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International Court of Justice

THE HAGUE

Cour internationale de Justice

LA HAYE

YEAR 2022

Public sitting

held on Friday 8 April 2022, at 3 p.m., at the Peace Palace,

President Donoghue presiding,

***in the case concerning the* Dispute over the Status and Use of the Waters of the Silala (Chile *v.* Bolivia)**

VERBATIM RECORD

ANNÉE 2022

Audience publique

tenue le vendredi 8 avril 2022, à 15 heures, au Palais de la Paix,

sous la présidence de Mme Donoghue, présidente,

***en l'affaire relative au* Différend concernant le statut et l'utilisation des eaux du Silala (Chili c. Bolivie)**

COMPTE RENDU

Present:	President	Donoghue
	Judges	Tomka
		Abraham
		Bennouna
		Yusuf
		Xue
		Sebutinde
		Bhandari
		Robinson
		Salam
		Iwasawa
		Nolte
		Charlesworth
	Judges *ad hoc*	Daudet
		Simma
	Registrar	Gautier

Présents : Mme Donoghue, présidente
MM. Tomka
Abraham
Bennouna
Yusuf
Mmes Xue
Sebutinde
MM. Bhandari
Robinson
Salam
Iwasawa
Nolte
Mme Charlesworth, juges
MM. Daudet
Simma, juges *ad hoc*

M. Gautier, greffier

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H.E. Mr. Hernán Salinas Burgos, Ambassador of the Republic of Chile to the Kingdom of the Netherlands,

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comme assistantes techniques.

The PRESIDENT: Please be seated. The sitting is open.

I would like to note that the following judges are present with me in the Great Hall of Justice: Judges Tomka, Xue, Sebutinde, Iwasawa and Charlesworth; while Judges Abraham, Bennouna, Yusuf, Bhandari, Robinson, Salam and Nolte, and Judges *ad hoc* Daudet and Simma are participating by video link. For reasons duly made known to me, Vice-President Gevorgian is unable to join us for today's sitting.

The Court meets this afternoon to hear the experts called by Bolivia, namely, Mr. Roar Jensen, Mr. Torsten Jacobsen and Mr. Michael Gabora, who are ~~***presenting***~~ ***participating*** in person in today's hearing.

The procedure for examination of these experts will be identical to that followed yesterday for the examination of the experts called by Chile. I now invite the three experts to each make ~~***a***~~ ***the*** solemn declaration set out in Article 64, subparagraph *(b)*, of the Rules of Court. I first call upon Mr. Jensen. Please proceed, Sir.

Mr. JENSEN:

> "I solemnly declare upon my honour and conscience that I will speak the truth, the whole truth and nothing but the truth, and that my statement will be in accordance with my sincere belief."

The PRESIDENT: I thank you. I now invite Dr. Jacobsen to make his solemn declaration. Please go ahead.

Mr. JACOBSEN:

> "I solemnly declare upon my honour and conscience that I will speak the truth, the whole truth and nothing but the truth, and that my statement will be in accordance with my sincere belief."

The PRESIDENT: I thank you. I now invite Mr. Gabora to make his solemn declaration.

Mr. GABORA:

> "I solemnly declare upon my honour and conscience that I will speak the truth, the whole truth and nothing but the truth, and that my statement will be in accordance with my sincere belief."

The PRESIDENT: I thank you. Before beginning the cross-examination and re-examination, may I recall that, as the Registrar has communicated to the Parties, the expert replying to a question should clearly identify himself, so that the statement can be properly attributed in the verbatim record. If the same expert replies to a series of consecutive questions, there is no need for him to repeatedly state his name; it will be sufficient for the record to be clear every time there is a change in the designated speaker among the experts.

I would also like to remind counsel, as well as the experts, to speak at an appropriately slow pace for the benefit of the interpreters.

I now give the floor to counsel for Bolivia, Mr. Rodman Bundy, who will ask the experts to confirm the written statement in front of them. Mr. Bundy, you have the floor.

Mr. BUNDY: Thank you, Madam President. I will address this collectively to DHI. You have filed four reports in the case, Annex 17 to the Bolivian Counter-Memorial, and Annexes 23, 24 and 25 to the Bolivian Rejoinder, plus the summary written statement of 10 January 2022. May I ask whether you confirm these statements?

Mr. JENSEN: Yes, we can confirm that.

Mr. BUNDY: Thank you very much. Madam President.

The PRESIDENT: Thank you, Mr. Bundy. I now give the floor to counsel for Chile, Mr. Samuel Wordsworth. Mr. Wordsworth, you have the floor for cross-examination, ***for*** which**,** I will recall, Chile has been allocated a maximum of 80 minutes.

Mr. WORDSWORTH: Thank you very much, Madam President. Good afternoon to Mr. Jensen, to Dr. Jacobsen and to Mr. Gabora. Now, I want to start off today's questions to you by returning to the issue of the measurements of Mr. Fox, because that occupied a fair amount of time yesterday. As I understand it, your position is that your sensitivity analysis results that put the reduction in surface waters in the range of 11 per cent to 33 per cent are consistent with the measurement recorded in the 1922 paper by Mr. Fox; that is correct, is it not?

Mr. JENSEN: It is correct that Mr. Fox's measurements is 18 per cent lower than the average of 160 l/s, yes.

Mr. WORDSWORTH: Exactly. That helps, because you are comparing, absolutely, the Fox measurement of 131 l/s with a reported measurement of 160 l/s, and that is at a location approximately 650 m above the boundary, correct?

Mr. JENSEN: That is what we assume, yes.

Mr. WORDSWORTH: And as I think came out of yesterday's cross-examination of Dr. Wheater, that is at a point that you call C-7 in your reports, correct?

Mr. JENSEN: As I remember, yes, that is just downstream of the confluence.

Mr. WORDSWORTH: Yes. So, C-7, and I can show you the passages in your reports if you like, but at the siltation centre is what you believe to be the same location that Mr. Fox was referring to?

Mr. JENSEN: Yes, more or less. Yes.

Mr. WORDSWORTH: More or less. Now, in 2017 we see from your reports that Bolivia's national metrological and hydrological service, called Senamhi, conducted a program of water flow measurements in the Silala, and that included manual measurements taken with micropropellers, did it not?

Mr. JENSEN: That is correct. Senamhi made a lot of measurements in the canals that are small and, therefore, using small propellers, along the reaches of the canals, in order to find out the variation in flow along the canals, yes.

Mr. WORDSWORTH: Exactly so. I think that is a helpful answer, because as I understand it, the intention was to take the measures simultaneously. Even though they are manual measurements, you refer to them in your report as simultaneous measurements because the aim is to take them at approximately the same time?

Mr. JENSEN: They are seen as simultaneous because they have to walk from one place to another, naturally, but it was within the same one or two days, yes.

Mr. WORDSWORTH: Thank you. So, if we can focus on the measurements, the manual measurements that were taken in 2017, of course, at the same time continuous measurements were also being taken — those are automatic measurements, is that right, if I think of continuous?

Mr. JENSEN: That is a mix of various measurements. The continuous measurements are done in, we heard yesterday, a control flume, with a V-notch in Bolivia — I do not know the exact flume in Chile. But normally I assume to be quite exact. But it is also true that here the automatic gauging of this has some problems, obviously, but they are also taken manually. So, it is a mix of these measurements.

Mr. WORDSWORTH: I see. But the continuous measurements, and you explain this in your report, you found to be problematic in certain ways, quite difficult to rely on?

Mr. JENSEN: Yes, you can find when you look at these records that they jumped very much from one day to another, and this is not what we see when we have this kind of hydrological régime that is fed by groundwater. So, we have to remember that automatic equipment under these environments is subjected to frost and all other kinds of things, so it is not so easy.

Mr. WORDSWORTH: Now, did you say subject to frost? Just to be clear. I did not quite hear. Because, obviously, the conditions can be very cold at night.

Mr. JENSEN: That is true. I do not think it is a big problem in the canals though, because this water that comes from groundwater is 9 degrees, as far as I remember, so it is much warmer than the environment. But as soon as you have automatic equipment with still-standing water, then this could be. I have not investigated this ~~***very***~~ in detail, of course, but it seems like there are jumps in these measurements, that is surely not correct, both on the Chilean side and on the Bolivian side.

Mr. WORDSWORTH: So if we can look at some of the results, and if we could have tab 1 from the judges' folder up on the screen. You see, there, the C-7 data — and that is in the brown-red colour — and we can see the continuous data at the top going up and down, correct?

Mr. JENSEN: Yes. But as I recall, this figure is from one of the provisional V-notch station we set up but as you can see it is a very short record. You can also see it jumps at certain locations. This is very preliminary. And we would have hoped to have this both sooner and to correct some of these things, but that was not possible due to time.

Mr. WORDSWORTH: And then if we look at the *manual* measurements. Can you see the manual measurements in the red dots —.

Mr. JENSEN: Yes.

Mr. WORDSWORTH: — which somebody has put a red arrow next to those. And you can see that one of those is approximately 131, and one of those is 140, is it not — or just below 140.

Mr. JENSEN: Well, I cannot read it I must say.

Mr. WORDSWORTH: Can you see if it is in your judges' folder? If you have a look, you can see on the y axis, the vertical axis, you can see 140 on the left-hand side.

Mr. JENSEN: Yes.

Mr. WORDSWORTH: So you see those two measures. They are both below 140, in the range 130 to 140.

Mr. JENSEN: That is correct.

Mr. WORDSWORTH: And if, in fact, we go through the records of the manual measurements that were taken by Bolivia's National Meteorological Services in 2017, in fact, we see that many of these — in fact, almost all of these — were within the same region as the Fox measurement. Do you recall that?

Mr. JENSEN: No. I recall that some of them are considerably higher.

Mr. WORDSWORTH: Well, I am going to take you to them. If we could see at tab 2 — the next slide, please. Here you see from May 2017, we see on the right-hand side that they are taken with a micro-propellor. You see on the left-hand side there at C-7, where everyone agrees that the Fox measurement was taken. And you see the measures there, 128 and 125.8, correct?

Mr. JENSEN: Yes. I believe that is one of the measurements, yes.

Mr. WORDSWORTH: So those two are definitely in line with Mr. Fox; correct?

Mr. JENSEN: That is true.

Mr. WORDSWORTH: If we go to the next slide, you will see one which is above Mr. Fox. Do you see 169.7?

Mr. JENSEN: Yes.

Mr. WORDSWORTH: And that is, I represent to you, and, obviously, Mr. Bundy will correct me in cross-examination if I am wrong, that is the only one that is in the region of or above 160. If we could turn to the next document, tab 3: these are two measurements for C-7 in October 2017. You see C-7 again, and you see how they are these manual measurements, 132.6; 132.7.

Mr. JENSEN: Yes.

Mr. WORDSWORTH: Again, very much consistent with what Mr. Fox was saying?

Mr. JENSEN: Yes.

Mr. WORDSWORTH: And we have actually put all the data from the 2017 measuring programme carried out by Bolivia on the screen, and there you can see it here. And there you see Mr. Fox's 131 measured by reference to a red-orange line. Can you see that the great majority of the manual measurements, they are all *below* Mr. Fox's measurement, are they not?

Mr. JENSEN: I do not recognise this. But I can see that the dots are below. I can also see that it goes up to 2020 or what is going on?

Mr. WORDSWORTH: No, this is the — do you not recall the monitoring programme was carried out.

Mr. JENSEN: Yes, I do.

Mr. WORDSWORTH: In 2017.

Mr. JENSEN: Yes, but —.

Mr. WORDSWORTH: Yes, and do you see how it is from May 2017 through to November 2017?

Mr. JENSEN: And then November — okay, maybe it is cut. Yes.

Mr. WORDSWORTH: And do you see the data? So the data: the blue is coming from the Senamhi reports, which are annexed to your own reports, are they not?

Mr. JENSEN: Presumably, yes.

Mr. WORDSWORTH: And you see the red is all from your Volume 2 of the Counter-Memorial of Bolivia, which, of course, is one of your reports of 2018, correct?

Mr. JENSEN: Correct.

Mr. WORDSWORTH: And, in fact, we can actually see from your own report — if we can go onto tab 5 of the judges' folder — the fact that most of the manual measurements are *lower* than 160. Can you see this on the left-hand column?

Mr. JENSEN: I see that, yes.

Mr. WORDSWORTH: So you see —.

Mr. JENSEN: Some are above, some are below. Yes.

Mr. WORDSWORTH: Well, when you say some of them are above: how many of them are above? I see that two of them are above and all the rest are below; correct?

Mr. JENSEN: In C-7, yes, and the other ones are.

Mr. WORDSWORTH: Well, C-7 is the point that you have identified as being where Mr. Fox took his measurement, is it not?

Mr. JENSEN: Approximately.

Mr. WORDSWORTH: Nobody has come up with a better location and it is the location you referred to in your reports, is it not?

Mr. JENSEN: It is about there that we assume he has taken it, yes.

Mr. WORDSWORTH: So there you see the high that I took you to, 169.70, but then they are around 126, then there is one at 130, 112, 128, 130, 138. And if you get — you have not calculated an average of all those, have you?

Mr. JENSEN: I think it is not particular for this station. I do not remember, at least. But I presume you have?

Mr. WORDSWORTH: Yes, it is actually 131, interestingly. So it is actually identical to Mr. Fox.

Mr. JENSEN: Interesting.

Mr. WORDSWORTH: So, in fact, by reference to Bolivia's own manual measurements, the Fox measurement does not appear to have changed at all. It appears to have been a constant. It was 131, measured, of course, manually in 1922 — although we do not know how. And from Bolivia's own figures it is still 131 measured manually by a micro-propellor in 2017; correct?

Mr. JENSEN: Correct. Measured in the trench where you have the uncertainty of the micro-propellors. The continuous series are continuously above that.

Mr. WORDSWORTH: They are continuously above it, but you say in your report that you did not consider the continuous records to be reliable, and, therefore, you did not use them, did you?

Mr. JENSEN: I think we do consider — we consider that there is a lot of errors in them, jumping up and down. But generally, the baseline of these records is considerably higher than this.

Mr. WORDSWORTH: If I can just take you to what you say in your reports, which is on the next slide. The continuous records have not been used in the flow distribution calculation, which has been based entirely on the simultaneous observations as described in the previous section.

Mr. JENSEN: That is true.

Mr. WORDSWORTH: So that obviously suggests that you think the simultaneous measurements are to be preferred, at least so far as concerns your flow distribution calculation; correct?

Mr. JENSEN: That is correct, and that is because that the continuous record does not show the flow distribution over the system. Therefore, in order to be consistent, we had to use the propeller ***~~machines~~ measurements***. They are the only ones that cover the whole system.

Mr. WORDSWORTH: Yes, I am not in any way criticizing your methodology or Senamhi's methodology. I am just trying to compare like with like. And obviously we do not know how Mr. Fox took his measurement —

Mr. JENSEN: Exactly.

Mr. WORDSWORTH: — in 1922, 100 years ago. But all we can presume is that whatever method he used, it was some form of manual method obviously, and conceivably it was with a micro-propeller; agree?

Mr. JENSEN: No, not necessarily. He could have used micro-propellers. He could also have used his weir, his small dam, to make a weir and measure through a pipe. He could have used many different methods. We do not know. But I am sure he did it well.

Mr. WORDSWORTH: As you say, we absolutely do not know. But what we do know is that when you measure manually, at C-7 today, you get almost identical figures to what Mr. Fox measured; correct?

Mr. JENSEN: That is correct. And if we use the other records, both in Chile and in Bolivia, we get considerably higher measures.

Mr. WORDSWORTH: I think that is not correct, is it, because Chile has not measured at the siltation chamber, has it? So Chile does not know what the right measurement is at the siltation chamber. That is point C-7.

Mr. JENSEN: That is true. They have measured further downstream. However, if you also refer to the slide you showed before, there is very little flow variation measured in that reach there. Actually, it rises a little bit: going up to about the 130 that you referred to, and then it drops again towards Chile. Now, Chile even reports higher numbers than Bolivia in this case, even though that it is almost a constant non-gaining and non-losing reach.

Mr. WORDSWORTH: So we can actually get that from the document at tab 6 of the judges' folder — which is again a Senamhi document: this is from Volume 2 to Bolivia's Rejoinder. And just to cite this document. You see how all the C-7 measurements you see there, from 132, 125, 144 and so on, it seems to come down to an average of 134. Do you see that?

Mr. JENSEN: Yes.

Mr. WORDSWORTH: And you can see also that it is depicted, again by Senamhi, you see in the graph at the top, you see C-7 is depicted, and the water flow *increases* towards the border, but there is clearly considerable variability, is there not?

Mr. JENSEN: Yes, the variability is probably from the measurements, I would guess, because it is the same points; right?

Mr. WORDSWORTH: It could be from the measurements, or it could be from the 650 m that . . . of the 650 metres of the channel from the siltation chamber down to the border.

Mr. JENSEN: Yes.

Mr. WORDSWORTH: So it is perfectly possible, as Dr. Wheater said yesterday, that the river channel depletes or increases in flow along its trajectory, is it not?

Mr. JENSEN: In this one, yes. But there is not very much variation along the reach. When you said "variability", I thought of variability within the single points here.

Mr. WORDSWORTH: There was clearly variability within the single points, but there is also, it seems to be, an increase in flow as you get to the boundary.

Mr. JENSEN: It is likely, maybe.

Mr. WORDSWORTH: And as you get to the boundary, it does appear to be more in the range of 160 — as opposed to 131, the Fox measurement; correct?

Mr. JENSEN: From this graph, yes.

Mr. WORDSWORTH: And it is one of your graphs. I mean, this is Bolivia's own measurement programme carried out in 2017; this is the only document we have from you which shows the measurements going into 2018. But you see the 2018 measurements there, again, they are consistent with Mr. Fox's measurement, are they not?

Mr. JENSEN: The 2018 is what you see here?

Mr. WORDSWORTH: Sorry, I did not hear.

Mr. JENSEN: They appear to be, yes.

Mr. WORDSWORTH: So ultimately there are only two choices, really, so far as concerns these statistics — these manual flow measurements that Bolivia carried out in 2017: either they are correct, and we agree they are basically the same as Mr. Fox's measurements, so there has been no change over the period; correct? I am asking, that that is *one of two* possibilities. You understand?

Mr. JENSEN: Yes. And the other possibility?

Mr. WORDSWORTH: The other possibility is that these figures are *wrong*, even though they have not been presented to us as wrong. But if the 2017 measurements, carried out by Bolivia's hydrology institute with modern equipment in 2017 are wrong, on what conceivable basis could it be said that Mr. Fox, carrying out his measurements 100 years ago with methodology we have no idea as to, is correct?

Mr. JENSEN: But I agree that probably Mr. Fox measured correctly, yes.

Mr. WORDSWORTH: No, no, no. I do not see on what basis you are saying that. Are you saying that on the basis that Mr. Fox measured correctly, and that is supported by these manual measurements? Is that your position?

Mr. JENSEN: Our position is that he was a professional engineer —

Mr. WORDSWORTH: Yes.

Mr. JENSEN: — so therefore he would have done this professionally and correct.

Mr. WORDSWORTH: Yes. And so do you agree then that Mr. Fox is correct and therefore one can take these figures as being correct also?

Mr. JENSEN: I believe these are also correct, but not because Mr. Fox is correct.

Mr. WORDSWORTH: Okay. Thank you very much. We will now leave the issue of Mr. Fox, and I want to ask a very basic question about your usage of the MIKE-11 and MIKE-SHE models, and I do not know who is going to be happiest to answer this question. But it is a fairly basic question. The question really comes down to your use in the baseline scenario, that is the scenario that is trying to capture how things are on the ground today; correct? I am afraid one of you will have to stand up.

The baseline scenario is trying to reflect what there is on the ground today; correct?

Mr. JACOBSEN: The baseline scenario describes the current conditions; that is correct.

Mr. WORDSWORTH: Exactly so. And for the baseline, you used both the MIKE-11 models, which model surface water channels, correct?

Mr. JACOBSEN: We described the entire system as we see it, including the canals, straight canals, straight 1D canals, with unidirectional flow described within MIKE-11. We described the hydrological component, the flow, and the subsurface and groundwater and the flow on the widespread areas that we saw in the wetlands.

Mr. WORDSWORTH: But that is with MIKE-SHE, is it not?

Mr. JACOBSEN: That is with the combination of MIKE-SHE and MIKE-11.

Mr. WORDSWORTH: Exactly. So, baseline MIKE-SHE and MIKE-11. Now, for what you call the no-canal scenario, i.e. somehow you take away the canal, or the restored-wetland scenario, in which you envisage peat slowly growing up: for that you just use the MIKE-SHE model. That is correct, is it not?

Mr. JACOBSEN: The MIKE-11 model is a one-dimensional hydraulic model and it represents the straight canals, as we saw in the video. That is the 1D component. So, when asked to evaluate what are the differences between a canal and a no-canal scenario, we remove that 1D component. Removing the canal corresponds to removing the MIKE-11 component.

Mr. WORDSWORTH: And the fact that you are using MIKE-SHE, alone, for the no-canal scenario and the restored-wetland scenario, means that all the surface water is run as overland flow, is it not? It is not in a defined channel, as it is within MIKE-11?

Mr. JACOBSEN: No, it is not within the canal which have geometry, sort of, narrow canals. The water may expand onto the areas in a two-dimensional flow pattern depending on the topography, the topographical gradients.

Mr. WORDSWORTH: Which is a little bit more clear-cut than that, is it not? You do not model on the basis that there is a defined river, that is flowing downwards into Chile so far as concerns the no-canal and restored wetland scenario?

Mr. JACOBSEN: We remove the canal. That is the question at hand, so we need to remove that out of the modelling system. What remains is a 2D description. Meaning that if you have

predominantly downstream flow according to the gradients, like towards the river, that would be reflected in our 2D overland model.

Mr. WORDSWORTH: Now, the question that I want to put to you is that you do accept, however, that — *in the natural scenario* — there is a natural flowing river down into Chile, is there not? So, if you are using MIKE-SHE just to model surface-water flow, running as overland flow, that does not model what the situation of the Silala environment was before the channels were constructed, does it?

Mr. JACOBSEN: Oh, yes, indeed, it does. It describes the full description of the topography. And whether, as you describe, as a river, I think what we have experienced from the field trip, is that it is an expansive flow field. So, you would see, for instance, in the wetlands, it does not stay within the narrow former canal. It expands onto the area. And that applies to the riparian zone all along the reaches, from the wetlands to the border. It is not a 1D canal flow as present. It is a 2D distributive flow.

Mr. WORDSWORTH: That all sounds reasonably helpful, but it does not reflect the fact that for the baseline, you are modelling with MIKE-11, on the basis that there is what you call a canal; and with the no-canal scenario, you are simply using the MIKE-SHE on the basis, ultimately, that there is no equivalent canal. Yet, in the real-world scenario, there is a naturally flowing river down into Chile, is there not?

Mr. JACOBSEN: No, that is not correct. When you remove the canal, the slope on the surface directs the water. And we do reflect that entirely in the model. We have a topographic gradient reflected in the model, so that means whatever the direction, whether it is a narrow flow, a wide flow, that is entirely depending on the topographical conditions, which are represented in the model.

Mr. WORDSWORTH: So, if we just look at the river in its natural state — if we can see this from tab 7 of the judges' folder. You are saying that with MIKE-SHE, you do model on the basis that there is that flowing river, even though you call it the no-canal scenario?

Mr. JACOBSEN: Well, now you show an old map with a blue line. Of course, what we use in our model is based on the field data: the actual topographical measurements. So that provides the basis for the direction of the flow. And even though it is a two-dimensional flow, as described, you may see a flow path similar to the blue one here. So that is possible within the 2D solution that we apply. We do not restrict the flow to the canal. That is the main point of removing the canal and this model component: there is no conflict between a blue line and what the model does.

Mr. WORDSWORTH: Well, in that case, why would you use the MIKE-11 at all if the MIKE-SHE satisfactorily models a flowing river?

Mr. JACOBSEN: Now, I do not recognize if this map is before or after —

Mr. WORDSWORTH: It is before. It is 1904.

Mr. JACOBSEN: Okay.

Mr. WORDSWORTH: So, this is long before any question of anything being built on the Silala.

Mr. JACOBSEN: Yes, you asked about the baseline, which, of course, reflects current conditions with the canal. So, obviously, the canal is represented in the model in that case.

Mr. WORDSWORTH: Yes.

Mr. JACOBSEN: And when we remove the canal — we have been asked to calculate the impact of removing the canal — it is by removing that feature from the model. And the rest remains in there, including topography, topographical slope. The flow pattern will be different without the canal; it would not be confined to 1D narrow canal, it would be more expansive. That is what is governed by the 2D flow approximation.

Mr. WORDSWORTH: Well, I understand that entirely. But in the natural condition, there is a natural flowing river, and you have not modelled that. You have not taken the best evidence as to what the river looked like prior to any — *any* — interference.

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: And tried to model.

Mr. JACOBSEN: Yes. We have, for what remains and what was there before the canal. That is the topography of the area, which is reflected in the ravine, in the slopes and so forth. And that remains in the model when we run the no-canal scenario. So, I do not see any conflict.

Mr. WORDSWORTH: I do not follow that at all, because when we look at your topography — and I will come to some questions later on topography, time allowing — when we look at your topography of the MIKE-SHE model, in these areas, indeed, the topography is as much as 6 m or occasionally 12 m above the natural situation. So how on earth can you say that MIKE-SHE models correctly the natural topography today?

Mr. JACOBSEN: It models the flow and the distributing, according to the topographical slope. So, if it is predominantly in one direction, we have a slope toward the Chilean border, we will see that flow is generated along this flow path into Chile. So, there is not really any conflict, as I see it.

Mr. WORDSWORTH: No conflict if, let's say, at the border . . . what you say is the natural topography, in fact, in your model is 6 m higher than the natural topography?

Mr. JACOBSEN: I am not sure what you are referring to.

Mr. WORDSWORTH: I will come back to it in a moment. I am now going to ask some questions about additions of unexplained water into your models, and I just want to start off with a reasonably simple question that came out of yesterday about Chile requesting the digital data from you. And it is correct, is it not — this may be a question more for Mr. Jensen — that DHI's position was originally to refuse to provide such data on the basis that everything necessary was contained in your reports. That is correct, is it not?

Mr. JENSEN: No, I do not think that is correct. The data has already — that is the property of Bolivia. You asked for them. We answered that we had provided what we thought was the essence of this. And when you insisted that we share the data, we organized them and we sent them as quickly

as possible. It is very important here to also recognize that this is not just a small folder. This is more data than you can have on a normal laptop computer. And I think it was worthwhile organizing them for you.

Mr. WORDSWORTH: We are well aware of the size of it because Dr. Wheater, Dr. Peach and his colleagues have spent many, many days going through it, including Magdalena Lagos, who has particularly spent time interpreting your models. Can we just see, in fact, Chile initially asked for this data; it was refused. Chile again asked for it, and this is what Bolivia wrote:

> "Regarding the request for digital data used by DHI for its conceptual and numerical modelling . . ., I would like to inform you that, in response to Bolivia's inquiry, Eng. . . . Jensen, DHI's Project Manager, has informed . . . that the digital data and the contents of the preliminary reports prepared within the context of DHI's Study are fully covered in the Final Report".

So my question to you was whether it was correct to say that you had originally refused to provide the data? It is correct, is it not? The digital data?

Mr. JENSEN: No, our position was that we have written the essence of these investigations in our report. Now, this is not a letter from me. But that we also provided the data as soon as we could when Bolivia asked for it.

Mr. WORDSWORTH: Well, plainly not as soon as you could because you refused, and if we go to your letter attached to this on the next slide:

> "The data that has been used in DHI's analyses and modelling are described and referenced in the Final Report and its annexes."

Mr. JENSEN: Yes.

Mr. WORDSWORTH: So you were not supplying the digital data, were you? You were saying we do not want to supply it — you do not need it.

Mr. JENSEN: That was our position. But when you insisted, we supplied it.

Mr. WORDSWORTH: Well, just focusing there. Your position is that without the digital data, it was sufficient, and we would be able to understand the workings of your model, correct?

Mr. JENSEN: Yes.

Mr. WORDSWORTH: But without the digital data, we would not have been able to find out that, in fact, you have added quantities of water that are nowhere explained or reported in your reports? That is correct, is it not?

Mr. JENSEN: Maybe, yes.

Mr. WORDSWORTH: Some of these quantities of water are very significant. So, in fact, there is an unexplained, unreported amount of 10 l/s that you are adding into your models, is there not?

Mr. JENSEN: That was found, yes, and has been corrected for.

Mr. WORDSWORTH: I am not sure it has been corrected at all. If we could see tab 9. This is part of the digital data. It is part of an Excel spreadsheet that we have grown to know reasonably well. And you see how there, on the inputs, you are adding an extra 10 l/s, are you not? Extra stabilization water for hydrodynamic canal flow, correct?

Mr. JENSEN: I do not follow you. Where is it? Yes, that is a correction.

Mr. WORDSWORTH: And if we go to the next page of the spreadsheet. Again, we see extra water being added in the MIKE-11 model of 10 l/s, correct?

Mr. JENSEN: Yes.

Mr. WORDSWORTH: Nowhere in your 2019 reports or in your earlier reports are you, in fact, telling us that you are adding this 10 l/s to the modelled scenarios, that is correct, is it not?

Mr. JENSEN: But I think this came up because there was a mistake in the model whereby some of the data that was added was not accounted for in the water balance.

Mr. WORDSWORTH: Well, there are two answers to that, are there not? One, it shows how important the digital data is so that Chile can understand your models, correct?

Mr. JENSEN: Right.

Mr. WORDSWORTH: Two, if you found a mistake, which meant you had to add 10 l/s, then surely you had to explain what you were doing in your Reply reports, correct?

Mr. JENSEN: Right.

Mr. WORDSWORTH: And you did not, did you?

Mr. JENSEN: But you, obviously, have the tables here.

Mr. WORDSWORTH: Well, it is only because we insisted that we got the digital data, and it is only because we have spent many, many days going through the digital data that we have been able to work out what is happening in your models.

Mr. JENSEN: I agree.

Mr. WORDSWORTH: Now, even to get your percentage reductions, we have needed to work out that, in fact, you are adding inconsistently the 10 l/s. I will try and take this as quickly as I can. But obviously, you will recall that in your 2018 report you were modelling simulated surface water flows being reduced by 31 per cent in the no-canal scenario and 40 per cent in the restored-wetland scenario. You recall that?

Mr. JENSEN: About that, yes.

Mr. WORDSWORTH: And you will recall Table 1 from your first report. And we can use this to see how you got those 31 and 40 percentages. Yes, you recall this?

Mr. JENSEN: I recall it.

Mr. WORDSWORTH: You can see the 40 per cent, if we look at the restored wetlands figure. If you look at the 40 per cent, you can see baseline is 150 l/s, restored wetlands is 90 l/s. The difference is 60 l/s. Sixty as a percentage of 150 is 40 per cent, correct? Yes?

Mr. JENSEN: Yes.

Mr. WORDSWORTH: So we do the same exercise for the no-canal scenario. We see outflow baseline 150 l/s. We see 94 l/s, the flow equivalent that you model for the no-canal scenario. We see a 56 l/s difference, yes, between 150 l/s and 94 l/s?

Mr. JENSEN: Yes.

Mr. WORDSWORTH: And that, you will see, in fact, is not 31 per cent, is it? It is 37 per cent. We can see 56 is more than a third of 150, correct?

Mr. JENSEN: [Yes.]

Mr. WORDSWORTH: The only way that we have worked out how you get to that 31 per cent figure is the fact that, thanks to the digital data, we have seen that you have been adding in 10 l/s inconsistently. You added 10 l/s to that 94 l/s to get 104 l/s and that leaves us with 46 as a percentage by reference to 150 l/s, and that is how you get your 31 per cent, correct?

Mr. JENSEN: I think maybe Torsten Jacobsen should comment on this table. I have not made it.

Mr. JACOBSEN: Yes. Referring to these 10 l/s that you showed before, it is related to the lateral inflows to the MIKE-11 model, and ***~~the left and~~ this left an*** unaccounted volume in the first baseline estimate of 30 to 40 per cent. That was later accounted for in our sensitivity study and you will notice that our upper bound of 40 per cent was reduced to 33. So that is accounting for the 10 l/s.

Mr. WORDSWORTH: Yes, we did notice that.

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: But without telling us, you were adding that 10 l/s to the 94, were you not?

Mr. JACOBSEN: This is from the first round-up runs on the baseline. What we did in the sensitivity studies was, we provided a lower bound for the impact and also corrected, or accounted for, this missing 10 l/s.

Mr. WORDSWORTH: There was a missing 10 l/s, so you just added it in?

Mr. JACOBSEN: No, I just did not just do that. It reflects, as I think you have pointed out, in the lateral inflows to the MIKE-11, that there were a missing 10 l/s. So to explain, the 30 to 40 per cent did not include the 10 l/s; the 11 to 33 range provided does include the 10 l/s.

Mr. WORDSWORTH: Yes. But to anyone trying to understand this model: what we see that is happening is, inconsistently, you have been adding 10 l/s and, most critically, you simply have not been telling us what you have been doing; correct?

Mr. JACOBSEN: No, it is not inconsistent. It reflects, as I said, that we saw this difference in the first round of simulations, and we accounted for that volume in the second, like the 11 to 33 per cent range.

Mr. WORDSWORTH: And you did not think you had to explain to us what you were doing in your reply report? You just added in this 10 l/s?

Mr. JACOBSEN: I think it is quite evident that that was reduced from 40 to 33 per cent, so it is quite obvious that we have corrected it.

Mr. WORDSWORTH: It was so obvious, there was no need to refer to it in your reply report? If you say so. Now, can I ask then about the 11 l/s that you have also added in. Also, you know about this 11 l/s, do you not? Because Drs. Wheater and Peach reported it in their additional pleading. Interestingly, you said nothing about it in your summary report, although you answered many other things — or sought to answer many other things in your summary report. And yet again you have added in 11 l/s into the model for the baseline scenario without explaining to anyone what you have done; correct?

Mr. JACOBSEN: I do not know what the 11 l/s are referring to. Could you please specify?

Mr. WORDSWORTH: It does seem curious then that you have not actually read the reports of Wheater and Peach and also their summary report. I will try and take this as quickly as I can. But are you aware that, in your second report, you revised your model, as you have explained, and, in

fact, in addition to the groundwater that you model coming in at the boundary, you also added 42 l/s into the baseline scenario; correct?

Mr. JACOBSEN: Yes, let me explain. The 42 l/s are included as an inflow in our surface water model, and it reflects the site conditions in the sense that, if you walk along the canals, you will see ditches and small canals connecting the main canal to individual springs, and at each of those spring locations, you have flow coming in as surface water into the upper ends of our canal network. That is what has been specified by the 42 l/s.

Mr. WORDSWORTH: It is terribly interesting to hear that, but you have never explained that in your report, have you? This is the first we have heard of it.

Mr. JACOBSEN: Okay. But what you should be aware of is that, by doing that, and checking model resource against our flow measurements, we are able to describe our flows through the system. So it is accounted for in our model.

Mr. WORDSWORTH: Obviously, you have not added this 42 and not accounted for it in your model. The point is you have added 42 l into the baseline scenario, as you have just explained; yes?

Mr. JACOBSEN: Yes, to describe the spring inflow, the surface flow into our canal network. Correct.

Mr. WORDSWORTH: But into the no-canal scenarios, you have only added 31; correct?

Mr. JACOBSEN: Yes. And the difference between these two numbers are the 10 or 11 that we have corrected for in our simulation.

Mr. WORDSWORTH: That is not correct.

Mr. JACOBSEN: That is correct.

Mr. WORDSWORTH: If I have time, I will endeavour to show why that is, in fact, not correct. But just so I understand, your position is that you have added an unreported 42 into the baseline scenario; correct?

Mr. JACOBSEN: Yes, to reflect the spring inflow. Correct.

Mr. WORDSWORTH: Right. And that is nowhere explained in your report, is it?

Mr. JACOBSEN: It may not have been described.

Mr. WORDSWORTH: And you have added 31 l/s as precipitation into the no-canal scenarios; correct?

Mr. JACOBSEN: Correct, in the first round of modelling. So this difference that we found would correspond to an unaccounted flow, the difference between the two. And to account for it, it was included, as we saw before, in our final sensitivity study, so it is included in the 11 to 33 per cent range that we present.

Mr. WORDSWORTH: But, again, my question is, you have added this 31 and you have not reported that anywhere. You have not explained what you have done; correct?

Mr. JACOBSEN: It is in the model that we have provided, but it may not be described in detail in the report. That is probably correct.

Mr. WORDSWORTH: Mr. Bundy will correct me if I am wrong. The fact is you have added into the model an additional 11 l/s, going into the baseline scenario; correct?

Mr. JACOBSEN: Yes. And corrected for it in our subsequent sensitivity analysis, and the impact range given there includes that water.

Mr. WORDSWORTH: Again, I think I will have to come back to this in a little bit more detail, if I have time. But if you are adding an extra 11 l/s into the baseline scenario, then surely it follows that you are going to get more surface water coming out of the baseline scenario, if you have just added in an extra 11 l/s — as opposed to the no-canal scenarios?

Mr. JACOBSEN: Yes. But as I said, this was in the *original* model, and the later revision and sensitivity studies, those differences were accounted for. So it is included in the 11 to 33 per cent range.

Mr. WORDSWORTH: You did not.

Mr. JACOBSEN: It *is* included in the 11 to 33 per cent range.

Mr. WORDSWORTH: It is included in the 11 to 33 per cent range. It is included in the 11 per cent range. And the point I am putting to you is that, if you put more water into the baseline scenario through the model — through unexplained additions to the model — then, of course, you are going to get more surface water coming out of the model at the other end, are you not?

Mr. JACOBSEN: But that is not the case in the final sensitivity studies. They add up. What is included as input in the canal scenario is correspondingly added to the no-canal scenario. So there is no difference in the final set-up. So the 11 to 33 per cent are corrected ~~***for***~~, for this difference.

Mr. WORDSWORTH: So you are saying that although, in fact, you — when we look, and it takes days to try and work out what is actually happening in this model, you are saying that in actual fact the 11 l/s is added in and then not accounted for?

Mr. JACOBSEN: No. I am saying that you are pointing to the difference between the 42 and the 31 from the *original* round we did, where we estimated 30 to 40 per cent impact. Then subsequently we corrected for that in our sensitivity study, leading to the range of 11 to 33, which means that this difference you refer to *has* been accounted for. The water has been accounted for in our final estimates.

Mr. WORDSWORTH: Now, I am going to come back to this if there is time. But surely, if the model is functioning correctly, you are not going to be adding any water into the model at all. You are just going to be taking the water, which you input as groundwater at the boundary conditions, and that will be the input. There would be no need for adding 31 l/s or 42 l/s into the model as spring recharge or precipitation, would there?

Mr. JACOBSEN: Now, as I explained, we are describing the actual field conditions and what we can observe is that spring water is flowing into the canal system. At the point where our network is set up, it has an inflow to the surface water from the springs, and that is reflected in the 42 l/s. Then

additional groundwater will enter into the canal system when we move further downstream into this deeper ravine range, the canal will receive a lot of groundwater. Eventually, what reaches the border is a combination of the spring flow and the additional groundwater flow from the groundwater boundaries, so it is a mix of the two.

Mr. WORDSWORTH: But the difficulty is that the spring flow should be from the groundwater that comes in at the boundaries, and you should be setting the boundaries correctly so that you have your modelled groundwater coming in, into the model. And if the model is functioning correctly, there would be no need to add in these 31 l/s or 42 l/s.

Mr. JACOBSEN: No, that is not correct. At the point where we start our surface-water model, we have a spring inflow. So that is a surface-water flow at that point. It came from the groundwater, but it appears as surface water, and that is why we are accounting for it in our surface-water model.

Mr. WORDSWORTH: Let me try to understand a little bit further. [Just going to try — just looking at the clock.] Now, as I understand it in your report of the model setup, you determined that the local recharge from precipitation for the near field area would be less than 2 l/s, is that correct?

Mr. JACOBSEN: I do not recall that exact number, no.

Mr. WORDSWORTH: Could we see that on the screen at tab 12. Do you see that

> "[a]ssuming a similar recharge within the Silala Near Field area covering 2.56 km^2, the corresponding local recharge from precipitation is less than 2 l/s. The local recharge by precipitation in the Silala Near Field Area is thus insignificant compared to the inflows across the model boundaries that sustain the cross-border canal outflows of approximately 150 l/s plus groundwater outflow. Consequently, local precipitation and runoff has not been included in the integrated Silala Near Field model."

Do you see that?

Mr. JACOBSEN: Yes, I see it.

Mr. WORDSWORTH: Having determined from your study that recharge from precipitation did not need to be included in the near field model because it was so negligible, less than 2 l/s, you then went on to add 31 l/s of water to the no-canal and restored scenarios as precipitation, correct?

Mr. JACOBSEN: Yes, to have a consistency between the water introduced by the springs, and the springs are still there. The difference is that it is not canalized. It is not going into the canals which are removed, but it is still a seeping spring source under the peat of the wetlands. So that has been described as a precipitation input.

Mr. WORDSWORTH: But you have just said there that precipitation is negligible and the whole point of this model, as I understood it, was to model by reference to groundwater coming in at the boundaries — and yet, you add 31 l precipitation.

Mr. JACOBSEN: Yes, because, as I explained, we can see now with the open canals that we have a spring flow. And even though we go to a situation without the canals, the spring flow remains. So, to have a consistent water balance, in that sense we have introduced this flow accordingly in our restoration and no-canal scenario.

Mr. WORDSWORTH: As I understand it you are saying because you introduced the 42, you felt you had to introduce the 31, correct?

Mr. JACOBSEN: No, because it is there. We can see it. We can walk into the field and see the spring flow appearing in the canals. And it is not removed because the canals are removed. It remains. So that is to be consistent in the way that we describe this input.

Mr. WORDSWORTH: But surely you would agree that such groundwater, as there is in the wetland area, has come from the local catchment area, which you modelled in your water base model, correct?

Mr. JACOBSEN: Yes. But when it appears as surface water, or in this case we introduced it as surface water, we need to do the same exactly to be consistent in the two different scenarios.

Mr. WORDSWORTH: So you just add . . . In that case, I am slightly puzzled as to what the point of fixing your boundary conditions is at all, because it seems to be the case that you report, to us, what your boundary conditions are and what you are including in at the boundaries through groundwater recharge, and then you add in these unreported sums of 42 and 31. It is up to us to try

and work out what function they fulfil, once we spend days and days going through the digital data. But if you are going to introduce these quantities into the model — just like that — then, what was the point in trying to get your boundary conditions right?

Mr. JACOBSEN: Well, it is a combined integrated model we are talking about. It is not solely a groundwater model that calculates the flow. It is a question to present the canal and the interaction with the groundwater correctly to represent all of these canal features, and since it has a major impact in terms of draining the wetlands and the inflow from the springs, we would need to represent that in our calculation model. And that is what we did.

Mr. WORDSWORTH: I am just reading from your report here. You say, from your analyses, that groundwater discharge is the principal source of water to the Silala spring system, correct?

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: And you further stated — we could have this on the screen at slide 24 — that the Silala springs and surface water system are fed entirely by groundwater, yes?

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH. " . . . from a large; poorly delineated upstream catchment".

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: Do you see that? It is in your reply?

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: So how are we to deduce from that that in fact you are adding in an extra 42 l or 31 l, either as precipitation or spring recharge?

Mr. JACOBSEN: It simply reflects that this groundwater appears in the spring as surface water, and since the surface-water model describes from the springs through the canals through the

ravines and so on, we need to account for that inflow of the springs. And that is at the point of spring as surface water flow.

Mr. WORDSWORTH: In that case, why on earth did you say this, that they are fed entirely by groundwater from a large, poorly delineated upstream catchment?

Mr. JACOBSEN: It is groundwater becoming surface water. At that point of reference, it is a surface-water flow.

Mr. WORDSWORTH: Okay, well, we should have added — how should we have redrafted that sentence, so that it reflects what you have actually done?

Mr. JACOBSEN: I do not see any conflict. It is coming from groundwater but it appears in surface water in the springs and that is where our surface model starts. So, it includes that spring flow.

Mr. WORDSWORTH: Now, I would like to move on to a different topic. This is the topography issue that I mentioned to Mr. Jensen, I believe. The question concerns the topographical differences that we see in the MIKE-SHE model. Now, you are happy to answer that, Dr. Jacobsen?

Mr. JACOBSEN: Yes, please.

Mr. WORDSWORTH: In your 2018 report you explained that there was a difference in topography between the no-canal and restored scenarios, and that small differences were expected given that long-term growth of wetland peat soils was included, correct?

Mr. JACOBSEN: That is correct.

Mr. WORDSWORTH: That difference in elevation due to assumed peat growth would be a maximum of 60 cm?

Mr. JACOBSEN: Yes, it reflects a restoration scenario and in the long term you will have a peat growth. And that has been then estimated from our field data to be up to about 60 cm, and then it has been described, the distribution across the wetlands, as part of the model runs.

Mr. WORDSWORTH: Just pausing there for a second. You say up to about 60 cm. And how long would it take to restore up to 60 cm? How many years would that be?

Mr. JACOBSEN: That depends on the growth rate of peat, and I do not have any numbers for that but that would take a longer time.

Mr. WORDSWORTH: Decades?

Mr. JACOBSEN: Something of that order, probably.

Mr. WORDSWORTH: Am I right in thinking that in your model you just assume that already the peat level has gone up to the maximum of 60 cm, correct?

Mr. JACOBSEN: We have a full restoration scenario, assuming that these peat depths are re-established.

Mr. WORDSWORTH: Now, you accept that there were are also differences between the topographies and the baseline and the no-canal scenario that you did not report, and you accepted the existence of these in your January 2022 summary report. You recall that?

Mr. JACOBSEN: Not specifically, but I think that is correct.

Mr. WORDSWORTH: If we could put tab 9.13 on the screen, please. You will be very familiar with this cross-section.

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: You described these topographical differences as minor and restricted to a small area close to the border, correct?

Mr. JACOBSEN: That is correct.

Mr. WORDSWORTH: Now, just so we understand the distances here, look at the right-hand side. A light green line shows what is supposedly the baseline ground level in the MIKE-SHE model, correct?

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: And that is purportedly modelling the ground level as it now is, because this is the baseline, is it not?

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: And, in fact, we can see that it has increased by around 4 m over the actual condition, is it not? If we take your canal cross-section and then see the height of your modelling, that is approximately 4 m, yes?

Mr. JACOBSEN: On the right-hand side?

Mr. WORDSWORTH: Yes.

Mr. JACOBSEN: Yes. But you have to consider the left-hand side along with the right-hand side to see the difference between the canal, because the canal exchanges with two neighbouring topographical elements. So, in this comparison, you will also notice on the left-hand side that the difference is small.

Mr. WORDSWORTH: Well, the difference is small so far as concerns the baseline condition, which is in the yellow. But so far as concerns the no-canal scenario, we can see that the distance is, in fact, roughly 6 m, on both sides.

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: So, when you are using the MIKE-SHE model, in fact, what we see is that the topography changes by about 6 m, correct?

Mr. JACOBSEN: Yes, I think you have found the maximum difference here. And I think, as you also said before, explained, and also described in our written statement — I think it is Figure 7-3 — we have shown the longitudinal profile of the topographical differences. So, what we are looking at here is the far downstream section close to the border. So, this is the maximum

difference found in that area. Whereas, for the upstream parts, the differences are small or much less than this.

Mr. WORDSWORTH: Right. So, this is — as you understand it — this is the maximum of the difference in topography, correct?

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: And upstream — when you say "small", what do you have in mind in terms of a topographical difference between the actual topography and what you are modelling in the MIKE-SHE? What would you call small?

Mr. JACOBSEN: That should be viewed in the context of the head drop that we see across the area. So, there is about 130 m elevation difference from the upstream part to the border. So, in that respect, the differences are very small between the two, with the exception of this downstream area where we have a different topographical data. Meaning, we have a very detailed topographical model that is measured by a drone for the upstream part of the Silala. It did not fly all the way to the border, so we have a small downstream area where we had to supplement with other topographical data. And those topographical data are coarser. That is the reason for the differences that we see in this reach.

Mr. WORDSWORTH: Now, you say they are small, and this is the largest that we can see. Now, if we go to tab 9.14, in fact, we can see that the topographical differences go 1.5 km from the boundary, do they not? They go way upstream.

Mr. JACOBSEN: No, I would not agree to that. I think these are two different topographical approximations and they cannot be 100 per cent the same. But where I see some larger substantial differences, that is in the far downstream part. That is about 300 m upstream of the border, and that is most of the locations you have pointed to in terms of differences.

Mr. WORDSWORTH: So, just so we can see this again in a plan view. At tab 9.15, we can see the topographical differences. This is one of Dr. Wheater's and Dr. Peach's reports. You see in

each case where there is a black square, that indicates a difference of 1.5 m or more between the topography used for the baseline scenario and that used for the no-canal scenario, correct?

Mr. JACOBSEN: That may be correct.

Mr. WORDSWORTH: So, in fact, we see they actually go back very considerably from the border. It is not correct at all, is it, to say, as you said in your summary report, that the topographical differences between what you have modelled and the real world are restricted to a small area close to the border, is it?

Mr. JACOBSEN: No, but this is actually not showing the correct difference. But as we saw before, we are looking at the difference between our canal and our surrounding topography level. So that is really what should be the focus. And as I pointed out, as you see in the downstream reach, far downstream, that is where we find the largest and the most consistent differences between the two. We will always have minor differences due to resolution issues in this case.

Mr. WORDSWORTH: Well, let's have a look at your graph. But we have replotted this just changing the axis, the Y-axis. So, in fact, here we see the topographical differences that appear from your report, and this is now going from left to right from the border. This is taking exactly the same data as on the preceding graph but one that we just showed you. And on the left-hand side, we can see the difference of nearly 6 m between the baseline scenario topography and the no-canal scenario topography. And that is the brown line on the far left. Do you see that?

Mr. JACOBSEN: Yes.

Mr. WORDSWORTH: Then moving left to right, we see 250 m from the border there is a difference of 2 m, where this time the baseline scenario is above the no-canal scenario topography. And then just after that, there is a difference of 5 m. And then about 850 m from the border, we see a difference of almost 12 m between the baseline scenario topography and the no-canal scenario topography. Can you see that?

Mr. JACOBSEN: I can see it in the plot. I do not recognize it from the previous cross-section profile that we showed. I do not know if it has been computed in the same way.

Mr. WORDSWORTH: All that has happened is we have taken the graph — and your graph was done on 20 m on the Y-axis, that is the vertical axis — and we have just changed it to 2 m so you can actually see more clearly what the differences in topography are.

Mr. JACOBSEN: Yes, but I cannot see how these differences are calculated compared to the previous profile.

Mr. WORDSWORTH: Well, it is taking your data.

Mr. JACOBSEN: Yes. But as we pointed out, and we saw in the cross-section before, you always need to take the lowest side of the canal. You were showing the right and the left. So our plot has always taken the lower point, which is important for the exchange between the canal and the surrounding area. So this does not reflect necessarily the lowest point that we should compare, like we saw in the profile before. I do not see the differences that you show in this plot.

Mr. WORDSWORTH: The final difference at about 15-20 m, we see a difference of about 7 m between the baseline scenario and the no-canal scenario topography, but you presumably answer the same thing. You do not understand this?

Mr. JACOBSEN: No, I say this is not the correct presentation. The profile before where we saw the differences, we have a maximum of about 6 m and that is taking the lowest point of ravine, comparing that to the canal elevation, and that is what we should do. This is not the case for this plot here. I do not know how it has been produced, but I do not recognize the 10 or 12 m that you are showing here.

Mr. WORDSWORTH: Okay. Well, I understand it is just the same data that has just been put on a graph with a different resolution.

Mr. JACOBSEN: I would have to disagree.

Mr. WORDSWORTH: But in any event, regardless of whether you think those distances are slightly less or maybe considerably less, the point is that raising the ground surface in this way would reduce the amount of water that would be able to enter the surface water system from groundwater, and it would increase the amount that would leak from the surface water system into groundwater also, would it not?

Mr. JACOBSEN: Potentially, yes. But what I think was also clear, from what we discussed previously, and focusing on the downstream reach, from the confluence to the border where the actual differences are, that is a reach where we do not see much exchange between the river and the groundwater system. It is close to zero, and that is what we see both in our measurements, we see it in our baseline, and we see it in our scenario run.

So if that had been the case, if it had changed the exchange and the flow, then it would appear. And that is actually something you can verify by looking at the actual model ***~~resource~~ results***, the model ***~~resource~~ results*** which Chile has actually received. Looking closely at the interaction at the downstream reach, you will see that it is basically zero in all of the three cases regardless of the topographical differences.

Mr. WORDSWORTH: Well, that is just a function of your model. That is just what your model shows. Chile's very strongly held belief, supported by its experts, is your model is completely inaccurate. So the fact that your model shows no difference does not really assist us.

Mr. JACOBSEN: No, but what we are discussing here is the potential impact on the model resource. We are talking about how the model may respond to these changes. And there is actually no reason for speculating. You can see it straight out of the results that there is no exchange, so it would have a very limited effect on the downstream reach.

Mr. WORDSWORTH: Well, just as a layperson I find it rather difficult to understand how the fact that the topography is in various sectors that you have modelled some 6 m higher, and more, that is, the height of a two-storey building, has no impact so far as concerns groundwater and surface water distribution. I find that utterly implausible.

Mr. JACOBSEN: Well, that is not what I am saying. I am saying at this specific location — and bearing in mind you say a two-storey building, that we have a very large elevation difference from upstream to downstream. The effect in this particular location is zero; meaning, that it does not affect the flow across the border, and that is what we are discussing here.

Mr. WORDSWORTH: That very large elevation from upstream to downstream, I think you referred to 130 m?

Mr. JACOBSEN: Approximately.

Mr. WORDSWORTH: So you are comparing this 6 m to 130 m, is that correct?

Mr. JACOBSEN: No, I am saying that whatever effect it may have is very localized and does not reflect on the exchange between the canal and, thus, it does not reflect on the actual simulated flow at the border, which is the question.

Mr. WORDSWORTH: I have just got one . . .

The PRESIDENT: Mr. Wordsworth, I just wanted to let you know you have about two minutes left. I just want you to know that.

Mr. WORDSWORTH: Exactly. I just have one very quick question. Can we go to Table 7.2 from your April 2019 report. This is Annex 25. Do you see there that is the impact that you are modelling overall in terms of your lower bound changes from canalized conditions. So you are saying in essence that if you remove the canals, then there will be a drop in surface water of 60 l/s, correct?

Mr. JENSEN: Yes, that is correct. This is showing the lower bound. It is important here to remember that the lower bound and the upper bound is the extremes of maybe 20 simulations, and for both of these we have discussed the boundary conditions. Both of these we consider are with boundaries that are imperfect too, but conservative on each side. So in this particular lower-bound scenario, yes.

Mr. WORDSWORTH: If we look at what you accept as being the storage in numerical inaccuracies, they come to 11.7 l/s?

Mr. JENSEN: In the baseline, yes.

Mr. WORDSWORTH: So, in fact, that means that your lower bound, the figure of 16 and 11.7 l/s, they are comparable, are they not? And, in fact, 11.7 l/s, that is three quarters of what you estimate the potential reduction to be, correct?

Mr. JENSEN: No, I do not see it that way. You have an inaccuracy in the baseline. You have an inaccuracy in the scenario. And what you see here in this text is the difference between, as you see it, the surface water flow is 149 l/s in the baseline. It is not 16 in the other. That is the difference. So the difference here is the 8.4 l/s in the inaccuracy. So that means, basically, that out of the 253 l/s, we account for 95 per cent of the flow. There is still 5 per cent that we do not account for.

Mr. WORDSWORTH: But even if that is right, it still means that you have got a potential inaccuracy of half what you are predicting is the difference?

Mr. JENSEN: That is correct, yes. In this particular lower-bound scenario, yes.

Mr. WORDSWORTH: Thank you very much.

The PRESIDENT: Thank you, Mr. Wordsworth. Before I give an opportunity to counsel for Bolivia to conduct a re-examination, the Court will observe a coffee break of 15 minutes. The sitting is adjourned.

The Court adjourned from 4.25 to 4.45 p.m.

The PRESIDENT: Please be seated. The sitting is resumed. Mr. Bundy, you are free to return to the podium, if you wish, and then you can go ahead and conduct a re-examination of the experts. I will remind you that you have a maximum of 40 minutes ~~***to do so***~~ for th***is*** re-examination. You have the floor.

Mr. BUNDY: Thank you, Madam President, distinguished judges. I will be taking well less than 40 minutes. Well, I will be taking less than 40 minutes. I cannot speak for DHI.

I was a little disappointed because I wanted to ask you about that gradient, that slope that Mr. Wordsworth displayed last Friday at great length in criticizing DHI, which underlaid those figures of the 400 m channel that were discussed yesterday. But since, apparently, counsel did not want to ask you any questions on that, I will refrain from coming back to them, since they were not dealt with in cross, but it would have been interesting to have been able to follow up on that topic with you.

Let me start on flows. Counsel took you to a number of selected flow measurements from a 20*1*7 and 2018 period at C-7, which was approximately, I think you said it, where the old FCAB intake was, just below the confluence of the two ravines, to suggest that although there were a couple of higher ones up in the 169 l/s area, when averaged out, they came close to Engineer Fox's 131 l/s average, those ones he picked on.

Now, in Annex G, which was in Annex 7, it was your report to the Bolivian Counter-Memorial, you had a table. Do we have it? We do not have it. You had a table there where you listed the average flow at point C-7 as 154 l/s, and then, I think, in the 2019 report — that was Annex 25 to the 2019 report — you reported roughly an average of about 160 l/s. What was the basis, do you recall, of the 154 and 160 l/s? Were those looking at measurements over a longer period of time than just a one-year period?

Mr. JENSEN: The average, the 160 l/s was an average over several years, from the flumes in Bolivia at the same locations, and were taken with different measurement methods, automatic and manual. Actually, all the measurements were considerably higher, but we took it as a lower, conservative estimate. That was basically the baseline of this. Only one or two measurements were, at two occasions, I think, below that, but the majority, far majority of the period was all above that, between 160 to 200 l/s.

Mr. BUNDY: Thank you. Did I understand that between the confluence of the two ravines, the point C-7 or approximately where the old FCAB intake was, and the border, which is 600-650 m downstream — did I understand correctly that the surface flow, in your view, neither increases

dramatically or decreases dramatically, or have I misunderstood that? Could you explain that situation based on your fieldwork there?

Mr. JENSEN: I think that this stretch of the river, this reach of the river, first you have a slight increase just after the desiltation tank and then it gradually decreases a little bit towards Chile.

Mr. BUNDY: Do they more or less balance out?

Mr. JENSEN: Yes, it is a very stable reach, where you more or less have the same. There is not a large variation there.

Mr. BUNDY: So would that mean that you would not be surprised that Chile's pleadings said 160 l/s — I think Drs. Wheater and Peach have used 170 l/s just down from the border — that figure would not surprise you then?

Mr. JENSEN: No, not at all.

Mr. BUNDY: Thank you. Mr. Jacobsen, I suspect this next one is for you.

Now, counsel was taking aim at your no-canal scenario — that was one of the scenarios that you ran in the model. If I understood correctly, you, on the no-canal scenario, were taking the actual topography and where the water would flow without the canals. That may be an amateurish way of saying it, but am I roughly right?

Mr. JACOBSEN: Yes, that is correct. So we were asked to look at what is the effect of removing the canal. So the cross-section itself and the 1D representation is taken out, and what is left is the topography and the slope. So we would have a flow in the ravine according to topography. It might be more distributed, might be a wider flow field, but that is according to our observations, the flow pattern we would expect.

Mr. BUNDY: Where the water would go without the canals?

Mr. JACOBSEN: Yes, it would flow downhill.

Mr. BUNDY: It would go downhill obviously?

Mr. JACOBSEN: Yes.

Mr. BUNDY: Now, counsel accused you of not relying on best evidence to support this approach, and the best evidence he produced, you may remember, was that old map on the screen. I do not seem to be able to put it up on the screen, but it is in your folders. Now, if the judges, and if you — I do not know if you have the folder there, but if you have it there, which tab was it? Apparently, it is going to come up on the screen.

Mr. JACOBSEN: Okay.

Mr. BUNDY: I will believe it when I see it. Let me start anyway. If the map comes up on the screen, but otherwise if you can bring it out on your folders, you will see that there is an enlargement with a great blue line on it, but then the original map is over on the left, the original 1904 map. So this is a map from over 118 years ago. And that map is at a scale of 1:500,000, which is quite a small-scale map. And in the large map, there has been a little red box drawn in the bottom corner. So that is where apparently the Silala is. I doubt you could even see it on the regular map.

So what counsel has done, and what Chile has done, is that they have blown up that box. But if you blow up that box, there is no blue line. The Silala River is a thin river just like any other. Somebody — and it was not us, that is for sure — somebody has added that blue line on this map that counsel showed you, and then tried to say this is the no-canal scenario you should have used. Do you think that would have been an appropriate methodology to follow?

Mr. JACOBSEN: No. I do not know what they knew about the river from this point in time in the old map. But as far as it sort of indicates a general flow direction, it is probably correct. I noticed that it is a quite wide line here. I do not know if that suggested that, in fact, it is a quite wide flow. Maybe that is the case. But that is actually what we are reflecting in the model, that you may have flow in a broader section of the ravine, for instance.

Mr. BUNDY: What I am suggesting is this wide blue line, which — there is the original map — that is what the map looks like, the original, if you enlarge it. The Silala looks like any of the other rivers there. But then, that — with the great blue line — is what Chile has produced, saying

that is what you should have modelled, and I am asking you if you really think that was the best evidence or was it better to look at the actual topography there?

Mr. JACOBSEN: Yes, it seems to be somewhat magnified in the map. And in reality, the flow we would see would, as I explained, be depending on the topography and the topographical slope, and that is what we tried to represent in the model, not a thin line, but wherever the water goes towards Chile. So, I think that is a better description of what the river or the flow path may have looked like.

Mr. BUNDY: Thank you very much. I just have one last question. You can decide who is going to answer this. Counsel suggested at the end of his cross-examination that your model was completely unreliable. And there have been some rather disparaging comments in the written pleadings as how it should be discarded, or I think one of the words was "meaningless". Do you think that is a fair characterization of your reports and your model?

Mr. JENSEN: No, I do not think so. It is a very complex model. It is built on the evidence we could collect from the field. We have spent a lot of time drilling boreholes in Bolivia. When we started, there was virtually nothing. There was some surface mapping of the geology. So, we have spent, well, almost a year in collecting all these hydrogeological data, collecting topographies, detailed topographical models, and we have built it into a quite complex system that, as far as we are concerned, can always be improved, but no model is perfect, and I do not see anything else that has been presented here to this detail that reflects the system better, actually. So, of course, we had constraints in time to live up to the temporal constraints of the Court, but we had to do what we could do in that time. But I think that the model is a fairly good representation of the conditions in the field. The reason why it is so small, that has also been criticized by Chile, is that having built a larger model, we would run into other problems, like we had to guess what was taking place underneath the surface because we did not have the time to survey all this area. So, we had to concentrate on the facts that we could actually collect. Also, we have visited the site several times, walked all the kilometres — not that it is a lot, but we have seen it and we have walked on it, and we have looked

at the springs. We have looked at where the water comes out of the rock, how it comes up. So, we think this is a fairly good representation. Of course, it is not perfect.

Mr. BUNDY: Thank you very much.

Madam President, I have no further questions on re-examination.

The PRESIDENT: Thank you, Mr. Bundy. In that case, let me take a minute now to ascertain whether there are questions ~~***to***~~ ***for*** these experts from the judges. I will start with those judges present in the Great Hall of Justice, who I am sure will let me know if they have questions, and then I will make the same enquiry of the judges who are joining remotely.

I will start by giving the floor to Judge Tomka. Go ahead, please, Judge Tomka.

Judge TOMKA: Thank you very much, Madam President.

I understand that one of the points of disagreement between the experts retained by Chile and the experts retained by Bolivia is the impact of removal or dismantling of channels on the surface flow. The Bolivian expert, DHI, indicate that that would be in the range of 11 to 33 per cent. It is quite a large range.

They explained that the high end, 33 per cent, is in the upper-bound scenario, that means constant pressure along the inflow boundaries, and the difference of 11 per cent is in the so-called lower-bound scenario — constant flux boundary. Could you please explain to me, so that I understand it better, these two scenarios, and also whether there is any seasonal impact in the amount of decrease of surface water flow in case of dismantling the channels and the restoration of the *bofedales*. Thank you very much.

Mr. JENSEN: To the first question, this upper and lower bound. First, I will say yes, it is a wide range. We were observant of the uncertainties there were in this estimate and that is reflected in the range. Also, that it was a very small model. We have been accused of not modelling the whole catchment, which is 250 sq km, approximately. The reason for that was that, actually, these canals do not impact the whole catchment. To us, it makes no sense to believe that these canals will have an impact more than 10 km away, as we saw yesterday. They have local impact, but also this local impact is very, very important to consider the split between groundwater and surface water, which is

what this model is actually all about. But the smaller area that we had to choose because of time limitation also has some disbenefit.

And it is important to realize also that when we started this, the overarching question we had to answer for Bolivia was that if we dismantled the canals, was it at all possible that all this flow that now runs in the canal would seep down in***to*** the groundwater and cross the border as groundwater, not as surface water. That was very important. I am not a legal expert, so I will not say if it was important, but that was the message given. When you ask this question, you have to produce a result that is on the safe side. You say, okay, the worst we can believe that it could — the biggest impact that it could create — would be the 30 to 40 per cent, as it was at that time, later on adjusted, as we have discussed, to 33 per cent. So that is why it is so high in this situation. That was the overarching question that actually leads to the acceptance of that flow actually crossing the border, which was a very important question, obviously.

Then also we were criticized for the boundary conditions, and we also could see that from the results. When the flow through the model is affected by the canalization, then there is an effect on the boundaries, and that was why we played another scenario that we also thought was on the safe side that gave the 11 per cent.

The difference between these two scenarios is that in the first one, based on a geological model that assumes, as the two countries agreed upon at the time, a very, very broad aquifer ~~***for***~~ crossing the border. But underneath the assumption of a fixed-head boundary, as we call it technically, is that if you fix the head and you impose a resistance, which you would do by removing the canalization, then water would find other ways around the model. We do not say this is correct, but it is a conservative estimate on the safe side. The other lower bound scenario, on the other hand, assumes that all the water will be pressed through this model, like pressing water through a bottle. That is also not correct.

The real answer, so to speak, we think, is somewhere between the two. And we ran, in the sensitivity analysis, I think more than 20 runs, and the majority of this is around 15-20 per cent, so they are well in the middle of this. These two are outer bounds. They are not the central estimate. We

found, contrary to Chile, that all this was based on a flow around 160 l/s. If you calculate Fox's measurements to that, they compare very well with the modelling.

As you have also seen, if I may, I will put a small comment to what we saw yesterday also. A simplified calculation, I have nothing against simplified calculation. But as I understood it yesterday, this was — the calculation we saw yesterday is important, but I do not think it shows the effect of the canals. It shows another thing. It is a pure groundwater simulation that compares the level changes of the canals compared to the total water level difference in the catchment. And that is very little, as also shown by Chile. This tells us that the canals will not affect the total flow from the catchment into Chile, total groundwater and surface water. They only calculated the groundwater. There was no surface water in this. But since it is the water coming from the catchment, it is the total flow. So that calculation you saw yesterday is simplified: it shows that there is very little difference. The 1.2, I think, was the number that was taken out of this per cent and it shows that the total amount of flow going from Bolivia into Chile — with and without the canals, groundwater and surface water — will not change. This is what we agree upon with Chile's experts. I do not know if I answered the question correctly.

Judge TOMKA: Thank you very much. I had a second question, which I formulated whether there is any impact of various seasons on the decrease in surface water flow in case that channels, or canals, are dismantled. Thank you very much.

Mr. JENSEN: We can see that there is an effect of seasonality. We saw Chile's satellite measurements yesterday, which is NDVI. That is a measurement on how much evaporation do you see from these wetlands, and you can see that they shrink in winter-time and they expand in summer-time. This is the evapotranspiration. It is not very surprising because that is also what we see outside here. Maybe two weeks ago, we have a forest, no leaves, it is winter: small evaporation. Here we are at 4,000 m; it is cold in winter-time, so the evaporation would definitely go down. What I think you also saw from these areas was that the small areas that actually do evaporate are the ones where the original *bofedal* vegetation, so it is the — I do not see the wetlands expanding and going down in size, but the vegetation is more or less active as a consequence of — mainly, I think, because of temperature. Because water is available at all times of the year.

Judge TOMKA: Thank you very much, Mr. Jensen. Madam President, I have no more questions. Thank you.

The PRESIDENT: Thank you, Judge Tomka. I do not see anyone else on the bench who is seeking to take the floor, nor do I see an indication that the judges who are joining by video conference wish to ask a question. However, I do have a question and I will leave it to the experts to decide who wishes to answer. I think it is probably a pretty simple question for you, if not for me.

So in your report, and I am looking at paragraph 70, but this will be a familiar statement to you, you say that the estimated surface-water cross-border flow from the natural un-channelized wetlands is assessed to be 11 to 33 per cent lower than today. But in that sentence, I do not know whether you are trying to model a comparison between today and what the situation was in, say, 1904 on the one hand; or, today and what the situation would be if the channels were deconstructed. In your response to Judge Tomka, I understood you to explain that the request from Bolivia was to try to understand the difference between today's situation and the situation hypothetically that would exist if the channels were eliminated.

So my question is whether those two exercises, modelling a hypothetical future on the one hand, or trying to model what might have been the case before the channels were created: are those the same questions? In other words, do I reach the same conclusion about both, or would you use a different model or different inputs if you were trying to understand what the situation looked like before the channels were created, as compared to what I understand you to have been doing, which is to try to model what the situation would look like if the channels were eliminated. That is my question.

Mr. JENSEN: It is a good question. Actually, the 33 per cent was a scenario where we had — that was a *restoration* scenario, where we removed the canals and then tried to say: what if this *bofedal* — what happens when constructing the canals is that you have removed a lot of this peat; you have drained the peat: it subsides. So the levels we see today are probably not what Fox would have seen before the canalization. We do not know exactly what these levels were, but this is what normally happens when you de-water wetlands — the soils compact and you get a depression in the soils. So, we cannot model again what happened in the time of Fox. We do not have the climatic

records, but we have looked at climate change and so on. There does not seem to be a very significant climate change in the nearest precipitation records, so we cannot see very much change. But it is true that, when we do the simulations, we try then to say: okay, what happens if we remove the canals, just simply remove them and cover them with soil — that is one scenario, that is the 11 per cent in this wide range. It is not the only one. But if you also restore the wetlands with the same boundary conditions, you get a much higher number.

So we have the two scenarios, either just eliminate the canals or try to re-establish the wetlands as we think a natural wetland would have been, which is adding, I think it was 0.6 m of peat over the surface. We do not know if that is correct. We believe that this is what would gradually develop. In other parts of the world, you might help the nature a little bit by putting up some of this — reinstalling these levels again. But we believe that this is gradually what would develop over time with a restored scenario. But it will not happen tomorrow. I do not know if that was sufficient.

The PRESIDENT: Thank you, Mr. Jensen. It is very helpful. But it leads me to ask you a follow-up question, then. So when I see a summary that refers to 11 to 33 per cent, it gives the impression of a large range that is a consequence of uncertainty. But the example you just gave suggests to me instead that the range is a consequence of uncertainty about the specific kind of measures that would be taken. And so if I understood you correctly, what you said was that the 11 per cent figure was premised on a certain kind of change to the status quo, and the 33 per cent figure would correspond to a different, maybe more substantial, change in the status quo. So I just want to make sure I understood what you said, and that is my last question.

Mr. JENSEN: That is correct. And it is not very well written in the report. I admit that. The 11 per cent is a pure removal of the canal, what we call the “no-canal scenario”. With the same boundary conditions, this would, with a restoration condition, that would give larger numbers. The 33 per cent is a restoration scenario with other upper range boundary conditions. I do not know if it is clear.

The PRESIDENT: Yes, thank you very much. That answers my question.

I do not see anyone else asking for the floor. So I believe, therefore, that that brings us to the close of the questioning of the experts for Bolivia. I thank each of you for appearing before the Court today.

The Court will reconvene on Monday 11 April, at 3 p.m., to hear the second round of oral argument of Chile. At the close of that sitting, Chile will present its final submissions on its own claim. For its part, Bolivia will present its second round of oral arguments, followed by its final submissions on the claims of Chile and on its own counter-claims on the afternoon of Wednesday 13 April 2022. And then, on the afternoon of Thursday 14 April 2022, Chile will present its reply and its final submissions on the counter-claim of Bolivia.

I would like to recall that, in accordance with Article 60, paragraph 1, of the Rules of Court, the oral statements of the second round are to be as succinct as possible. The purpose of the second round of oral argument is to enable each of the Parties to reply to the arguments put forward orally by the opposing Party. The second round must, therefore, not be repetition of the arguments already set forth by the Parties which, moreover, are not obliged to use all the time allotted to them.

The sitting is adjourned.

The Court rose at 5.15 p.m.

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