we have increased human or anthropogenic fossil fuel combustion, and we also had many land use changes for us to cut down to agriculture, for example. As a result, the atmospheric greenhouse gas concentrations is up significantly. So I'm talking about CO_2, methane, and nitrous oxide in particular. Water vapour is also up because it's warming, there's more evaporation. But that's considered internal to the system.

So as a result of the greenhouse gases going up, you have probably heard of the so-called global temperature hiatus. So the global average temperature, instead of increasing about the typical 0.17 degrees Celsius per decade, over the last decade and a half it's only increased -- originally, it was thought it was only up about

.06, but recent papers show that they didn't account for the Arctic, lack of temperature stations in the Artic and the great temperature increase in the Arctic. So that number is closer to .09, almost .1 degree Celsius per decade, the global average even over the last 15 years or so. But in the Arctic there's been no stalling of temperature. In fact, because of sea ice covering the Arctic ocean, the snow cover covering the terrestrial land in the Arctic, Siberia, Northern Canada, especially in the spring, and Greenland melt, leaving melt pools on the surface covering up the snow, the Arctic region is darkening. In fact, in the last few decades it's darkened, the average reflectivity or albedo of the entire Arctic region has declined from about 52 percent reflectivity to 48 percent reflectivity. So this is significant because a darker surface will absorb more solar energy. And when it absorbs that extra solar energy, it warms much faster, it melts more ice, and then it leads to even a darker surface and warming. So you get all these feedback effects known as the albedo effect.

So the Arctic temperature amplification, or rate of change of Arctic temperature rise is roughly five times to eight times the global average. So the Arctic region is warming at about a degree Celsius per decade, as opposed to the 0.17 global average rise. And this is a rate, so this is why you get this five to eight times number.

So what this does is this changes the heat balance on the planet. Think about it, because the Arctic is warming that much faster than, for example, the equator. The equator doesn't warm too much because extra heat at the equator goes to evaporating water, causing more clouds, but that doesn't change the temperature of the equator. So, because the Arctic is warming much faster, the equator to Arctic temperature difference is rapidly decreasing.

What this does is this causes less heat to be transferred from the equator to the pole, because the Arctic is warmer and heat moves from warm to cold areas, and the rate of heat transfer depends on that temperature difference. So a lower temperature difference, less heat.

So in the atmosphere, where about two-thirds of the heat is transported, the jet streams are slowing down, they are becoming wavier, they are becoming more persistent or stuck. And also because the climate is warmer, for every degree increase in temperature rise, there's 7 percent more water vapour in the atmosphere. So that extra water vapour is fueling, you know, these extreme weather events also. So the extreme weather events are becoming more frequent, they are stronger, they are more intense, and they also last longer.

And I can give loads of examples. I mean, Calgary and Toronto are two in Canada, those flooding events where you get four months of rain in a night or two.

Also, the heat is carried from the equator to the pole in the oceans, about a third of the heat is in the oceans. The ocean current such as the Gulf stream are slowing down. For example, there was very large sea level rise up the U.S. east coast a few years ago, about five inches in the space of two years.

So the climate system is changing. So I'm going to talk about more of the details of some of these things.

So slide 6 just gives an example of some software called Climate Reanalyzer. So if you just Google Climate Reanalyzer and have a look at that, you can select through the different menus on the left, for example, and you can get the previous day's weather, global, you can get the condition on the globe. So I selected temperature anomaly in the slide. So the anomaly is the difference on that particular day, April 1st, relative to a 30-year average. So you can -- and then the scale on the right shows that North America, mostly western North America is warmer than normal, and there's dark purple areas that are colder than normal. And then there is very bright red area in this case in the Arctic. So there is lots of data online, and this is a very good one. So anybody can go and get a good picture of the weather systems and the anomalies on the planet with this particular software. And there's some other links that I'll highly recommend that everybody have a look at.

So the next slide, slide 7, just gives an overview schematic of the earth system. Remember, I'm trying to emphasize the treatment of the earth as a system. So there is five main elements. I mean, there's the atmosphere, which everybody thinks of when we think of climate, and it contains stable gases, nitrogen and oxygen are gone, and then the greenhouse gases, water, CO_2, methane, nitrous oxide, et cetera, also aerosols are very important. Of course, the sun is the input of energy into the whole system. Then we have the hydrosphere, the oceans, lakes and rivers, we have the lithosphere, the land, we have the biosphere, including the flora and the fauna, of which, you know, we fall into the latter category, the human influences. And then there's the cryosphere, the ice sheets, the glaciers on mountains and so on. So we need to think of the whole thing as a system. And if one element in the system changes, then it has influences on all the other elements. So the whole, so we're looking at the whole system here.

And this is the opposite of how we typically study climate. Typically, we have a glaciologist will do his thing, and then we'll have an atmospheric physicist, and then we'll have, you know, maybe a soil person, a permafrost person, and they are all doing research in their individual areas. But we need a lot more system studies, how the whole system is interacting.

So the next slide, slide 8, just shows

a historical view of methane and CO_2, where we are. So today, methane is a very powerful greenhouse gas. Most people see the number, you know, it's about 25 times more powerful than a CO_2 molecule, but that's over a hundred year time scale. Over a short time scale of a few decades, methane is actually about 86 times more powerful than CO_2. And over the space of a few years, so think of methane coming up over the Arctic over the space of a few years, the warming compared to CO_2 is about 150 times.

Now, the levels of methane are about 1,860 parts per billion now. During the last 800,000 years, as shown here, this is the ice core records in Antarctica, extract bubbles going down through the layers, date the layers, and the concentration of methane has varied between about 400 -- between actually about -- well, it shows here about 400 and 750 parts per billion. And now we're much, much higher than that.

With CO_2, a similar, you know, thing today versus what we have seen in the last million years or so. The levels in the atmosphere were about 180 to 280 parts per million over this long time period going back, and we're pushing over 400 parts per million today.

So in the next slide, I showed some recent atmospheric greenhouse gas concentration trends in the upper plot, and then the rates in the lower plots. So the CO2 is on the left, far left. And you can see the fluctuations. And those are seasonal fluctuations. Those are basically, you're seeing the earth breathing in a way. Most of the land on the earth is in the northern hemisphere, so during the summer of the northern hemisphere, the plants are all growing and they are extracting CO2 from the atmosphere. So towards the end of the summer are the dips, are the annual low points of the CO2. And in the winter, when the vegetation, trees have lost their leaves and there's a lot less CO2 being extracted by the plant, the levels are at the yearly high. The rate is increasing. So since '85 till now, we have actually, recently we had a three part per million increase.

Now, you might have heard that global emissions have levelled off in 2014 versus 2015. This is great. But the CO2 concentrations in the atmosphere still went up significantly, about two and a half parts per million.

So the middle plot is the methane. And you can see that the trend of the methane was actually decreasing slightly, so the slope was decreasing down to zero in the red below. And then in 2007, there was a significant rise and it started rising up. So a lot of people have attributed this to wetlands. But if you look at the spatial breakdown, the levels of methane in the Arctic are increasing more rapidly than anywhere else.

And this is being attributed to methane coming up from the thawing permafrost on land, also from marine sediments, specifically on the eastern Siberian Arctic shelf, where it's a continental shelf in the Arctic, it's enormous. The water is only 50 to 100 metres deep. And in the last few years, the water temperature has increased, you know, anywhere from five to seven degrees above normal. And it's thawing out the sediments on the sea floor, and we're getting methane coming up from the sea floor, bubbling up and then going through the water column, going up into the atmosphere. We're also getting methane clathrates, which is frozen methane in the water, lake, is melting, thawing, bubbling up. And it's the clathrate that is responsible for the -- identified as craters in Siberia. Dozens of these holes have appeared in Siberia, went up to a kilometre in diameter, big huge holes in the ground. And those are attributed to methane. They have measured high amounts of methane. So those have to be the clathrates. We haven't seen them in Alaska yet but I expect that they will be there soon.

And then on the right side, it shows the nitrous oxide, which has a very high global warming potential, and the concentrations are slowly increasing. So the greenhouse gases are up.

Now on slide 10, the key is that the planet does not warm uniformly. We can take a global average temperature, and that's in the top right, that 0.66 degrees Celsius, that's the global average temperature rise between 1960 and 2009. And the plot shows the temperature rise at all different locations on the planet. And so the red at the very top is a 2 to 4-degree temperature rise over that five decades.

And if you look at the inset plot, it's zonal mean. So zonal is just west to east.

So if you take the average temperature around the earth at a particular latitude, and you plot that average versus the latitude, you can see the curve I show, that's shown in the inset. And what you can clearly see is at 90 degrees. So the far right, the temperature rise, zonal mean has gone up about 2.3, almost 2.4-degrees. And if you divide that 2.4-degrees by the global average rise of .66, that's where you get a factor of three to four there. So that's the Arctic temperature amplification that I'm talking about. So the heat distribution clearly has changed on the planet. Why is it warming so much in the Arctic? Well, I'll get to that in a minute.

But if you go to slide 11, you can see that the warming -- so this is the different seasons. So the top left map is winter, December, January, February, and then we have the spring in section B. And then the summer in the bottom left, and then the fall in the bottom right.

So what you can see is most of the warming has occurred in the winter months, which is the top left map; and in the bottom right map in the fall months. So that's when most of the warming has occurred. And if you wanted to see what the warming has been, for example, in the Winnipeg basin, you could go to, you know, the latitude of Winnipeg about 50 degrees north, you know, the basin maybe 57 degrees or something, and you can go across to 57 degrees and you can get the zonal mean temperature rise and, you know, relate it to the average.

So we have seen significant temperature rise in the Winnipeg basin in the last say five decades, and the further north you go, the greater the warming typically.

So the next slide, slide 12, it shows the Arctic sea changes, the sea ice change. So on the left we have 1979, mid-September, from the satellite record -- we started getting good data from the satellite record in '79. Before then we didn't have decent sensors and we didn't have enough satellites, the technology was evolving. So you can see, this is a birds eye view looking down on the North Pole. And you could see that at the end of the -- mid-September is when the sea ice is minimum area, it's been melting all summer, fall is coming and it's starting to freeze up. So it reaches the minimum area at this time. And you can see it covered most of the basin on the left-hand side. On the right-hand side is what happened a few years ago, that's how much sea ice was left.

Now, sea ice, new ice, new snow typically reflects about 90 percent of incoming light, the term is the albedo. As the ice ages, it gets a bit dirtier, doesn't melt, the reflectivity may drop to about 80 percent. When the ice melts and is no longer there, you have dark sea water underneath, and that only reflects about 10 percent or less of the incoming light. So, solar radiation from the sun coming in, basically, a lot of it is reflected away by the snow and ice in the Arctic. As we get less and less sea ice and less and less snow cover on land, then that high reflectivity or high albedo is replaced by the low albedo of ocean water or permafrost on land, whatever the case may be.

So I won't play these movies, but I do have a couple movies, the links are given on the slide, to show how the September sea ice has varied from '79 to 2014. It's not just a continuous decline, there is variation.

So if you look at the next slide, this shows the Arctic September sea ice extent. The data is the red line. That's the observations. So the minimum -- the dip in the red line in 2012 was the sea ice minimum extent. And you can see that there is variation, there is fluctuations in the curve. But the noticeable thing is that the IPCC, the Intergovernmental Panel on Climate Change global climate change models, there is many of them, there are different research groups around the world, and they all use physical models, physical equations of heat transfer, mass continuity, et cetera, so the physics of the atmosphere. And they are very similar models to what we use for weather forecasting. For weather forecasting, we may run the model just for up to a week or so, but there's chaotic behaviour. So beyond about four or five days or so, you just can't do it. You could have the best super computer and the best model in the world, and there's a random element to it, you couldn't do it. But over a longer period of it actually -- so when you do the climate projections, the reliability is much better than say a very short-term weather prediction.

So these models are all run projecting what will happen to the sea ice extent. And they show, the black line is the mean of the models, and then the grey is the spread of all the models. And clearly the sea ice is behaving in a way that is not being predicted by the models.

In fact, if you look at Antarctic sea ice, the models all predict that it will also be declining. And we know that it has been growing at about a percent and a half in a decade or so, and I can explain why that is due to Arctic temperature amplification, but that's another issue.

The plot below shows the thickness of the sea ice. So not only is the extent declining, the area declining, but the thickness is also getting rapidly declining. So the dark blue is, it is submarine data, so it's ice thickness 1958 to '76, and then the red is more recent submarine data. A lot of this data was declassified not too long ago. And then ICESat is a satellite which uses radar to measure freeboard of ice. So there is an open area of water, it measures the distance to the water surface, measures the distance to the ice around it. That difference gives you the ice thickness above the water. And we know 90 percent is below the water, so then we can extrapolate and get the thickness or mass of the ice. That's the light blue data.

So in all the different regions of the Arctic, the different basins, we have seen a sharp decline in sea ice over time.

So we get the volume of the ice -- so we'll go to slide 14 -- we get the volume of the ice from the thickness times the area or extent, depending on what you're looking for. And the black curve is showing the September minimum from about 1979 to present day. And you can see the trend is clearly down. And all the different colour lines are different types of fits to the data, so best fit cases. And what they show clearly is that it looks -- they are all heading to zero basically. No sea ice in the Arctic Ocean, essentially nothing, and before the end of this decade.

Now, there is fluctuation from year to year because it depends a lot on the weather conditions, the way the winds are blowing, et cetera. Because the ice melts from above in the summer, it melts from below with the warmer water. There's also import of warm water from the Pacific to the Bering Strait, which can melt a lot of ice.

There's also run-off from the many rivers going into the Arctic, and that's warmer fresh water which can melt ice. And if the winds are blowing the ice out into through the Fram Strait between Greenland and Svalbard, then there will be a lot of ice export.

So the wind does have a big factor. And this year we had loads of export through the Fram Strait and also through the Bering Strait. Normally ice bridges form in there which keeps the ice on the water, but this year there hasn't been, this winter there hasn't been an ice bridge, so there's been a lot of export down to the west of Greenland, and that's going into Maritimes -- that's been clogging up and blocking ferries in the Maritimes. Okay. So basically the trend is, you know, no sea ice in the Arctic. And I call this a blue ocean event. And let's say it happens in 2020.

So if we go to the next slide, 15, when will the sea ice volume reach zero? Will we get a blue ocean event? Is it possible that this downward trend can reverse and start going up?

I should note that the IPCC models say that the sea ice could head to zero, their best estimate is between 2040 and 2070. More recent peer-reviewed papers are talking about 2025, 2030. If the trend continues from this data, like in the curve I have just shown you in slide 14, then we're talking about 2020 or before. So zero is essentially when sea ice extends less than a million square kilometres at the end of the melt season. There still could be some ice stuck in the Canadian Archipelago islands and around shorelines and things. But basically blue ocean, the Arctic Ocean being a blue ocean event is coming if you look at these trends. So there's a high probability that will occur on or before September in 2020. So what happens if that occurs?

So slide 16 just shows another depiction of Arctic sea ice volume. So the blue curve is showing the yearly ice maximum is decreasing over time, and in the satellite record from '79 till now, and the yearly ice loss is increasing. So what's left over is the bar in between. So in 2012, 3.261, that's 3,261 cubic kilometres of sea ice left.

So slide 17 shows -- okay, so what we're showing is we're showing what happens each month of the year. So the previous curve I showed you was September. So that relates to the green curve, the lower most curve, which is the green curve. So that's the September ice.

Now, notice -- significant here is that the trend downwards is occurring through all months of the year, okay. Each curve is kind of going down almost in parallel to the September curve. So if the September curve goes to zero in 2020, when might these other curves go to zero? And if all of these curves went to zero, that would mean that we would have a completely different planet. We would have a planet with no Arctic sea ice at all year round. So is it possible that this could happen?

So slide 18, suppose that the first blue ocean event occurred in 2020, so we would expect an ice free duration likely less than about a month duration in September. So the month of September may be ice free, or maybe just a couple weeks in September, but that's where the trend is heading.

So what would happen? Well, I'll lead you down to the -- well, okay. So what would happen is the ice free duration would be extended to three months within about two years, about 2022. So we'd have August, September, October ice free. Within a couple more years, you'd add a month, an ice free month on either side, so five months of ice free. And within six more years on top of that, so a total of a decade or so, one could expect an ice free duration year round in the Arctic. And the main reason for this is that there are enormous feedbacks. I had mentioned the darkening region, as the ice goes, it absorbs more solar energy. But the biggest feedback is the quantity of heat, it's called latent heat, to change the phase of ice. So to melt one kilogram of ice at just blow freezing to result in one kilogram of water just above freezing, there's a certain amount of energy required to do that. Now, if you apply that same amount of energy to the one kilogram of water that's just above zero, that same amount of energy to melt that kilogram block of ice would raise that kilogram of water to 80 degrees Celsius, from just above zero to 80 degrees Celsius. So the Arctic Ocean sea ice is, it keeps the temperature close to zero as long -- as there's ice there that's melting, the temperature of the surface is zero.

Remove that ice and the temperature of the water skyrockets, literally, because there's no energy, that solar energy does not go into latent heat, there's no phase change anymore. It goes into warming up the water and causing evaporation. So the argument is that if we lose that sea ice in the Arctic and we get, you know, for a short period of time, and we get a huge change in the whole system leading us to no sea ice year round there, and obviously a much different planet. And this is what we talk about when we talk about abrupt climate change. So slide 19 shows --

MS. WHELAN ENNS: Mr. Beckwith?

MR. BECKWITH: -- so that's the sea ice -- the snow cover mostly in the spring, so that's the red curve.

MS. WHELAN ENNS: Mr. Beckwith, can you hear me?

MR. BECKWITH: -- snow cover anomaly in June. And what you see is since about 2004, we have had a large yearly decrease in, and we're talking about up to 4 million square kilometres decrease of snow cover in June. The December snow cover is slightly increasing, and you would expect that because the Arctic is warming. And if it's very, very cold it doesn't snow much. You know, as it gets warmer, but it's still below zero, you tend to get more snow.

So, of course, the chain is much less snow cover in spring, darker surface, more solar energy absorption, more heating of the ground, more snow melt.

So we've got the sea ice decline, we've got the snow cover decline. And the rate of snow cover decline is actually, it's about double that of sea ice decline.

So the next curve is the Greenland melt. So the Greenland ice is melting. Now, Greenland is at high elevation but the ice is melting on the surface. And in fact, the blue curve shows that there was very, very high melt in 2012. In fact, about 95 percent, 97 percent of the Greenland ice cap was above zero on the surface, and it was melting ice, forming melt water, and that makes it darker so it absorbs more light. And the curve below shows the melting rate over time. Okay. So the net result is the Arctic is darkening up very quickly.

So, slide 21 shows the -- it shows

some of the statistics. So just look at the colours here. Basically this study looked at heat waves, or June, July, August temperature anomalies over land relative to an average. And the units are in standard deviations on the scale. So when you get more and more red areas, or dark black areas, then we've got a lot of -- the temperature is -- there's a heat wave going on. So what you can see is you can see the years, the progression on the globe through the years, and you can see the numbers at the top of each graph show the percentage in the different standard deviation bin. So the numbers to the right are getting higher and higher, the curves are getting redder and redder. So you're seeing more and more heat wave anomalies over time. So the statistic of the weather is changing.

So plot 22 just shows some of the other big impacts. The oceans are changing. We know about sea level rise increase, which is the top left graph. Because there's more CO2 in the atmosphere, when it rains the CO2 forms carbonic acid, falls into the ocean, makes the ocean acidity drop, which is a problem for the marine life. So the plot on the bottom left shows the pH of the ocean dropping. And it's going into regions it hasn't been for 20, 25 million years.

Of course, the melt of glaciers on mountains and the melt of ice that is on Greenland, and the melt of the ice on Antarctica, and we have measured these rates of loss from very accurate gravity anomaly satellites, GRACE satellite data, and we see a drop -- we are losing a lot of mass on these ice caps and the sea level is rising accordingly from that, but also from expansion.

The doubling period of the melt rate is about five to seven years for both Antarctica and Greenland, and that's held over three or four doubling periods. And if that doubling rate continues, we're not going to get the 1.2 metres of sea level rise by 2100 that's in the latest IPCC report, we're going to get more like two or three or five metres, something like that.

So if you go to the next plot, 23, this shows another very strong feedback in the Arctic, and that is methane. There is huge amounts of methane in the terrestrial permafrost on the eastern Siberian Arctic shelf. And if we had a release of 50 gigatons, which would be in the top layers of the soil, you know, in the ocean sediments, that would raise the levels of atmospheric methane by 11 times. You would have this huge feedback load. We'd get enormous warming in the Arctic. We'd get a very rapid change in jet stream behaviour, and extreme weather events would spiral up, and we would have problems growing food. That's the biggest impact on people.

So there was a study in nature last summer by Wadhams, and they modeled a 50 gigaton release, whether it be over a year or it would be 5 gigatons per year over a decade, and they found economic costs globally of something like 70 trillion, I believe, or 60 trillion, just enormous numbers.

So the next plot shows some of the ways that methane is coming up in the Arctic. So up to now, emissions have been estimated to be quite small. There has been an increase within a few years. So, specifically the Russians have been sending scientific expeditions out on the eastern Siberian and Arctic shelf, measuring methane, and a few years ago they measured hundreds of plumes in their study area with tens of metres (inaudible) and now there's hundreds of plumes in the study area. So this is a very rapid expansion of methane being emitted in that particular region.

And you may have heard of these Siberian methane craters that have been appearing on land. And this is an image, the bottom right image, you can see some people standing at the top. And the largest is a kilometre in diameter. So it looks like a lot of the soils and materials were just pushed out explosively, and the only thing I can see doing that would be methane clathrates. So the methane clathrates would thaw, the volume expands about 190 times, the gas pressure builds up and it starts putting a buckling in the ground, called a pingo type thing, and then boom, you get the big crater form. So they are identifying a lot more of these things, so the methane is definitely coming out more on the land.

Slide 25 shows the methane as measured by satellite, infrared devices on satellite, and it shows a rise over the Arctic from 2009 to 2013 over a particular week in January. The red being more and more methane coming up. So where there is no sea ice, where the sea ice hasn't formed, you get higher concentrations of methane coming up. And that's because the sea water is warmer, it's melting the sediments, thawing the sediment below on the sea floor.

Slide 26 just shows the permafrost map of Canada. And you can see the northern extent of Lake Winnipeg is in the light blue region where there's isolated -- there's isolated patches of permafrost there. So there can be, as this permafrost thaws, the organic matter decomposes. And if there's no oxygen available, so if it's in a marsh underwater, then methane is produced. If it's at the surface of soils, then it decomposes by bacteria, it produces CO2. So as the climate warms, if it warms and dries, we get more CO2 out. If it warms and gets wetter, we'll get more methane out.

Slide 27 shows what happens now with the jet streams. So I had mentioned that the Arctic temperature amplification changes the heat balance on the planet, and that changes the nature of the jet streams. So the jet streams are areas moving from the equator northward in the atmosphere, it curves to the right, the boreal forest, forming the jet streams at high latitudes. The typical pattern of the jet stream is in the right-hand image. So the white line would be the location -- the white border between the purple and the brown is the location of the jet stream. So they circumvent the planet. This is looking down on the north.

And this is what we have been seeing lately on the left-hand side. So we have been seeing a very, very -- waves forming in the jet streams. So if you look over North America on the left, you'll see the wave jet stream dipping down far into the United States. So the jet stream, think of it as a wall separating cold, dry Arctic air from warm, moist equatorial air. So it's like a wall separating those.

So where the jet stream dips down far south into these troughs, that's when we get very cold conditions. So we have had the jet stream being stuck over eastern North America pretty much all winter giving us a very cold winter. In fact, it snowed in Ottawa today, but the jet stream is still extended far south.

Meanwhile along the west coast of North America, the jet stream has moved up and you can see the trough and the crest of the wave and it is very warm there and, of course, you know, drought in California.

So these patterns of the jets are much wavier now and they are more persistent. And they are directly responsible for the extreme weather event.

So if we go to 28, this just shows a side view of the jet stream, an exceptionally wavy jet stream. So, again, in the crest of the waves is warm, in the troughs is cold. So rather than just thinking that you can go north and get colder temperatures, it's not -- quite often now regions that are far north are much warmer temperatures than regions that are far south, and vice versa, depending on where you are relative to the jet stream.

We saw this in Antarctica. The tip of the Antarctic peninsula reached 17 and a half Celsius last week, 30 degrees or so above normal, because the jet stream dipped down to that region bringing warmer air.

Slide 29 shows -- okay, so now we get these extreme weather events. So I'll show a couple of examples of the extreme weather event.

So this plot, slide 29, a few years ago in March we had record heat waves over much of North America, March 8th to the 15th, temperature anomalies were over 15 degrees Celsius warmer than normal. In Ottawa, for example, we reached almost 25, 30 degrees Celsius for the entire week. Lake Michigan surface water temperatures, you can see a spike in March as a result of the heat wave, in the top right plot.

In Ontario, the growing season started five weeks earlier. The apple crop all bloomed, and then towards the end of March we had a frost and it killed a lot of the buds and it cost Ontario about a hundred million on the apple crop.

So these are the sort of things that happened. In this case the heat wave is, the jet stream is basically a big wave forming a ridge over North America.

Okay. I'm going to speed up a little bit.

So slide 30 shows the jet stream configuration over Calgary which resulted in record floods in June of 2013, with costs about 6 billion.

And then slide 31 shows what happened

in Europe, for example, in August of 2003. There was a European heat wave that killed 70,000 people. The root cause was wavy and persistent jet stream ridge over Europe. And you can see the red areas are where there's heat waves over Europe, there's a lot of people, and it had big effects. It also affected many other parts of the planet, but that was not really mentioned because it didn't have human impacts.

Slide 32 shows some of the impacts of what can happen when lake temperatures get too warm. You can get an algae bloom, and in this case it was the blue-green algae and it shut down the water supply in Toledo for many days.

So we have good software that can allow us to look at what the jet stream is doing. So if you just Google earth.nullschool, which I am showing on slide 33, and then you click on the earth text in the bottom left, you can look at what the jet stream is doing today and yesterday basically. So this is showing some of the output from that software, that website. And you can see Lake Winnipeg basin in the centre there. And the pink lines are the wind speed. So where the green circle is, we are talking about 174 kilometre an hour winds of the jet stream. So you can get all of the different metrics, you can see what's going on.

Slide 34 just has a blown up view of slide 33. So you can get good detail on particular regions. And you can get all of the weather conditions. You can get pressures with elevation, you can get precipitation, you can get temperatures, temperature anomalies. You can get all of this information from this software.

Now, slide 35 shows a little bit about what's happening with the mountains in California. The Sierra Nevada snow pack was the lowest ever recorded in California history on the April 1st reading. And the stream flows as a result are all extremely low. Of course, the Saskatchewan River is impacted by this.

So slide 36 shows some of the drought globally. So wet areas are getting wetter, dry areas are getting drier. The Lake Winnipeg lake basin pretty much straddles white and dark orange regions. So this is a projection from the climate models, 2060 to 2069. And if you go to slide 37, it shows an expanded view. So you can see where, you can estimate where Lake Winnipeg is and see, you know, the projection is that it becomes drier and drier as we go forward. Of course, there will always be wet and dry cycles. But globally the dry areas are increasing, about 1.74 percent of the global land area per decade is becoming drier.

Slide 38 just talks about an overall picture. You know, if we have ice free Arctic (inaudible) methane coming up, we're going to get more and more effects globally. Think of it as the climate casino. Some areas are hit very, very badly. Like Calgary, you know, on a summer day, a few summer nights in 2013, Toronto few weeks later, the State of Colorado, massive flooding about a month after that. Just more recently, I mean, they had massive rainfalls, they had 14 years of rain in I believe a night or two in the Atacama, the driest area of the planet in the southern hemisphere. They get about a millimetre of rain a year. Usually, it doesn't rain for about 10 years, a centimetre in 10 years. A few years ago they had 40 centimetres of snow on two different occasions. This year they had massive flooding, just in the last week or two. So no part of the planet is left unscathed by these rapid, these global changes.

So slide 39, this is just a repeat of one of my first slides, it shows the connections again. Arctic temperature amplification is the key to disrupting jet streams, to causing extreme weather events and global changes. And then you can find out what happens on local regions.

So slide 40 and slide 41 are just some of the key web links. I highly recommend that you play around with some of these links because you can get a good understanding for weather and climate from them.

Now, let's go -- I have a few minutes left so I'm just talking about the local Lake Winnipeg effects. So, you know, the studies that look at climate history are, like, we can only do so much, right. We can look at what happened in the past, we can have our models, we can try to project what's happening in the future. But we have to be careful, because the climate history assumes the climate is -- if we make statements based on the climate history, we assume that the climate system is stable, that it's been changing linearly. Like a one in a hundred year flood is a one in a hundred year flood. If the statistics have changed, if the climate regime has shifted, then we no longer have that one in a hundred year flood. When it happens three years in a row, or when it happens three out of five years, we start wondering what's going on? Things have changed, right. So you have to be very careful about looking at the climate history saying what is going to happen now. Also the variability has increased across many most time scales, whether it be daily, weekly, up to monthly.

We're getting weather whiplashing. Like an example, the Mississippi River had record flood levels one year, the very next year it had record low water levels, in fact, barge traffic was threatened. The U.S. Army Corps of Engineers went and dynamited out the rocks in the riverbed to make sure that the passage was still okay. And then a year later it had record flood levels again. You can also have whiplashing over a few weeks. You can have record temperatures in a city, and then really low temperatures, and then you can swing back to record high temperatures. So it all depends where the jet streams are relative to you. If you're near the jet stream and it's moving sharply between a ridge and a trough, all you need is a translation east or west of this jet stream to put you, instead of being under the ridge where it's really warm, you go under the trough which is really cold.

So one of the big things that need to be looked at is, this is having an enormous effect on infrastructure, on roads, on rail lines, for example. You know, if you go from 20 degrees Celsius above normal, the steel on the rail line expands. Then you go to 20 degrees below normal on that rail line a few days later, then it contracts. And then you go back up higher and it expands. So all of these things, they have severe effects on infrastructure. You know, of course torrential rains on roads and rail and river levels and things, they all -- you know, we are moving into a different climate system, you know, we had been there, you know -- over the last decade or so, weather extremes have taken off. Just talk to any insurance company.

So slide 43, other studies are looking at regional climate projections that are based on downscaling. Like the Manitoba Hydro climate study. So we can downscale a global circulation model, and this works well when the global circulation model projections are for a slowly varying linear climate system. Right. When we get rapid changes in the climate system with the jet streams, and the methane coming up, and torrential rains and, you know, things -- I mean, the models are looking at averages, right. But it's actually the extreme peaks and valleys, it's the really wet years and the really dry years have the largest effect on Lake Winnipeg water levels, right. So the models are looking at sort of the average trend, but they don't -- they clearly don't have the resolution to pick out -- they tend to shave off the peaks and the valleys.

So, you know, you are basically, number 4, you are basically trying to assess lake levels, stream flows and water temperatures based on historical data, and then project into the future again. And the variability is much larger now. So I'm just cautioning people that, you know, the models can only take you so far. And they certainly don't predict -- like also the IPCC, so there's 20 or 30 models run globally and then all the information goes into the IPCC reports, and you get your global projections. But in order for the IPCC to accept a paper, to include a paper in their document, the paper has to be in the peer review system for two years. It may have taken a year to run the study, run the data, and then another year to get published. So we're talking about a year plus a year plus two years, about four years or five years. So what's in the IPCC is already, you know, it's already dated by about four or five years. So if the jet streams are fluctuating a lot more in the last few years and ocean currents have slowed down, as was reported in a very recent study, these things, and methane is coming up in the last few years, these things are not accounted for at all in the global climate change models, which are then downscaled to the regional models. So the whole point is, the statistics have changed. The historically stable climate that we have been used to, that our civilization has developed on since the end of the last ice age, about 10,000 years ago, is no longer as stable as it was before. It needs to be re-evaluated, all of our information, to account for these, the new changes that we're seeing.

So, for example, you know, maybe when we want to do a risk assessment, it's a lot better to -- instead of using the last hundred years, maybe we should just be rating the recent behaviour in the last decade much, much higher, to get a better, more accurate risk assessment, say on one in a hundred year flood type number.

The next slide, 44, you know, lake temperature becomes very important during heat waves, like with extended droughts. Annual evaporation typically is 20 percent of inflow, but it's a lot higher when the water temperature is higher. So the lake volume, when it decreases, there is much greater risk of eutrophication and blue-green algae blooms, for example, as I mentioned in the Lake Erie case last summer. And Lake Winnipeg, the average depth is only 12 metres, so this becomes, there's not a huge water volume that we're talking about.

And the inflow, the annual mean inflow in the watershed has increased, according to one of the slides presented, by 58 percent from 1924 to 2003. So, as I have been trying to show, things are changing, we can't necessarily assume that this will continue.

The next slide is about the importance of the glaciers, okay. The Saskatchewan River has shown a decrease in mean discharge, and that will likely continue because it's a glacially fed river. Now, many glacially fed rivers are drying up. And I mentioned the Sierra Nevada snow pack, which feeds the rivers in California, it's only 6 percent capacity. We have seen the decline in spring snow cover in U.S. Rockies, 20 percent since '80. The Peyto Glacier, which feeds a few rivers, including the North Saskatchewan River, has lost 70 percent ice mass.

So we have to be careful not to be fooled. If we get a year when there's a lot of run-off from the glaciers, that's as the glaciers is declining, we could have some years which are sort of like last gasp years of the glacier water output. And of course, there's huge numbers of people that get their water supply from glaciers, not just in North America.

The next slide basically talks a bit about a few more details on the North Saskatchewan and South Saskatchewan River basins, the last gasp of the glacier idea. And I had mentioned that the water access rights of the river, the Saskatchewan River in Alberta gets 50 percent, Saskatchewan gets half of the remainder, and Manitoba gets what's left over, the 25 percent. So Manitoba is at the end of the chain. These ratios were determined under drought conditions so maybe they need to be re-evaluated.

And then slide 47, a lot of the studies use climate normals for a 30-year period from '81 to 2010. Now, most of the abrupt changes or rapid changes in the climate system have been since 2000. So it may make more sense to reanalyze this data using the '71 to 2000 climate normals and that would capture more of the change since 2000.

And the wet cycle for the Lake Winnipeg watershed, there's no expectation that this will continue as global climate system changes accelerate. This weather whiplashing which I had mentioned in some areas can also hit the Lake Winnipeg basin.

And then the last slide, 48, is just another image of the basin.

So I think I'll finish up here.

THE CHAIRMAN: Thank you, Mr. Beckwith. I'm the Chair of the panel, Terry Sargeant. You will be available for questions?

MR. BECKWITH: Yes, I will be.

THE CHAIRMAN: I think we'll take a short break right now.

How much time would you like, 10, 15 minutes? Fifteen? Okay.

Is there more to come now or after this, Ms. Whelan Enns?

MS. WHELAN ENNS: That would be up to you, Mr. Chair, but I think probably completing all of the steps with Mr. Beckwith's presentation and questions, and then the short Manitoba Wildlands presentation would be preferable.

THE CHAIRMAN: Without taking a break?

MS. WHELAN ENNS: No, I meant after the break.

THE CHAIRMAN: Like next is Dr. Beckwith's questions, and then you are on? That's what I understood. Okay. So we'll come back at five to.

(Proceedings recessed at 10:41 a.m. and reconvened at 10:55 a.m.)

THE CHAIRMAN: Are you ready to go? Okay. So we've got Mr. Beckwith back up. There we are.

Okay, Mr. Beckwith, thank you for your presentation. I think you have depressed all of us. But having said that, I'll turn it over to Manitoba Hydro who will be the first to direct questions at you.

MS. MAYOR: Mr. Beckwith, my name is Janet Mayor, I am a lawyer with Manitoba Hydro, and I have a few questions for you today. I am in absolutely no way an expert in climate change or any of the topics that you have spoken of this morning, but I am smart enough to bring with me some other folks from Manitoba Hydro who are. And so I just wanted to, just for the sake, you know who I'm sitting with and who I'm chatting with as we go through our questions. With me is Christina Koenig, who is a professional engineer and section head of the hydrologic and hydroclimatic studies at Manitoba Hydro. And she is responsible for the climate change impact studies at Manitoba Hydro, with a particular focus on water supply, energy demand and extreme events. So she's sitting with me. And I know you can't see us all, so this is why I'm going through and just letting you know who is with me. I have Phil Slota, who is the hydrologic studies engineer. His role at Manitoba Hydro is that he conducts hydrological modeling studies and statistical analysis of hydrologic data. And finally I have with me Bob Gill, who is the senior environmental specialist who coordinates Manitoba Hydro's reservoir greenhouse gas program. And then I have some others who are other engineers and lawyers, but they are not nearly as important for the purposes of this discussion this morning.

So to all of those, I apologize for not introducing you.

I'd like to start, Mr. Beckwith, with just a few questions about your background. You have indicated that are a Ph.D. candidate at this time?

MR. BECKWITH: Yes.

MS. MAYOR: And your Ph.D. thesis is on abrupt climate change?

MR. BECKWITH: Yes, that's correct.

MS. MAYOR: Have you published any written work related to your Ph.D. thesis or climate change in either peer-reviewed scientific journal papers, or refereed abstracts in technical conference proceedings?

MR. BECKWITH: I talked about my work at the Cop 20 Lima, Peru conference in a number of different press conferences there. That's the most recent work that I have done. I haven't, I am working on, as I said, my thesis with -- I'm working on publications on sea ice, methane, jet streams, the different components of what I have discussed. But I haven't, you know, there's been reports, there's been -- but not in peer-reviewed journals.

MS. MAYOR: And although you have a masters degree, it is not in the area of climate change; is that correct?

MR. BECKWITH: My masters degree is in laser physics.

MS. MAYOR: And your Ph.D. has not been defended, because I'm assuming from what you've just said, your thesis has not been concluded?

MR. BECKWITH: Yes, I have completed the courses, I have completed the comprehensives, it's working on the thesis.

MS. MAYOR: Now, you made reference this morning a number of times to the United Nations Intergovernmental Panel on Climate Change, or the IPCC, correct?

MR. BECKWITH: Yes.

MS. MAYOR: And according to the IPCC website, the reports that are prepared by the IPCC's working groups and task forces are the work of thousands of international scientists who contribute on a voluntary basis as authors, contributors and reviewers. Is that your understanding as well?

MR. BECKWITH: Yes. The IPCC pulls it together from volunteer scientists. They pull all the information on topics together from volunteer scientists. And like I say, they only consider papers that have been in the public domain for two years.

MS. MAYOR: Well, I'll get into the timing first. But you would agree with me, and I had been told the IPCC has been described as the leading international body for the assessment of climate change, acting as a scientific body under the auspices of the United Nations, that reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. Would you agree with that characterization?

MR. BECKWITH: Yes, sure.

MS. MAYOR: Now, in your report, the written report, and I didn't see any reference to that in today's presentation, but in your report you make reference to the IPCC's fifth assessment.

Is that correct?

MR. BECKWITH: Yes, the most recent one.

MS. MAYOR: And on its website, the IPCC fifth assessment is described as a comprehensive report about the state of scientific, technical and socio-economic knowledge on climate change, its causes, potential impacts and response strategies. You would concur with that description?

MR. BECKWITH: Yeah. I think this is all well-known public knowledge on the IPCC. I'm not sure where the question is leading.

MS. MAYOR: Well, Mr. Beckwith, it may be well-known to you, but it isn't necessarily well-known to all of those that are reading the reports that are available. So that's part of it. I also want to ensure that you are in agreement with my descriptions of them before I ask you any further questions.

So you have indicated that you are.

MR. BECKWITH: Yes. So working group one came out I believe September or October -- September of 2014. That's what we're talking about, the physical basis of the climate system from the IPCC AR 5, assessment report five.

MS. MAYOR: And the reports that form the basis of that assessment were published in 2013 and 2014?

MR. BECKWITH: I had been told that the IPCC would have had a copy of the paper, you know -- like the 2014 ones, I'm not clear on, because I understood it was a two-year vetting process of papers being in the peer-reviewed literature. But there is a cut-off date for papers which they do accept.

MS. MAYOR: Mr. Beckwith, I'm looking at the website, and the cut-off date is July 31st, 2012. And at that point in time, they are then peer-vetted to ensure their accuracy.

MR. BECKWITH: Okay.

MS. MAYOR: That would be correct?

MR. BECKWITH: If that's what the website says, yes, okay.

MS. MAYOR: And the IPCC's fifth assessment, and the multiple reports used in that assessment represent the current mainstream consensus view on climate change?

MR. BECKWITH: Yes, it's the mainstream consensus view.

MS. MAYOR: Now, a key focus of your report is on a type of abrupt climate change due to Arctic methane emissions. The extensive body of work compiled by the IPCC has reached the conclusion that such emissions are growing slowly and will continue to do so for the foreseeable future over the next century.

MR. BECKWITH: Yes. The IPCC is discounting climate effects from rapid growth of emissions. But the work, the basis of my work is on observations of the jet stream behaviour. Methane is not the primary point of my -- for me saying that we're getting rapid changes in the climate system, a ramping up of extreme weather events, that's not, that doesn't have anything to do with methane. That has to do with Arctic temperature amplification, and as I have shown in the peer-reviewed maps, in my presentation, and also on the changes in the jet streams.

Now, the jet stream connection to the Arctic is gaining more and more weight, but it is very cutting edge and new research, mostly being lead by Jennifer Francis.

The sea ice decline information is mostly based on a lot of work from, first of all, its data showing the trends. So, you know, you can look at where the trends are and, say, make a projection, where is it heading? It's based on observations. And a lot of observations come from Peter Wadhams, who is the U.K.'s premier sea ice expert, who has actually been going up into the Arctic for 30 years plus on British nuclear submarines, measuring ice thicknesses from below. So this is all either peer-reviewed work, or its observations of what the climate system is doing today and last year and the year before, which doesn't fall into a lot -- you know, the IPCC stuff clearly, the last few years.

MS. MAYOR: Going back to the IPCC, you would agree with me that the IPCC differs with your hypothesis and your views that the impacts of such climate change are much more imminent?

MR. BECKWITH: The IPCC projects that the sea ice will banish for the first time somewhere in the time period 2040 to 2070, and they base that on their models. And I showed the plot of what the mean of the models was, what the range of the models was, and what the actual data is doing. I also pointed out that the models project Antarctic sea ice will decline. And

Antarctic sea ice is growing and it has been for the last 30 years. And there's no global climate model that can properly project or explain what is happening to the Antarctic sea ice. And so, you know, it's very clear how that fits into the Arctic temperature amplification system picture, but it's just the models fail on this.

MS. MAYOR: And I'll get to the models in a moment, but I'd also like to put to you, you reference in your paper the National Research Council of the National Academy of Sciences. As recently as 2013, it also concluded in a published report that methane emissions will not rise significantly enough over the next century to cause abrupt climate change. Is that correct?

MR. BECKWITH: Yes, that's correct. Methane is not the issue, the issue is the rate of Arctic temperature warming, and the change in the jet stream circulation patterns, and the decrease in the AMOC, the Atlantic Meridional Overturning Circulation. And that report is, you know, over two years old, right, and the data is probably from a year before that or something, I don't know.

MS. MAYOR: Are you familiar with an

article that was published yesterday in the journal called Nature, entitled Climate Change in the Permafrost Carbon Feedback?

MR. BECKWITH: I did see the title of that paper, yes.

MS. MAYOR: Are you aware that its conclusion is that the current evidence suggests a gradual and prolonged release of greenhouse gas emissions in a warming climate? So gradual and prolonged?

MR. BECKWITH: Yeah. Okay, fair enough. But there are things happening all the time which are unexpected in terms of methane. A lot of the Russian work by Shakhova and others is not getting the public recognition and press that it should. And it is all peer-reviewed by a battery of Russian scientists who look at methane emissions from the eastern Siberian Arctic shelf. I don't believe that that's covered. This article is mostly terrestrial permafrost. There are published reports on terrestrial permafrost saying that the threshold is about one and a half degrees, and then emissions substantially increase.

Also, the methane information from the

permafrost is based on slab computer models that assume, look at how long it takes for a warmer atmosphere, for that heat to penetrate deep down into the permafrost through the ground materials. And that takes a long time. That takes hundreds of years. But what we're seeing -- I would remind you that these same people and these same models were saying that it was not possible for methane to come up from the eastern Siberian Arctic shelf. That's what the models were saying. It would take a long time for heat to go downward. The observations show differently.

Also, this new phenomena in the last -- first recognized last summer, about these dozens of blow holes or craters that are appearing in the Siberian permafrost. If you look at the meteorology, those are regions that are seeing temperature anomalies of 20 degrees Celsius or warmer over large regions of the Arctic. And it's sitting right over those parts of Siberia where these blow holes are appearing. And these blow holes weren't there a few years ago. Like I said, they are as large as a kilometre in diameter. And the only plausible explanation I can see is that it's not just organic material that is decaying, it's methane clathrates. Because when they melt, they expand 190 times, and the pressure builds up, and it's blowing the holes. But this is all cutting edge research.

I'm sure you would agree that we need a lot more research on this type of thing, because the precautionary principle states that if we are wrong on this, then the implications are enormous, the risk to society is enormous. The nature paper on the 50 gigaton release talked about, you know, 60 trillion or 70 trillion cost to people. It would basically be turning a switch on the climate, ramping it up. But methane is not the primary part of my presentation. The primary part is the observed Arctic temperature amplification and the observed changes in the jet streams. And this is all published work. It's cutting edge in the last few years, but it's all published work.

MS. MAYOR: Mr. Beckwith, in reading your report, the key criticism that you have of the Manitoba Hydro Lake Winnipeg hydroclimatic study is that the future climate projections are too conservative in that they rely upon global climate models that don't incorporate the very rapid changes due to abrupt climate change that you are speaking of. Would you agree with me that, in fact, there are no modeling studies -- sorry, there are no scientifically-accepted and peer-reviewed global circulation models available to incorporate your suggestions at this time?

MR. BECKWITH: I'm not aware of any global models that look at the -- that model the jet stream behaviour correctly. Their modeling of the ocean currents I think is better, but not of the jet streams and the wave events, not that I'm aware of anyway.

MS. MAYOR: In preparing its hydroclimatic setting, Manitoba Hydro used 147 future climate scenarios to assess the potential impacts of climate change in the Lake Winnipeg watershed. You were aware of that?

MR. BECKWITH: Yes. Yes, I read the report.

MS. MAYOR: And the 147 future climate scenarios were based upon the same global climate models that were used in the most current IPCC fifth assessment report?

MR. BECKWITH: Yes, I have seen that file, yep.

MS. MAYOR: Were you aware that the

hydroclimatic study done by Manitoba Hydro was also endorsed by expert climate scientists at URANUS, a recognized expert in the field of climate change assessments?

MR. BECKWITH: Yes, I know about this group that does a lot of contract work for Environment Canada and others, yes.

MS. MAYOR: You were aware that they had endorsed the Manitoba Hydro study?

MR. BECKWITH: Yeah. I mean, the models, as I mentioned, they shave off the extreme events, like they shave off the torrential rain events, they shave off peak flood events, they shave off peak drought events. I mean, do these models, do any of these -- do you think that these models would be able to predict that the watershed to the west of the City of Calgary gets 220 millimeters, which is basically three to four months of rainfall, rain on snow event near Banff, and that flood of water goes down the river system and floods out Calgary to the tune of 6 billion, or three weeks later a similar amount of rainfall widespread over the City of Toronto, which causes a billion dollars event, were properly -- model the severity of the California drought? I mean, these models, you know, models only go so far. You know, you have to really look out the window sometimes and see, you know, the extreme weather events that are occurring. And these are not being picked up properly in these models. So the question is why?

MS. MAYOR: Thank you, Mr. Beckwith. I have no further questions.

MR. BECKWITH: Thank you.

THE CHAIRMAN: Thank you, Ms. Mayor.

Do any of the participants have questions? Mr. Williams, nothing? Mr. Shefman? Mr. Lenton? Mr. Yee?

MR. YEE: No questions.

THE CHAIRMAN: Ms. Suek?

MS. SUEK: No.

THE CHAIRMAN: Looks like you're going to get off relatively easy, Mr. Beckwith.

I have a couple of questions -- well, one of them is just a question of clarification. On slide 45, point number 8 in your local Lake Winnipeg effects, towards the bottom, I guess it's the second last sentence, it says Rocky Mountain glaciers supply a majority of stream flow in Alberta, Saskatchewan and Manitoba. Does that refer to the Saskatchewan River, or just the Saskatchewan River, or does that refer to all stream flow in those three Provinces?

MR. BECKWITH: Sorry, what's the slide number, did you say?

THE CHAIRMAN: Forty-five.

MR. BECKWITH: Oh, there we go, okay. Rocky Mountain glaciers supply majority of stream flow in Alberta, Saskatchewan, Manitoba. So, sorry, your question is?

THE CHAIRMAN: Does that apply just to the Saskatchewan River, or does that apply to all stream flows in those three provinces?

MR. BECKWITH: In the case of Manitoba, I think it's just the Saskatchewan River. The other rivers have different sources. In Alberta and Saskatchewan, most of their rivers I think are -- the proportion of their rivers from glacier-fed stream flow I think is higher. But I'd have to, I'd have to -- I'll have to confirm the source for that, the article the link below.

THE CHAIRMAN: Okay. And perhaps Ms. Whelan Enns can provide that to us at the beginning of next week when we return.

I just have one, sort of a big picture

question. What lesson should we, the panel, take from your presentation and how this might or might not impact on the regulation of Lake Winnipeg?

MR. BECKWITH: Yeah. I think the key thing to -- the key take home message that I have been trying to get across is that it's very important to look at the global climate system and to realize that all of the components are connected. And that one of the key -- the key area of the planet that is changing most rapidly is the Arctic region. And what happens in the Arctic doesn't stay in the Arctic, right. I say this expression. It's not like Las Vegas. The rapid temperature rise in the Arctic, it has global implications. Because the Arctic is darkening, it absorbs more sunlight so it heats very rapidly, so there's less heat moving forward, and then it affects circulation patterns, it affects -- because the equator, less heat is moving north from the equator, more is moving south, it's making the jet streams around Antarctica increase in strength, drawing sea ice out. Like the whole system is connected and different -- we're seeing different places being subjected to extreme weather events, either never experienced before, or completely, you know, many standard deviations, if you talk about the statistics of the events happening. So we have to stop being surprised when a city gets inundated with torrential rain and has massive flooding, whether that city be in the northern hemisphere or southern hemisphere, in Winnipeg, or elsewhere.

We have to start recognizing that when we design new infrastructure and we design it for, you know, one in a hundred year event or one in a thousand year event, that that number may not be valid anymore. Maybe we need to err on the side of larger pipes for drainage, et cetera. Like this is affecting -- this affects people wherever you are.

So, in Winnipeg, for example, now, what will happen to water regulation in Lake Winnipeg if a torrential, if we get four or five or six months of rain over the Winnipeg Lake basin, and then within a few days, or within a week, we get huge floods of water coming down the rivers inflowing into the lake, that would be a Calgary type event, or what would happen if we get three or four months of rainfall directly over Lake Winnipeg, Lake Manitoba, Winnipeg, you know, City of Winnipeg, what will happen? Where will that water go?

We need to know these things because these things can happen. The risks of these type of events is very high. I mean, I'm sure people in Calgary never expected what happened, or in Toronto, or other places. So, you know, because there is so many inflows to Lake Winnipeg, we can certainly, you know, increase marshlands upriver of the lake. We can, you know, follow procedures that are suggested by the IISD, for example, of taking drainage ditches next to the road and making their cross-sections larger to store more water and things like that. Like there's lots of things that we can do. And those will also store a lot more water so that the -- like Manitoba Hydro generators, whenever the lake is too high and they, you know, 715, they have to open the floodgates, they have to let a lot of water go through the bypasses, it doesn't go through turbines, so that water does not generate power, right, that's like dollars lost. If that water could be stored upstream and then released slowly over longer periods of time, then the turbines could be running at higher flow rates for longer periods of time. Like there's a lot of economic benefits to really considering what's going to happen.

Of course, you know, we're not going to know everything about it, we never will, but we do know the statistics is changing.

THE CHAIRMAN: Thank you very much, Mr. Beckwith. We have no further questions for you, so I'd like to just thank you for your presentation here today. And before you hang up the phone, Ms. Whelan Enns has a comment or a question.

MS. WHELAN ENNS: Just one offer based on our morning, and thank you very much Mr. Beckwith for what you have provided this morning. And that is based on the questions from Manitoba Hydro, I wanted to know whether they would want an undertaking in terms of providing the peer-reviewed reports and sources that you were, that you have cited in your report and also in questioning.

MS. MAYOR: I am advised that we have access to all of those reports from his citations that he has provided. Thank you very much, though.

MS. WHELAN ENNS: Thank you. I just wanted to offer, and also because the references then from Mr. Beckwith this morning in terms of peer-reviewed material went beyond what's in his report. So, we'll take that as a no, Mr. Chair.

THE CHAIRMAN: Thank you, Ms. Whelan Enns.

Mr. Beckwith, we'll let you go and enjoy the snow in Ottawa. We had it the day before yesterday, but it's melting today. Thank you and good day.

MR. BECKWITH: Thank you.

THE CHAIRMAN: Ms. Whelan Enns, a minute or two, you can turn over to your other.

MS. WHELAN ENNS: Thank you, Mr. Chair.

The intent here is a very short presentation from Manitoba Wildlands that's in relation to the research we have been doing, and the chart and set of sheets regarding our desk study in terms of public policy regarding Lake Winnipeg.

There were two items, two e-mails yesterday evening to the list for these hearings that are updates, with an explanation that we were basically looking for typos, grammar errors, repeats, that kind of thing in the spreadsheet. So that was a fax sent out again yesterday evening. And because of two sheets being dropped, because it wasn't content, or the content was moved out of them, we also updated the introduction to the public policy chart last night and sent that out. So that's just a point of information.

There was then also filed a short report to give an indication of what we were trying to do, where we were looking, what we were trying to learn, what we were trying to in fact provide to inform all of us as parties to the hearings.

So the first slide is the title of that report and its presentation today in relation to the research we have been doing.

Slide number 2, and I guess we're going to do a little bit of reading here because we're on transcript. And it's all information that is known and or already provided.

Manitoba Wildlands has participated in each stage of the regulatory processes for Manitoba Hydro projects since the beginning of the

Wuskwatim process, which was in fact in winter 2001/2002. And in case there's head scratching on that, that has to do with the series of meetings around the province that the Clean Environment Commission held to arrive at the content for the environmental impact statement guidelines for the two Wuskwatim projects. So that's why the starting date.

We had a little bit of thunder stolen here, or a little bit of agreement among participants in terms of the second item here on this slide. And we also had been looking then at the recommendations from the Clean Environment Commission, from that Wuskwatim report. And yesterday the Consumers Association of Canada here in Manitoba and their experts gave us a fair bit of content in terms of what was recommended and where we are now and also some suggestions.

So, from our perspective in terms of Manitoba Wildlands' perspective, we haven't reached these standards or met these recommendations, certainly with respect to the Churchill River Diversion augmented flow program and now Lake Winnipeg Regulation. What we're doing here in terms of the mandate for this hearing falls short of what the Clean Environment Commission was seeking in their recommendation at that time. And we have consistently, since 2004, supported those recommendations from the Wuskwatim report.

The comment then at the bottom of slide 2 is that a public utility, in this case our public utility, whose social licence to operate is living and active and adaptive and based on their ongoing practice, would have paid it more attention in our estimation 10 years ago, and have been working on the intent of those CEC recommendations and anticipating that they wouldn't go away.

On slide 3, this relates to the desk study and the research we have done, that our aim was to provide the CEC panel and the participants, and Manitoba Hydro, with an overview of the public policy situation for Lake Winnipeg as its status as regulated reservoir for the last 40 years, and as what many of us refer to as Manitoba's great lake. And there's a reference here then to the chart and each of the topic sheets that are in it.

What we set out to learn in terms of undertaking this research was to find out what the public policy framework for Lake Winnipeg has been, what it is, and perhaps what it needs to be, especially given the size of the lake, the size of its watershed and basin, and its status as a reservoir for 40 years. We wanted to learn whether the public policy was accessible, understandable, whether it was being applied by the utility and by Manitoba's Governments, that's a plural here, before different governments in a period of 40 years.

We were also wanting to learn whether the utility and various Manitoba departments, agencies and programs are cooperating regarding all aspects of Lake Winnipeg operation as a reservoir, as an economic engine for several sectors in our province, is home to over 25 communities, and is habitat for many species in a range of ecosystems.

We wanted to learn what kind of governance, management, monitoring and protection system is in place for the lake, especially given it is regulated as a reservoir.

And we all always need to know what the role Aboriginal peoples have played in establishing public policy about the lake.

On slide 6, there's a short version here of what we found. Again, the report is a little bit more thorough, and the charts and sheets are more thorough again.

The public policy regarding regulation of Lake Winnipeg and the establishment of our hydro system began in 1916, when the Conservation Commission of Canada published Water Powers of Manitoba, Saskatchewan and Alberta. We can make this available to anybody who would like a copy. The volume followed an earlier Pan Canadian study that was also Dominion of Canada done in 1911. At the time of both these reports, the Dominion government controlled the water resources for the Prairie Provinces.

So we found that public policy programs, studies, regulations and reports about Lake Winnipeg are a hodgepodge. It's a term we use in our office in terms of GIS, but it certainly applies here. That is, it's a hodgepodge of single issue, single location, single species, or single environmental element, tools, materials. There is an incremental pattern of new laws, new policies, but most continue to be in relation to one element or one aspect lake management or operation.

Slide 7. All of these policies seem to leave the onus on the citizens, communities, the environment, and are curative, after the fact that is. They are curative rather than preventative management. The report, some of you will remember, has a series of definitions in terms of public policy. And most of them in fact say that the relationship between public policy and law and regulation has to be close, has to be clear and understandable and, of course, updated.

So what we're saying here is that once a problem exists, then a public policy process about that problem is attempted.

So, the current example in Lake Winnipeg that we're all, in terms of media coverage, would be aware of would be the zebra muscles situation right now in Lake Winnipeg.

Another example, and there was a lot of good work done by the Lake Winnipeg Stewardship Board, is that their mandate was specific. It was about reduction of nutrients.

Often it turned out to be a significant lack of access to information, follow up, report back, and overall planning, accompanying these single element, single issue policies. All of which, of course, affect and are affected by our largest reservoir, Lake Winnipeg.

All of these policies appear to be hampered by the regulation of lake levels in Lake Winnipeg.

Now, we have undertaken this research and put these products together within the capacity that we had, which is why we're quite clearly saying it's a desk search. We have not, for instance, had the capacity to go into some of the repositories in the province that we wanted to go to. So when I say appear, where we're at right now, there appears to be a block. It appears that the regulation of Lake Winnipeg levels is primary throughout our system. And so it's primary, but it's rarely even mentioned, and I am serious here, even mentioned, let alone taken into account, in the public policy process. And there's all kinds of examples of that. You can open up the different stages of, you know, Manitoba lake strategy. Even the consultations and work being done in the 1990s on water policy in Manitoba consistently delete the fact that the lake is regulated and it is a reservoir.

So we have come to some conclusions at this stage in the work. There's a great deal of current public policy that affects Lake Winnipeg. For those who have taken a look at the charts, there is also, both Federal and Provincial, more laws than we've got fingers and toes for, more regulation one way or another that has potential impact or effect on the hope for future for the lake in terms of governance, regulation, management, protection.

So we've got lots of policy and lots of laws and regulations that relate to Lake Winnipeg, and could in fact, and/or should be pertinent and applied to Lake Winnipeg. It's a whole other topic whether they are being applied. Also, none of the policy, as I just said, seem to refer to the fact that the lake is a reservoir. Much of the current public policy and regulatory elements also need to be taken into account in decisions for regulation of the lake.

There was some content in our day yesterday about silos. We are a province of silos and we all, everybody in this room has a role and a responsibility to find a way in governance of the future of the lake, future of the hydro system, to dramatically reduce the walls around the silos and begin to find collaborative and systems-thinking based approaches to the future for the lake.

While we have located a great deal of public policy, there appears still to be a gap or absence of policy in law to actually lead us to best governance regulation, management, monitoring and protection of Lake Winnipeg.

Slide 9 has a handful of recommendations on it. We will return in our closing statement to recommendations, having had the opportunity to learn from the hearing process itself.

We found last winter that that was, that the Keeyask hearings were extremely helpful to all of us in terms of what we learned during the hearings and before closing statements, so hoping that that's an outcome again. But we do need to apply a 21st century lens and thinking and know-how for the future of the lake. We need to apply a whole system and whole lake integrated approach. The reservoirs expert that the Clean Environment Commission brought into the hearings in the second week, Mr. McMahon, certainly was very, very clear about how best regulation and best management demands a whole system and a whole lake approach.

So, Lake Winnipeg must have a comprehensive governance, regulation, management, monitoring and protection system. We all need this, the lake needs it, but also all of us need it.

The communities, stakeholders, fishers and ecosystems would all benefit. There are simply too many players and not enough accountability, planning, reporting, or beneficial outcomes. It should be noted that the Lake Winnipeg Implementation Committee recommended the approach in these recommendations 10 years ago. And if anybody is having trouble finding the technical annex for all of their work, we can provide that out of our office, because sometimes people just do policy, but there was a tremendous amount of technical work also done to come to these conclusions.

So the closing comment here is, we trust the CEC to consider the public policy situation in your report and your recommendations. Thank you.

THE CHAIRMAN: Thank you, Ms. Whelan Enns. Manitoba Hydro, questions?

MR. BEDFORD: No questions, thank you.

THE CHAIRMAN: Thank you, Mr. Bedford. Any of the participants? Do you have any questions? Panel members, Mr. Yee?

MR. YEE: Yes, thank you, Mr. Chair.

Ms. Whelan Enns, in your first recommendation you mentioned apply a whole system. What do you mean by a whole system?

MS. WHELAN ENNS: Thank you. It occurred to me quite late last night that I should bring some definitions in terms of systems thinking and whole systems. So I didn't manage that when I was sending that e-mail, but I'll give it a shot.

To be the generalist, the generalist as a researcher in this and to answer your question, it means holistic. It means some of the things, for instance, that your reservoirs expert was talking about in terms of -- and it goes to your mandate. So this is a side statement about how we're all very aware of how specific the mandate is for this set of hearings. The ideal, going back to the recommendations from 10 years ago, would be that we would be finding a way so that we are not simply going through a series of proceedings and reviews where we're doing one project at a time. Okay. Where we're thinking about, at all times, public policy, regulation, operation of Lake Winnipeg regulation, operation of the elements in the hydro system, we're thinking at all times about the whole hydro system and also the whole natural system.

We don't know at this point whether we're going to be in a similar exercise regarding review of the Churchill River Diversion, but again, I think your reservoirs expert was pretty specific about how this isn't necessarily a whole Lake Winnipeg regulation review because the whole system is not connected.

So, holistic of course is one of the very common used terms. Systems thinking has to do with thinking always about all of the elements in the system. I would suggest that Paul Beckwith, in his contribution this morning, has been emphasizing that there is risk if we're not paying attention to what's going on in the whole climate system with respect to, again, the mandate for these hearings.

Am I at the sufficient point?

MR. YEE: Thank you for that.

MS. WHELAN ENNS: Thank you.

THE CHAIRMAN: Ms. Suek?

MS. SUEK: I'd just like to follow up on that, just to clarify. You're talking about looking at managing the Lake Winnipeg Regulation system, the environmental impact of the dams -- I'm thinking of topic areas here. But are you thinking more broadly in terms of the whole health of the lake, and pollution and erosion that are not related to Manitoba Hydro developments but other causes, are you looking at that too when you recommend this, or are you thinking specifically about the Manitoba Hydro?

MS. WHELAN ENNS: Thank you for your question.

Again, this is the challenge we all have in these proceedings is the mandate that you have now. But everything is connected. And so yes, when talking about the whole system, that definitely includes the ecosystems and natural systems around the water bodies that are what makes the hydro system work and produce energy.

We have a huge challenge perhaps at

this stage in these hearings, because there are a range of effects on Lake Winnipeg and there has been -- I mean, we're talking about a great lake in Canada that's the least, practically the least studied lake in the country. And so the challenges that we have is that there are a variety of effects and impacts that are being identified on the lake, that from Manitoba Hydro's perspective, are not directly related to regulation. So to take your question, we need to be definitely on the whole system and those impacts also.

One of the things we do at Manitoba Wildlands, and it's often myself, or myself and researchers on conference calls, we talk to experts across the country.

In preparation for this hearing, I spoke to a variety of people whose scientific and academic careers started in the 1970s and 1980s with work on Lake Winnipeg. And the assistance and the observations included, in relation to your question, that somehow it's going to be necessary to identify how much of the, let's take soil erosion, how much of the soil erosion is caused by the dramatic increase in inflows to the lake. How much of the soil erosion and shoreline damage is caused by the period we are in now of high water levels. And how much of it is then affected by the controlling of the levels of the water on the lake. Okay. I have no ability to name the individual, who was very, very pointed with me, and more than one expert I spoke to has said, we all have to find a way to unbundle that. So that goes I think to your question in terms of shorelines and the rest of the system around the lake. Yes.

MS. SUEK: Okay, thank you. I have another question. You mentioned in point 3 the Lake Winnipeg Implementation Committee. It seems that there were, over the years there's been some efforts to set up a committee on various topics. Do you know much about what this committee was supposed to do and why it ended? There's been others. Do you know what the history is about, what's been tried, and did it work or not work, and why did it end?

MS. WHELAN ENNS: And I can certainly give you a bit more background on them, and perhaps we will arrive at an opinion from my side.

The Lake Winnipeg implementation

committee, and there are, I think there are others in the room who attended the sequence of workshops, I'd have to think about that. But it was actually put in place by the Government of Manitoba and the Government of Canada, so it was bilateral in that sense. And so Canada appointed a co-chair and Manitoba appointed a co-chair. Those two individuals were Terry Duguid, a former chair of the Clean Environment Commission of Manitoba, and Norm Branson, a former Deputy Minister of Manitoba Conservation and Water Stewardship. And there was a mandate agreed to by the two governments and a work plan. I think a fairly, well, highly well-attended and thorough series of workshops, as I said earlier, a lot of technical work and analysis provided by a range of scientists, I think all with their Ph.Ds. Then in the final workshop there was a charter discussed and reviewed, and a report issued that's very short, very clear set of recommendations, which bring us back to some of what is being recommended in these hearings.

Now, to go to your question, the Federal Government changed. And so a lot of the work that went on, sort of '03 through '05, I might be a little off on the calendar here, is just sitting there waiting to be used.

MS. SUEK: Okay. Thank you.

THE CHAIRMAN: Just on that last point, I'm not sure that the Province of Manitoba was a party to that committee. I could be wrong, but I believe it was more a quasi-federal initiative. The link to the province might be the fact that Norm Branson was then a former Deputy Minister of Conservation, and Terry Duguid, of course, was a former chair of this commission.

MS. WHELAN ENNS: Well, thank you, Mr. Chair, I was qualifying my recall. Certainly that's how the two co-chairs were taken in the dynamic. Point well taken. If it was completely Federal, including in terms of funding, certainly they were making sure that there were co-chairs, and that there was a co-chair that was an expert from the point of view of Manitoba. And anything else probably on this topic gets a little bit political in terms of what the intentions were of the former Federal Government at the time.

THE CHAIRMAN: I'm not saying completely or firmly that the province wasn't a party, but my understanding is that they were not, but that can be corrected.

MS. WHELAN ENNS: Thank you.

THE CHAIRMAN: Mr. Harden?

MR. HARDEN: Okay. I have I guess one sort of question. In your last bullet on page 7 and your second bullet on page 8, there seemed to be an inherent implication that because Lake Winnipeg is used as a reservoir, there were public policy implications that would be different than if there was an uncontrolled natural lake. Can you expand on that a little bit?

MS. WHELAN ENNS: Certainly. You are right to ask, and I qualified this in terms of opinion. But the pattern we found in the research is that there is a fairly steady, particularly in the last 20 years, pattern of public policy work from the Manitoba Government, a variety of different kinds of remediation and/or problem-solving programs and so on. We have also had, starting with the Sustainable Development Act of the Province, a pattern in terms of water policies and water strategy for the Province, and we now have a Water Council that is involved in some of this policy work. What we found is that the references to Lake Winnipeg never included that the lake was regulated, whether it was a reservoir. So that's the starting point for us trying to figure out why.

So your question is a good one, it probably needs more work. I'm going to take the opportunity, if I may, to say just what our report says, which is we're quite aware of where this kind of research needs to go in terms of further product and more investigation. And so you're asking a question about something that probably needs to be pegged. But that is the pattern in the research and the materials that we handled, is that it's like two tracks, where everything to do with Lake Winnipeg in respect to the hydro system clearly, of course, talks about regulation of the lake. But the public policy pattern, the water strategies for the Province, the publications and investigations for the Water Council leave it out. Hence the statement.

MR. HARDEN: Okay. Thank you very much. That was my question.

THE CHAIRMAN: I have no further questions.

So Ms. Whelan Enns, Mr. Whelan, the rest of your team, thank you very much for all the work you have done and your participation in these proceedings to date, and in particular for these two presentations this morning. Thank you.

MS. WHELAN ENNS: Thank you, Mr. Chair.

THE CHAIRMAN: That brings today's presentations to a conclusion. We do have two or three items of business to take care of before we all leave this room. First, I'll ask the Commission secretary to register documents.

MS. JOHNSON: Okay. MWL number 1 is the outlines minute on February 24th. Number 2 is Mr. Beckwith's paper on climate change. Number 3 is the governance summary submitted. Number 4 is the workbook material. Number 5 is the climate change presentation. And number 6 is the policy presentation.

(EXHIBIT MWL 1: Outline minute on February 24th)

(EXHIBIT MWL 2: Mr. Beckwith's paper on climate change)

(EXHIBIT MWL 3: Governance summary)

(EXHIBIT MWL 4: Workbook material)

(EXHIBIT MWL 5: Climate change presentation)

(EXHIBIT MWL 6: Policy presentation)

THE CHAIRMAN: Thank you.

Mr. Bedford, you have a point or two?

MR. BEDFORD: I do, thank you. A week ago, we were provided with a paper by a Dr. Clark, on behalf of the Manitoba Metis Federation. I have read the paper. I'll tell you that the advice I gave my client, having read the paper, that this was an expert witness that I thought we should be cross-examining when the time came and he presented his paper.

I have been told this morning, quite to my surprise, that Dr. Clark will in fact not be appearing before you to present his paper. The paper, of course, has not yet been entered as an exhibit in these proceedings. Given the fact that Dr. Clark is not going to be provided for cross-examination on the paper, I would ask you to confirm that the paper, in fact, will not become an exhibit to these proceedings, and accordingly, concerns I have about an expert opinion going in and not being subjected to cross-examination would no longer prevail because the paper would not be made an exhibit.

If to the contrary, you decide that

nonetheless you want the paper to go in, I don't know how we are going to handle cross-examining the author of the paper when he's not here.

Now, I have been told this morning as well that Mr. Chartrand will be appearing to do something before you next week. And I would like clarification on that as to whether or not Mr. Chartrand's presentation will be treated as just that, a presentation, not subject to cross-examination? And in the course of this proceeding, we have had a number of those. And I'll know if it's just a presentation, that I don't need to prepare, nor does Ms. Mayor, a cross-examination. If on the other hand, the understanding is that Mr. Chartrand will have to be open to taking questions, then I'll know that today and we'll prepare ourselves accordingly.

I think it would be frustrating and not useful for my time, nor yours, for me to cross-examine Mr. Chartrand, not the author of Dr. Clark's paper, about the contents of Dr. Clark's paper. I have tried to think that through, and I think we would just be faced with the obvious common sense responses, that I didn't write this and we'll pass on your questions to

Dr. Clark, and when he has time in the summer maybe he'll provide an answer to you.

So the two issues, to repeat, is Dr. Clark's paper going to be allowed to become an exhibit in this proceeding? And secondly, is Mr. Chartrand just a presenter or is he a witness who has to be open to cross-examination?

THE CHAIRMAN: Thank you, Mr. Bedford.

On the first point in respect of Dr. Clark's paper, just for the record so that people don't think I'm making an off-the-cuff decision at this moment, counsel for Manitoba Hydro approached the Commission Counsel this morning with this issue. We have had discussions on our side of the table in respect of this matter. Our counsel has engaged in a bit of shuttle diplomacy back with Manitoba Hydro's counsel. What we are prepared to, or what we will decide right now is that we will, either this afternoon or tomorrow morning, contact Manitoba Metis Federation. We will inform them that if Dr. Clark is not available, either in person or by phone or Skype, on Tuesday afternoon, that the paper will not be entered into the record.

And I'll seek guidance from you that

they let us know by noon on Monday whether Dr. Clark will be present? It's a bit tight, I realize that. We will ask them to let us know sooner if they can. But given that it's a weekend coming up, I suspect they wouldn't be able to let us know much before then. Will you accept that, noon on Monday?

MR. BEDFORD: Thank you, that's fine. I mean, one of the mysteries was no explanation as to why the gentleman isn't coming.

THE CHAIRMAN: I wasn't aware of it until this morning, as you were not.

And on the second point, Manitoba Metis Federation is registered as a participant in this proceeding. As you know, our procedural guidelines say that anybody presenting on behalf of a participant is subject to cross-examination. We will also, before President Chartrand makes his presentation on Tuesday afternoon, we will let him know that he will be subject to cross-examination.

MR. BEDFORD: Thank you.

THE CHAIRMAN: Okay. Any other business to deal with? Okay. We're adjourned until Monday at 9:30. So see you all Monday.

(Proceedings adjourned at 12:00 p.m.)

OFFICIAL EXAMINER'S CERTIFICATE

Cecelia Reid and Debra Kot, duly appointed Official Examiners in the Province of Manitoba, do hereby certify the foregoing pages are a true and correct transcript of my Stenotype notes as taken by us at the time and place hereinbefore stated to the best of our skill and ability.

Cecelia Reid

Official Examiner, Q.B.

Debra Kot

Official Examiner Q.B.