Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River

Commission d'enquête sur le déclin des populations de saumon rouge du fleuve Fraser

Public Hearings

Audience publique

Commissioner

L'Honorable juge /
The Honourable Justice
Bruce Cohen

Commaissaire

Held at:

Room 801
Federal Courthouse
701 West Georgia Street
Vancouver, B.C.

Thursday, September 15 2011

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Salle 801
Cour fédérale
701, rue West Georgia
Vancouver (C.-B.)

le jeudi 15 septembre 2011

Errata for the Transcript of Hearings on September 15, 2011

Page	Line	Error	Correction
11	39-45	DR. BRADFORD	DR. ORR
12	3-21	DR. BRADFORD	DR. ORR

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APPEARANCES / COMPARUTIONS

Patrick McGowan Jennifer Chan Patrick Hayes	Associate Commission Counsel Junior Commission Counsel
Mark East Charles Fugère	Government of Canada
Boris Tyzuk, Q.C. D. Clifton Prowse, Q.C.	Province of British Columbia
No Appearance	Pacific Salmon Commission
No Appearance	B.C. Public Service Alliance of Canada Union of Environment Workers B.C. ("BCAUEW")
David Bursey Matt Keen	Rio Tinto Alcan Inc. ("RTAI")
No Appearance	B.C. Salmon Farmers Association ("BCSFA")
No Appearance	Seafood Producers Association of B.C. ("SPABC")
No Appearance	Aquaculture Coalition: Alexandra Morton; Raincoast Research Society; Pacific Coast Wild Salmon Society ("AQUA")
Tim Leadem, Q.C. Karen Campbell	Conservation Coalition: Coastal Alliance for Aquaculture Reform Fraser Riverkeeper Society; Georgia Strait Alliance; Raincoast Conservation Foundation; Watershed Watch Salmon Society; Mr. Otto Langer; David Suzuki Foundation ("CONSERV")
No Appearance	Area D Salmon Gillnet Association; Area B Harvest Committee (Seine) ("GILLFSC")

APPEARANCES / COMPARUTIONS, cont'd.

No Appearance	Southern Area E Gillnetters Assn. B.C. Fisheries Survival Coalition ("SGAHC")
No Appearance	West Coast Trollers Area G Association; United Fishermen and Allied Workers' Union ("TWCTUFA")
Keith Lowes	B.C. Wildlife Federation; B.C. Federation of Drift Fishers ("WFFDF")
No Appearance	Maa-nulth Treaty Society; Tsawwassen First Nation; Musqueam First Nation ("MTM")
	Western Central Coast Salish First Nations:
No Appearance	Cowichan Tribes and Chemainus First Nation
No Appearance	Hwlitsum First Nation and Penelakut Tribe
No Appearance	Te'mexw Treaty Association ("WCCSFN")
Brenda Gaertner Michael Bissonnette	First Nations Coalition: First Nations Fisheries Council; Aboriginal Caucus of the Fraser River; Aboriginal Fisheries Secretariat; Fraser Valley Aboriginal Fisheries Society; Northern Shuswap Tribal Council; Chehalis Indian Band; Secwepemc Fisheries Commission of the Shuswap Nation Tribal Council; Upper Fraser Fisheries Conservation Alliance; Other Douglas Treaty First Nations who applied together (the Snuneymuxw, Tsartlip and Tsawout)
No Appearance	Adams Lake Indian Band
No Appearance	Carrier Sekani Tribal Council ("FNC")
No Appearance	Council of Haida Nation
No Appearance	Métis Nation British Columbia ("MNBC")

APPEARANCES / COMPARUTIONS, cont'd.

Nicole Schabus	Sto:lo Tribal Council Cheam Indian Band ("STCCIB")
No Appearance	Laich-kwil-tach Treaty Society James Walkus and Chief Harold Sewid Aboriginal Aquaculture Association ("LJHAH")
No Appearance	Heiltsuk Tribal Council ("HTC")
No Appearance	Musgagmagw Tsawataineuk Tribal Counsel ("MTTC")

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Called

Vancouver, B.C./Vancouver
(C.-B.)
September 15, 2011/le 15
septembre 2011

THE REGISTRAR: Order. The hearing is now resumed.
MS. GAERTNER: Mr. Commissioner, I'm pleased to say that the reason why I'm starting here at the podium is simply to introduce Michael Bissonette, an articling student with our firm.
THE COMMISSIONER: Thank you very much, Ms. Gaertner.
MR. McGOWAN: Mr. Commissioner, today is the commencement of the hearings dealing with the topic of hydro, water flow and temperature. Today's hearings will include the examination of a panel of three scientists: Craig Orr, Steve Macdonald and Mike Bradford, moving from my left to right looking at the witnesses. Dr. Orr and Dr. Bradford have been here before. This is Dr. Macdonald's first appearance. If we can have the witnesses sworn, please.
THE REGISTRAR: Dr. Orr, your affirmation is still in effect. First of all, would you just turn on your microphone, please? Thank you.

CRAIG ORR, recalled.

THE REGISTRAR: Mr. Bradford, we'll re-affirm you again.

MICHAEL BRADFORD, re-affirmed.

STEVE MACDONALD, affirmed.

THE REGISTRAR: State your name, please.
DR. BRADFORD: Michael Bradford.
DR. MACDONALD: Steve Macdonald.
THE REGISTRAR: Thank you.
DR. ORR: And Craig Orr.
THE REGISTRAR: Thank you. Counsel?
MR. McGOWAN: Mr. Commissioner, I will start with the qualifications of the witnesses. I will be seeking to have each of them qualified as an expert witness. Starting with Dr. Bradford, I'll be seeking to have Dr. Bradford qualified as an aquatic habitat ecologist.

EXAMINATION IN CHIEF ON QUALIFICATIONS BY MR. McGOWAN:

Q Dr. Bradford, you hold a Ph.D. in Biology from McGill?
DR. BRADFORD: That's correct.
Q And you also have a Bachelor and Masters degree in biology from Simon Fraser University?
DR. BRADFORD: Yes.
Q You've been a research scientist with the Department of Fisheries and Oceans since 1992?
DR. BRADFORD: Correct.
Q And one area in which you research is the effects of flow regulation on stream ecosystems and salmon?
DR. BRADFORD: Yes.
Q You're the associate editor for the *Canadian Journal of Fisheries and Aquatic Science*?
DR. BRADFORD: Yes.
MR. McGOWAN: If we could have Dr. Bradford's c.v. which is on the screen presently marked as the next exhibit, please?
THE REGISTRAR: That's been marked as Exhibit 912.
MR. McGOWAN: Thank you. Thank you, Mr. Giles. So that's already an exhibit before you, Mr. Commissioner.

Moving on to Dr. Orr, I'm going to seek to qualify Dr. Orr as a behavioural ecologist with a speciality in salmon habitat ecology. Perhaps I'll just go through all the qualifications and then have the witnesses qualified at the end.

Q Dr. Orr, you hold a Ph.D. in Behavioural Ecology from Simon Fraser University?
DR. ORR: Yes, I do.
Q A Masters in Wildlife Ecology from Acadia University?
DR. ORR: Correct.
Q And a Bachelor's degree in Biology from Central Michigan University?
DR. ORR: Correct.
Q You're currently the executive director of Watershed Watch Salmon Society?
DR. ORR: That's right.
Q And you were the founding chair and board member of BC Hydro's Bridge Coastal Fish and Wildlife Restoration Program?
DR. ORR: Correct.
Q And you held that position from 2000 until 2004?

DR. ORR: That's right.
MR. McGOWAN: And Dr. Orr's c.v. is Exhibit 1760.
And finally with Dr. Macdonald, and we would seek to have Dr. Macdonald qualified as an aquatic habitat ecologist.
Q Sir, you hold a Ph.D. in Zoology from the University of Western Ontario?
DR. MACDONALD: Yes.
Q And a Bachelor's degree in Biology from Simon Fraser?
DR. MACDONALD: Yes.
Q You've been a research scientist with the Department of Fisheries and Oceans since 1983?
DR. MACDONALD: That's correct.
Q One of the areas of interest to you in terms of research is aquatic habitat ecology with a focus on experimental design and statistics?
DR. MACDONALD: Yes.
Q You're currently the director of the department's Centre for Aquaculture and Environmental Research?
DR. MACDONALD: Yes.
Q And you're the head of the department's Environmental and Aquaculture Research Section in the Pacific Region.
DR. MACDONALD: Yes.
Q You're also an adjunct professor at UBC in the Forestry Department and at SFU in the Resource and Environmental Management Department?
DR. MACDONALD: Yes.
MR. McGOWAN: If we could have Dr. Macdonald's c.v., which is at our Tab 3, marked as the next exhibit, please.
THE REGISTRAR: 1846.

EXHIBIT 1846: *Curriculum vitae* of Dr. Steve Macdonald

MR. McGOWAN: And, Mr. Commissioner, subject to any questions from anybody else, I am going to seek to have the witnesses qualified in the areas which are articulated.
THE COMMISSIONER: Yes. Thank you very much, Mr. McGowan.

EXAMINATION IN CHIEF BY MR. McGOWAN:

Q Now, Dr. Bradford, the commissioner has heard from

Dr. Hinch on the matters related to temperature and sockeye in an earlier piece of evidence which you are familiar with; is that right?

DR. BRADFORD: Yes, I am.

Q This expands on the issue of temperature and moves us into some issues related to flow and hydro projects. I wonder if just to get us started, you could take a moment and very briefly explain to the commissioner the significance of water flow and temperature to sockeye at the various life stages.

DR. BRADFORD: Sure. Well, of course, without water there won't be fish, but fish have certain preferences with respect to flows and temperatures at different stages in their life cycle. The commission has heard evidence on the migration of salmon upstream from the ocean to the spawning grounds and the importance of appropriate levels of flow and temperature within the Fraser River and the potential changes that might occur with respect to climate change.

When these salmon reach their spawning grounds, they require, of course, adequate flow and temperatures within an optimal range in order to be able to spawn successfully. Spawning often occurs in the Fall months when stream flows are naturally low and those flows are often supported by ground water that flows into the channel.

The eggs are laid in the Fall months and remain in the spawning gravels for six months or longer during the winter months. And at this time, especially in the northern parts of the basin ground water is particularly important because without ground water the stream beds would probably freeze solid or dry up, so the ground water plays a particularly important role during the incubation of eggs in the winter months.

In the Spring of the following year, the fry move from the streams to the lakes and the flows during that time can be very important. High flows can scour the spawning gravels and destroy the spawning beds and cause significant mortalities.

Finally, when -- the fish-rearing lakes which are relatively buffered from stream inflows but again, flows become important when the smolts leave the streams and move down the Fraser River. There's been suggested interaction between the

timing of the hydrograph in the Fraser River and productivity in Georgia Strait, so flows continue to play a role for sockeye salmon at that stage.

Q I wonder if you can briefly address for the commissioner please the relationship between water flow and temperature.

DR. BRADFORD: Well, it's a very complex one. In the Fraser River, I think the commissioner has heard evidence that in years when snow packs are low you tend to have lower flows and coupled with warmer temperatures and, for example, this year we had very high flows as a result of the delayed snow melt and the river was extremely cold and so there's an inverse relationship. But there are times of the year in places it -- you can have low flows and low temperatures in the winter months, for example. So it's a complex relationship.

Q Thank you. Having heard of the significance of flows, I'm going to start by asking some questions to you, Dr. Bradford, about surface water extraction for uses such as agriculture, domestic use or industrial purposes. Can the extraction of water lead to difficulties for salmon or for sockeye specifically?

DR. BRADFORD: Certainly. Surface water extraction is the removal of water for these various uses and many parts of the province the demands for water are greatest in the late summer and Fall for irrigation purposes and that's a time when flows are naturally low and so in some river systems they can become very stressful for fish, because the low volumes of water often corresponds to high temperatures and producing an environment that can be unsuitable for salmon.

Q Okay. Are there areas or streams in the Fraser watershed, if we're thinking only about sockeye, where sockeye are potentially impacted negatively by water withdrawals at present?

DR. BRADFORD: It's not as big a problem for sockeye as it is for the other species. Many of the major sockeye producing areas, the spawning grounds are located downstream of large lakes such as the Adams River, for example, and water withdrawals, there aren't water withdrawals in those systems that would impact the spawning areas. But there are areas, particularly around the Shuswap, in the Shuswap Basin, where water withdrawals in some of

the -- some of the rivers may have some effect on the quality of the environments for sockeye but I don't think it's as big a problem as it is for coho salmon, for example.

Q Okay. Given what you've said about that and given what we know about climate change and population growth and the potential for future development, are there areas in the province where you have concerns about potential impacts on sockeye habitat from water withdrawals in the future?

DR. BRADFORD: Yes, there are concerns beginning with Cultus Lake sockeye and the water withdrawals in that basin for groundwater use, not so much surface water in that case. But I think population growth, certainly in the drier parts of the province, in the Okanagan and in the Cariboo areas potentially in the future could have impacts on sockeye habitat.

Q Dr. Orr, I wonder if you have anything to add to the issues surrounding surface water extraction and its potential impact?

DR. ORR: I think Dr. Bradford's covered most of it, but, you know, the issue with surface water licensing is we're way over-subscribed and, you know, I think there's something like 40,000 water licences out there right now and we go on the principle of first in line first in rights, and these are granted in perpetuity, so there's always conflicts over the amount of water that's available for fish and wildlife, especially when humans move into these areas.

MR. McGOWAN: Thank you for that. Mr. Commissioner, just for your benefit, we will be hearing from Mr. Glen Davidson, who's the chief water comptroller who issues the licences in British Columbia tomorrow.

Q I'm going to move on now to the issue of groundwater extraction and Dr. Macdonald, I wonder if you could please explain to the commissioner briefly the significance of groundwater to sockeye? Dr. Bradford introduced it in his introductory comments, but maybe you can --

DR. MACDONALD: Yes.

Q -- expand a little bit.

DR. MACDONALD: Yes. Dr. Bradford has touched on some of it, but I'll begin by saying that groundwater is generally warmer in the winter and cooler in

the summer than surface water. So anywhere that groundwater is having an influence, it tends to be a moderating influence on the environment in that area.

There's other benefits to groundwater. It delivers ions, it delivers nutrients to the stream, so it does have an influence on water chemistry and it can have an influence on the productivity of streams, as well. And I think as Dr. Bradford has suggested, it maintains flows in the summertime.

What I'd like to do is just talk quickly about the winter and then about the summer.

Q Please.

DR. MACDONALD: And in the winter, particularly in the northern parts of the Fraser watershed, northern parts of this province, the influence of groundwater is to keep the stream fluid, in other words, prevent the stream from freezing up, prevent anchor ice from forming. And as far as sockeye are concerned, yes, many of the streams are below lakes as Dr. Bradford has suggested, but in the case of the Early Stuart run, historically very famous run, most of the natal habitat is actually above the lake in very small, narrow streams, maybe a third the width of this courtroom. And these streams are flowing all winter long, despite the fact that the temperature might be minus-40 for long periods of time. And that's because of groundwater.

These eggs, the Early Stuart, arrive early as it suggests such so that the eggs can actually incubate and be in -- the alevins can be in a position to actually move through the gravel. They don't emerge, but move through the gravel through the wintertime to avoid anchor ice and actually find these pockets of warm water. So in the wintertime, there's certain parts of this province where we wouldn't have sockeye salmon if it wasn't for groundwater.

In the summer the easiest way to point out the importance of groundwater in the summer is just to look at the temperatures that these fish experience as they enter the -- as the Fraser River, they enter coming out of the Strait of Georgia where temperatures might be 12 or 13 degrees. Fraser River it's a little bit warmer.

And as they proceed up the Fraser River, say past Hell's Gate, temperatures might be 15, 16, 17 degrees and in warmer years, even warmer. They get into the Nechako, temperatures are even warmer. They go up - this is talking about the Early Stuarts here - they go up through Stuart Lake and when they get into the lakes, they try to seek cooler temperatures down deep.

When they arrive in the spawning grounds, they arrive at temperatures that could be single digit temperatures. They come out at 20 degrees into temperatures that might be nine, ten or 11 degrees on the spawning grounds, and that in the small streams, that's because of groundwater and they could not survive if they had to spawn in 20-degree water. They have to find these cold water sources to spawn.

Q Okay. Is that -- you've touched on the spawning grounds. On the way up, is there an issue of thermal refugia provided by groundwater in some circumstances?

DR. MACDONALD: It's thought there is. Certainly on the warm years you do see fish holding at the mouths of tributaries to the Fraser River and these are -- this is cooler water and so it's thought that these are thermal refugia for these fish. These fish can't delay very long though, because they're on a time budget. They have to get to the spawning grounds to spawn obviously before they die. But I do believe that there are thermal refugia on the way up through the river.

Q Dr. Orr, through your involvement with Watershed Watch, have you become familiar with the extent to which groundwater is licensed in British Columbia?

DR. ORR: I am.

Q I wonder if you could explain to the commissioner your thoughts on that.

DR. ORR: Yeah, it is an area of concern in terms of all salmon species. And you've heard for sockeye, as well, but currently only extremely large extractions of groundwater are required to have licences. I think the threshold is 75 litres per second and it's hard to put that in perspective, but that's a lot of water. Watershed Watch has commissioned a legal review of our groundwater protection in the past and done several reports. Unfortunately, we are not protecting groundwater

at this time. It is promised as one of the themes under the ***Water Sustainability Act***, the ***Water Act*** modernization process, but at this time we don't know to what extent groundwater will be licensed or protected and there's only a couple of special areas where it's been studied. We don't even know the full extent of where groundwater is in this province in terms of how it may moderate temperature flow and streams. So we don't know where it is and it's not really licensed at this time like surface water. And the concerns that we have seen, especially in some of these arid areas is where surface water licences are fully subscribed. We're seeing in areas like the Nicola wells being drilled into the ground right next to streams to extract groundwater where no licence is needed. So I think the licensing of groundwater has come up in certainly in the public consultations on ***Water Act*** modernization as something that needs to move forward.

Q To the extent the ***Water Act*** modernization process proposes to move to greater regulation of groundwater, do you and your organization support that?

DR. ORR: Absolutely. It has to be done in order to maintain the resilience of the salmon habitat.

Q Either Dr. Orr or Dr. Macdonald, are there specific areas or streams associated with sockeye productivity where you have particular concerns of the negative impact of groundwater extraction or the potential for it?

DR. ORR: I think we've already heard about Early Stuarts and the situation there with that -- you know, with those fish is that they've been in some decline and they're currently trending at very low levels over the past 20, 25 years and, you know, if we want to maintain those stocks we're going to have to, you know, do something about protecting the groundwater.

Q Thank you for that. I'm going to turn now and move to the issue of potential impacts associated with hydro projects and I'm going to start by focusing on BC Hydro projects, so leaving aside the Kemano projects and independent projects, I'd like to focus first of all on BC Hydro projects.

Dr. Bradford, I wonder if you could just take the commissioner through the several BC Hydro

operations that are in existence in the Fraser watershed and explain either the historic or potential present impacts associated with those different projects, maybe starting with the Coquitlam and Alouette examples.

DR. BRADFORD: Surely. There's, of course, working up through the watershed, there are a number of older hydroelectric facilities in the Lower Mainland and both the Coquitlam and Alouette dams which are built in the early 1900s prevented sockeye salmon populations that existed in those watersheds from migrating to the ocean and so the anadromous segment of those populations were extirpated a long time ago and there was no provision at that time made for the passage of fish up and down through those power projects or water retention projects.

The one system, hydro system that has potential impacts on sockeye salmon is the Bridge Seton hydroelectric system, which was -- most of it was completed in the middle 1900s and there are two conservation units of sockeye salmon that have to pass through that hydroelectric system and impacts could occur. And there's potential for some impact of BC Hydro's Shuswap Falls facility on downstream flows, but I don't think those are particularly significant. So relatively limited in comparison to the Columbia River, for example.

Q So if we're looking at present concerns or present issues, the Bridge Seton is the operation that you would focus on?

DR. BRADFORD: For sockeye, yes.

Q For sockeye. Thank you.

Now, we heard about two populations that historically existed having been blocked at the Coquitlam and Alouette facilities. Dr. Orr, have you had some involvement in initiatives exploring the possibility of restoring access to at least one of those systems?

DR. ORR: Yes. We've been quite involved in trying to restore sockeye to the Coquitlam River. They were, of course, extirpated over a hundred years ago when the dam went up, the oldest one in the Fraser, and we worked with Coquitlam First Nation very closely and the citizens of Coquitlam and I think we've been meeting now for seven years on what's called the Coquitlam Salmon Restoration

Program. In fact, we just had a meeting two days ago to look at the issue of sockeye.

I can tell you from my experience, it's much better idea to protect fish than it is trying to restore them. It's very, very difficult to re-anadromize fish. We did find through almost five years of feasibility studies that there are residualized sockeye in Coquitlam Lake and we worked with BC Hydro and others in Metro Vancouver or GVRD as they were called. They were very concerned about the issue of re-introducing sockeye in terms of what it meant for water quality, because that's the major drinking water supply for Greater Vancouver. And we spent something in the order of nearly $2 million on feasibility studies, just to get to the state where we all agree that it's possible to start -- restart a small run. And I believe the first fish that came back were -- in 2008. This year we had six fish return to the system. Two died, they were eaten, one impaled itself and three were trapped and released back in the lake. So, you know, from tens of thousands in the past we're looking at very, very modest returns of fish. So it's very difficult to re-establish these fish and we've just been told by BC Hydro that we're going to have to fund a lot of the operations that BC Hydro had been funding, including the trapping and trucking and the smolt out-migration monitoring program. So it's a very difficult situation to re-establish fish and, you know, Coquitlam literally means "red fish up the river", so, you know, we're hoping that we're going to see more sockeye going back up the river in the future. But it's a very difficult process.

Q Is the Alouette operation in terms of re-establishing the run, a little bit further advanced than the Coquitlam one?

DR. BRADFORD: It's further advanced. They have fewer logistical problems but one of the biggest advantages they have there is they fertilize the system and so the productivity is much higher, so they get returns there are higher. But they had fairly low returns this year too from what I understand from briefings from BC Hydro this week.

Q In terms of re-establishing either of these runs for the long term going forward, I take it trap

and truck might not be feasible if run sizes get to a more sustainable level?

DR. BRADFORD: Trap and truck is something that can be maintained for awhile. You know, there are feasibility studies hopefully going ahead on putting in a fish ladder, but you have to make a business case to BC Hydro. They made it a very difficult hurdle to get over at this time in terms of fish ladders. But trap and truck has been going on at the Capilano dam for probably about three decades now for coho and, you know, several hundred fish, so it does work. The real limiting factor that we're facing now is getting smolts out of the system. We only got an estimated 120 smolts out of the entire system this year. Our best year for smolt emigration was 1500 smolts. So when you consider that we have, you know, less than one percent survival for many of these sockeye stocks, you can understand where the limiting factor is and why we're getting so few fish back.

Q Thank you. I'd like to turn now, Dr. Bradford, to some evidence with respect to the Seton Dam and the Bridge Seton system. If we could please have the Policy and Practice Report page 50 put onto the screen. Zooming in on the chart which you'll find, Ms. Panchuk, at the top of that page. It's at our Tab 9.

And just while that is being brought up, Dr. Bradford, I'm going to ask you with the assistance of this map to the extent that it provides you any assistance, to identify for the commissioner the location of the Seton Dam, identify the sockeye runs which are present in this system and explain in general terms how the operation here works.

DR. BRADFORD: Certainly. If you're looking at the panel, Mr. Commissioner, the Fraser River is on the right-hand side flowing near the town of Lillooet and on the very left-hand side of this figure is Seton Lake. And so salmon -- sockeye salmon are moving upstream in the Fraser River on the right side and would swim up through the Seton River into Seton Lake and some of them will swim the length of Seton Lake and onwards to Anderson Lake to spawning in the Gates Creek and there's a second population that spawns at Portage Creek between Seton and Anderson Lake.

As far as -- in relation to the hydro project in the 1950s, I believe, a dam was built and indicated on the left side of this figure across the Seton River and raised the level of Seton Lake somewhat and then the vast majority of water is diverted down the power canal indicated by "canal" and then there's a powerhouse at the -- on the banks of the Fraser River on the right-hand side of the panel. And so the challenges for sockeye moving upstream is that when they come up the river, they will begin to encounter Seton Lake water, if you like, at the tail ways to the powerhouse and that attracts them to that because they think that's the way to getting upstream, so there can be a delay there. If they figure that out, they go further and find the Seton River, swim up the Seton River and they will encounter the Seton Dam where they have to get over the fish ladder to continue their migration upstream.

I should mention that the spawning channels indicated on this figure are primarily for pink salmon which are common in the system and they were built as compensation because the dam flooded out some pink salmon habitat right below the lake.

Q Okay. To the extent that sockeye spawn in this system, they are primarily if not exclusively spawning above the Seton Dam?

DR. BRADFORD: Yeah, that's correct.

Q I wonder if you could now take the commissioner through potential concerns that you've become aware of with respect to impacts of the Seton Dam and the infrastructure associated with it on sockeye returning or otherwise.

DR. BRADFORD: Yeah. As I mentioned, there's a couple of concerns. One is the delays associated with the fish being able to find the right path to move up and then so there's been attempts to alter the scent of the water by using this -- indicated by the Cayuse Creek on the left side of the figure there's -- shows a tunnel and so sometimes water is diverted into the Seton River. These are attempts to get the fish to move efficiently up the Seton River to the base of the dam. And then the second issue is the --

Q I'm just going to stop you. Before you move on to the second issue, I just want to make sure we have clear the first issue. And I want to re-

articulate it and see if I've got it right. Is it essentially a homing issue created at least in part by the fact that much of the water that used to flow down the Seton River is now diverted out the power canal creating water that smells very much like the water these fish are expecting to be migrating to?

DR. BRADFORD: That's correct.

Q Okay. Thank you.

DR. BRADFORD: Yeah.

Q Moving on then to the second issue that you --

DR. BRADFORD: The second issue is when they reach the Seton Dam there's water flowing over various controlled structures in that one side of the dam is the fish ladder and the fish have to be able to find the fish ladder, which is the sort of attraction to the entrance to the fish ladder, and then ascend the fish ladder and there are potential for stress and energetic expenditures during that ascent that can compromise their ability to complete their life cycle to migrate upstream and spawn.

Q Thank you. Are there also issues associated with mortality to smolts that have arisen and have to be addressed?

DR. BRADFORD: Yes, there are. So in this -- much of the year, the vast majority of water coming out of Seton Lake travels through the power canal and goes to generation. And smolts, when they're leaving the lake, are attracted to the strongest flows and so they're naturally attracted to the power canal rather than the creek itself and are subject to passing through the turbines which can cause through a variety of mechanisms mortality and stress on those fish. And so BC Hydro, in cooperation with the Stellat'en First Nation and the Salmon Commission and DFO over the years have experimented with various techniques to try and minimize the passage of fish through the power canal and route the fish, if you like, over the dam which is not that high a dam, and so they are able to pass through the dam and migrate downstream with less stress and impact.

And most recently, the mitigative measure that seems to be the most successful is actually to switch off the generation at night. Most of the smolts migrate at night. And by switching off

the powerhouse, there's no flow in the canal and the smolts are naturally attracted to go down the river, the creek instead of the canal and that minimizes the impact.

Q And relatively speaking, that's a fairly recent initiative?

DR. BRADFORD: I don't know the date, but I believe it is, yes.

MR. McGOWAN: Mr. Commissioner, we'll have Mr. Paul Higgins from BC Hydro here tomorrow who can explain the process which led to that.

Q One of the other issues I wanted to ask you about was one of the concerns that was brought to our attention I wanted to ask if you have an opinion on it is the issue of turbidity in Seton Lake that is perhaps changed somewhat by the system and the alterations to it.

DR. BRADFORD: This -- could we go back to the other figure?

MR. McGOWAN: Certainly. Can we have page 47 please of the Policy and Practice Report.

DR. BRADFORD: So the -- that's fine. This blows out and shows the full extent of the Bridge Seton project and so just north of Seton Lake is the Bridge Basin and so the generation capacity of the Seton system comes from water diverted from the adjacent Bridge watershed which is shown through that dash line that extends into Seton Lake. The Bridge system drains the Bridge Glacier, a large glaciated area and so the water is coloured and it enters Seton Lake. Seton Lake -- Anderson Lake upstream is relatively clear. Seton Lake was clear before this project but is now a turbid colour much like other glacial lakes you'll see in the province.

So there are definitely concerns about whether that turbidity has impacted productivity. I did consult with my colleagues who do limnology studies on these lakes and they found that the smolts -- the juvenile sockeye within Seton Lake were larger than they are in Anderson Lake and so they seem to be foraging successfully. And they suggested that perhaps along with the turbidity that comes in is additional nutrients to Seton Lake which has enhanced productivity and the presence of turbidity means the fish are not as concerned about predators as they are in a clear

lake and so they're actually foraging longer. So I think there's reason to believe that the turbidity effects, although they are striking to the visual eye, may not have as great an effect on sockeye as may have been previously thought.

Q Thank you. Coming back to the issue of flow and temperature, does the Bridge Seton project have an impact on the flow or temperature of the Fraser mainstem?

DR. BRADFORD: It -- the Bridge River in particular is a large tributary of the Fraser River and so, like many storage projects, the system is designed to store the Spring and summer glacial melt, the runoff, and then use that to generate throughout the year. And so what the hydro project does is it prevents the large Spring flows -- Spring and summer flows that would normally enter the Fraser River just north of Lillooet.

Now, because it is a glacial system, there's potential that the Bridge River was probably quite cold and it may have provided a significant thermal refuge for migrating sockeye salmon during the summer months, and the volumes of water now leaving the system are significantly longer than they were then. But we don't have any data or direct information of how significant that thermal refuge would have been. But there is some potential there.

Q That's speaking of the summer months. Is there an impact in the winter months and is that significant to sockeye?

DR. BRADFORD: No. It actually adds flow to the Fraser River in the winter months then more than there would have been historically.

Q Dr. Orr, one of the things that we heard, at least by implication through Dr. Bradford's evidence was some initiatives aimed at trying to benefit sockeye through the management of the system and when water's released. And I think we're going to hear that some of this has come either through consultation with multiple stakeholders or through the Water Use Planning process that was associated with BC Hydro projects and specifically the Bridge Seton project. I wonder if you could address the commissioner about your thoughts on the Water Use Planning Process and whether it's beneficial.

DR. ORR: Absolutely. We didn't participate in the

Bridge WUPP as they're called, but we were a member of the Coquitlam WUPP and we worked with First Nations, I worked with First Nations and also on several government scientist on providing advice during the Water Use Planning Process.

I found that the Water Use Planning Process was a model that we should be looking at in British Columbia and I'll just state it that baldly. Watershed Watch also did an analysis of fish conservation gains from the Water Use Planning Process and we found that many of the decisions through consultative committees that were reached provided -- ended up providing more water for fish in several of the systems. In the Coquitlam, I think we nearly tripled the flows of water coming out, although that -- in one respect it tells you how little water was coming out of the system. It was basically just seepage that was coming out of there at one time.

So the Water Use Planning Process was well-funded. It had very good technical support. I think there were five levels of government involved. It in many cases, you know, it came out with a lasting solution that had social and ecological benefits. And the other really good thing about the Water Use Planning Process that we've documented and others have too, is the monitoring of the flows. The Coquitlam has a 15-year monitoring plan to look at changes in productivity of the various flows because changing flows has caused -- you know, it has some degree of uncertainty in terms of the benefits, but it's mainly to increase the productivity of the system for insects, things like that.

So all these things, for, you know, the handful of dams that it was done at in the Fraser system was a really good thing in terms of increasing flows, not necessarily for sockeye but, you know, for other species, chinook and coho and steelhead and things like that, but in certain systems the sockeye did benefit from increased flows.

MR. McGOWAN: Thank you, Doctor. Mr. Commissioner, for your benefit a description of the Water Use Planning Process, what it is and how it's applied to some extent is dealt with in the Policy and Practice Report and you'll hear some evidence on

it tomorrow, as well.

If I might just have a moment. Now, the one thing we haven't got to yet, the Policy and Practice Report is on the screen and it's been referred to now several times. This might be an appropriate time to mark it as an exhibit or as the next PPR.

THE REGISTRAR: It'll be PPR number 21.

MR. McGOWAN: Thank you.

PPR21: Regulation of Water Uses in the Fraser River Watershed - 18 August 2011

MR. McGOWAN:

Q I'd like to move now, Gentlemen, to some evidence respecting the Kemano power project. It's not a BC Hydro power project. Dr. Macdonald, you have some experience and have conducted some research with respect to that operation; is that correct?

DR. MACDONALD: Yes, I have.

Q I'm going to ask that we turn to page 60 of the Policy and Practice Report and highlight that diagram and with the assistance of that diagram, could you please describe the Kemano Power Project and the infrastructure associated with it and any alteration to topography, et cetera?

DR. MACDONALD: Yes. It's a complex system. Let's start with the Kenney Dam. When it was decided to create an aluminium smelter at Kitimat, the Kenney Dam was constructed in the early 1950s and it created the chain of lakes that you see there. Kenney Dam is in red in the centre of the figure, Ootsa and other lakes. That water is an impoundment but it's important to say -- for you to know that it's also a diversion because certain portion of that water goes out through the tunnels, the power tunnel on the left of the figure through a power generation station, the Kemano, and then out into the Gardner Canal and is therefore deprived of passage through the Fraser River.

The other important point to make at this time is that the Kenney Dam is -- does not have a water release facility associated with it. It's an earth-filled structure, a big pile of rock, and water does not pass through there.

For water to enter the Nechako River from the

reservoir, it must go through the Skins Lake Spillway, over to the left of the Kenney Dam there off Ootsa Lake and to do that it must pass through the Cheslatta system and then enter the Nechako River. A couple of points here. There is about nine kilometres of Nechako River Canyon that -- below the Kenney Dam and above Cheslatta Falls that is essentially dewatered. It has groundwater and it's forested at this time because no water leaves the Kenney Dam and the other point to make is when the Skins Lake Spillway came into action, the amount of water passing through the Cheslatta system went up by at least an order of magnitude. So this operation has had some major effects on the Cheslatta system, as well as obviously the Upper Nechako, which is now a reservoir.

A few other points. The sockeye that spawn in this area, the Early Stuart, which I've already talked about, will experience the portion of the Nechako River from Prince George to the Stuart River confluence, so a fairly short portion of the Nechako River, and they may only pass through -- it's approximately a 30-day migration for the sockeye salmon which they may spend two or three days in that stretch before moving into the Stuart, but there are sockeye stocks that spawn further up the Nechako, the Nadina, and the Stellako River and these have a late run and an early run, as well. So early in the year there's a lot of sockeye, early being mid-summer. There's a lot of sockeye or we'd hope there's a lot of sockeye migrating through this stretch of river. But they don't all use the entire portion of the river.

Another point to be made is please look at the town or the location called Finmoore, just above the confluence with the Stuart River. Finmoore is the location of a very important data logger. It logs water temperatures and it's a site that the -- a temperature target is located and it's a temperature target of 20 degrees and as we get into talking about the temperature management program, it's Finmoore that is used as the target for trying to achieve temperatures of 20 degrees or less during a period in the summer when sockeye -- the early runs of sockeye are using this stretch of river.

So I'll let you guide me into the next stage of this.
Q Thank you. That was helpful. That's a lot of information so I may just take you back --
DR. MACDONALD: Yes.
Q -- through a little --
DR. MACDONALD: Please do, yes.
Q A couple of pieces again to make sure we have it all. There are several sockeye runs which pass through the Nechako, including the Stuart, the Nadina and the Stellako; is that correct?
DR. MACDONALD: Yes, that's correct.
Q Now, none of those actually passed up the Nechako to the Kenney Dam or through the Cheslatta system, but they are impacted by the flows in the Nechako in the stretch of the Nechako between Prince George and either the Stuart River or the Stellako River, correct?
DR. MACDONALD: That's a very good point to make. These are downstream effects we're talking about, as opposed to actual impacts to the spawning ground.
Q Okay. And the Kenney Dam, which we see about just right of centre near the bottom of the page --
DR. MACDONALD: Yeah.
Q -- that's the earthen structure you're referring to and no water ever passes through that.
DR. MACDONALD: No, not at this stage.
Q To the extent any water from the Upper Nechako system makes its way back into the Nechako River, that's accomplished by releasing that water through the Skins Lake Spillway, correct?
DR. MACDONALD: That's absolutely right.
Q And prior to that water rejoining the Nechako, it has to go through the Cheslatta Lake system?
DR. MACDONALD: That's correct.
Q Which is -- maybe you can tell the commissioner the approximate length of that diversion?
DR. MACDONALD: Oh, actually, not off the top of my head. If you look, it's about 50 kilometres, 60 kilometres.
Q Okay.
DR. MACDONALD: Just based on the index at the bottom.
Q Yeah, there is a scale at the bottom --
DR. MACDONALD: Scale, yeah.
Q -- of the page, yes. And the Cheslatta Lake system was originally a series of lakes and river

that was much smaller than it now is, at least when water is flowing through it from the Upper Nechako system?

DR. MACDONALD: Well, it certainly had a lot less water in it. That's correct.

Q Yes.

DR. MACDONALD: In fact, the very upper reaches below Skins Lake had no water at all, as I understand.

Q And the power generation from this operation occurs by way of release through a tunnel on the left side of the page, through power generation turbines?

DR. MACDONALD: That's correct. Yes.

Q Released out into the inlet, into the ocean?

DR. MACDONALD: Yes. It's a tunnel, yes.

Q Okay. Thank you. So I think we now have a sense of the system. Now, the -- you explained to the commissioner that the sockeye that are returning to these systems have had a very lengthy migration.

DR. MACDONALD: Correct.

Q And this comes where in the length of that migration does this stretch of the Nechako come?

DR. MACDONALD: Well, it's near the end of the migration at the very -- again, picking on the Early Stuarts, at the very top of your -- of this figure you'll see Takla Lake and Takla Lake and the river connecting Takla Lake to Trembleur Lake are the locations of the small -- most of them small or medium sized natal streams for these fish. So although later in the year there's runs that actually spawn in some of the larger rivers, as well, but the early runs spawn in the smaller systems that feed into this. So it's I'd say three-quarters of the way through the migration that they reach this site.

Q Now, I understand that there's something called the Summer Temperature Management Program that is operated with respect to the system and I wonder if you could explain what that program is to the commissioner, please?

DR. MACDONALD: Yes. In 1980 concern for -- well, I should start by saying, as I'm repeating myself, as I said, there was a reduction in water when this system of power production was put into place and there was concern, along with influence of climate change to the temperature, water

temperatures in the lower part of the Nechako - certainly lower being down to the confluence with the Stuart - were getting to be inhospitable for sockeye salmon in late July and early August, mid-August. So Summer Temperature Management Program, STMP, was put into play and what it does, it's still being used, is starting on July 20th, it attempts to achieve by releasing additional amounts of water than the base flow, it attempts to achieve lower temperatures to lower the temperature and the target that it tries to achieve is 20 degrees at Finmoore.

I don't know how much detail you want to get into here, but it's -- I'll say that it's run by a model that uses meteorological and hydrological information that specifies what or anticipates the temperatures at Finmoore and if it anticipates that the temperatures are going to exceed 19.6 degrees, the plan is put in place, water is released, and that water is designed to maintain temperatures or cool temperatures at Finmoore.

Now, a few details here are actually pretty important. I mentioned July 20th. This program is in place until August 20th. So you're dealing with a 30-day period. It actually starts on July 10th, ten days before I mentioned, because there is a requirement, just from the mechanics of this system, to precharge the Cheslatta Lake system, so that come July 20th, if the model indicates that you need to add water to the system, by adding water at that time, you'll get a -- well, we'll say instantaneous or very rapid response. If you were to wait without -- with the Cheslatta Lake not kind of inflated, you would have a problem. If you understand electricity, it's like a bit capacitor. And so you need to charge it up so that when the time comes if you need the water, you can just pound away at it and release the water.

Now, that has some pretty dramatic effects on the Cheslatta system because, of course, this is an odd time of year if you're comparing it to natural conditions, to be pouring a lot of water into the Cheslatta system and it's also a kind of an odd time of year to be putting a lot of water into the Nechako, as well, because you're creating a hydrographic peak in the middle of the summer

when hydrographic peaks should normally be in the Spring.

But -- would you like me to carry on and talk about the effectiveness of this plan?

Q Yeah. I'm going to come to some questions about the effectiveness. Let's just make sure we understand the program. As I understand your evidence this is a program operated whereby water is released between the 20th of July and the 20th of August to ensure that water temperatures at Finmoore do not exceed 20 degrees; is that correct?

DR. MACDONALD: Correct.

Q Okay. And for whose benefit is this program operated?

DR. MACDONALD: It's to benefit sockeye salmon. I wasn't involved in the history of this, but I understand it was designed to benefit those sockeye salmon that spawn above Finmoore, above the confluence with the Stuart, so that it really -- now, people weren't discussing the lower part of the Nechako and the influence that this program might have on Early Stuart, but as it turns out, it -- jumping ahead here, but it has been beneficial for Early Stuart. It has been beneficial for areas below the Stuart River, as well.

So I believe the design was to deal with Nadina and Stellako fish and not so much the Early Stuart, but any fish that turns left at Prince George stands to benefit from temperature control. I should just remind - in case you're going to take me here - these -- temperatures in this stretch of river, the Nechako and the Stuart, are the warmest temperatures these fish will ever experience in their entire lives. This is the hot spot on the Fraser River. This is the hot spot in their entire four- or five-year cycle.

Q You've conducted some research with respect to the effectiveness of the Summer Temperature Management Program at achieving its target?

DR. MACDONALD: That's correct.

Q I wonder if you can -- and maybe I'll just take you to some of that research, if we can get those papers entered as exhibits.

MR. McGOWAN: Could we go to Tab 4, please, of our documents.

Q As I understand it there's at least two pieces of literature that you were responsible with others for authoring that addressed this; is that right?
DR. MACDONALD: Yes.
Q Okay. And is this one of them we see on the screen now, Examination of Factors Influencing Nechako River Discharge, Temperature, and Aquatic Habitats?
DR. MACDONALD: Yes.
MR. McGOWAN: If that could be the next exhibit, please?
THE REGISTRAR: 1847.

EXHIBIT 1847: Examination of Factors Influencing Nechako River Discharge, Temperature, and Aquatic Habitats - Macdonald et al

MR. McGOWAN:
Q And the second document addresses this, among other things, The Efficacy of Reservoir Flow Regulation for Moderating Migration Temperature, our next tab, for Sockeye Salmon in the Nechako Watershed?
DR. MACDONALD: Yes. This is a slightly earlier edition, but it suffices -- this -- Mr. Commissioner, this paper has been accepted for publication but isn't in print yet.
MR. McGOWAN: If that could become the next exhibit, please?
THE REGISTRAR: 1848.

EXHIBIT 1848: The Efficacy of Reservoir Flow Regulation for Moderating Migration Temperature for Sockeye Salmon in the Nechako Watershed - Macdonald et al

MR. McGOWAN:
Q I wonder if you could please then explain to the commissioner the conclusions you drew from your research regarding the effectiveness of the STMP at meeting its target.
DR. MACDONALD: Well, in a nutshell, it works. And it works because, very simply, if you have a large amount of water, it takes more energy to heat it than a small amount of water. It's just an issue of thermal mass. The more -- the additional water

that's added to the system when it's anticipated the temperatures are going to be warm is enough to moderate those temperatures, even though the temperature -- the water that's being added is often fairly warm, it's been coming in from the surface of -- well, Skins Lake surface of the reservoir and but -- it can be quite warm, but despite that, you just, by having this volume at that time, you are -- you're preventing the water from heating up dramatically. So the STMP has been a success and I sure hope it will continue.

Q In terms of reaching the 20-degree target, does it routinely achieve that target --

DR. MACDONALD: Yes, it does.

Q -- or below the target.

DR. MACDONALD: Yeah. There's times where the 20-degree temperature has been exceeded in days in certain years, but in general it's kept temperatures below 20 degrees.

Q In your opinion does the program benefit sockeye?

DR. MACDONALD: Yes.

Q If we look at historic temperatures that this river may have seen, perhaps even prior to the Kemano project, how do temperatures achieved under the Summer Temperature Management Program compare to that?

DR. MACDONALD: Well, that's tricky. Because we -- to the best of my knowledge we only have three years of data and there's some question just on -- I don't want to suggest that the data is poor quality, but I mean at my age and my ability to look at the data, I just can't be sure how -- what the quality of those data are. So when you actually compare the three years, 1950, '51 and '52 before any actions took place to the rest of the -- to the other years, there is definitely something to be drawn from it. The temperatures back in the early '50s were quite warm. But -- and despite the fact the temperatures, air temperature, for instance, was cooler. But the general conclusions of our research was that more water will keep temperatures lower and that applies when comparing pre-STMP to post-STMP and it also applies to four years of data during which the reservoir was being filled, because when the reservoir was being filled, four years, there was very little water entering the Upper Nechako and

so water levels at Finmoore were very low, but the data from those years would suggest that they're very warm and that's because there wasn't a lot of water in the system.

Q Acknowledging that there are variations from year to year, generally speaking how do the temperatures of the Nechako run under the Summer Temperature Management Program compare to the temperatures of the Stuart --

DR. MACDONALD: Oh, good. Okay.

Q -- flows in.

DR. MACDONALD: Many days, most -- many years, most days most years, the Stuart is a little bit warmer, less than a degree, but a little bit warmer than the Nechako, so the Nechako, before it meets or as it meets the Stuart is actually moderating the temperature of the Stuart. And I've got to be careful here, because there are years where it's exactly the opposite and in almost every year there might be a day or two where it's the opposite, but in general, there is a moderating influence by the Nechako before -- as it hits the -- as it joins, mixes with the Stuart.

Q Okay. What's the Department of Fisheries and Oceans' position on the desirability of continuing the Summer Temperature Management Program?

DR. MACDONALD: They're in favour of it.

Q One of the issues that has been identified - I just want to take you to a document, our Tab 7, and this is a document entitled Nechako Cold Water Release Facility Summary of DFO Position.

DR. MACDONALD: Yes.

Q And I don't know if you can help us date this document. I see at the very bottom it says 2005, so it's a little bit dated.

DR. MACDONALD: Yes. Yeah.

Q Does that seem about right to you?

DR. MACDONALD: That was about the time I was doing this analysis.

Q Okay.

DR. MACDONALD: So it would make sense.

Q And you participated in the production of this document or at least the analysis --

DR. MACDONALD: Yes.

Q -- that fed into it?

DR. MACDONALD: Yes. I did.

Q If we turn to Ringtail page 6, halfway down the

page there's a heading with the letter "B" and halfway down that paragraph the following point is made:

> Additionally, summer temperatures have been set by the agreement to a maximum of 20 degrees C. Research indicates this temperature to be lethal to salmon particularly when the fish have been exposed to these temperatures during a large portion of their freshwater migration. A maximum target of 18 degrees C at locations in the migration corridor where temperature control is a possibility is more precautionary and scientifically defensible.

So let me ask you first of all about the suggestion that 20 degrees is lethal, and we've heard some evidence on that. Can you sort of put that in context with respect to the length of this corridor and the history of migration through this area?

DR. MACDONALD: Yes. Well, I've already mentioned that this is the -- these are the warmest conditions these fish will face. You know, it's a sliding scale, of course. If you go back to some of the work of Rollie Brett in the 1950s, Rollie Brett suggested that anything above 16, any temperature -- fish experiencing temperatures above 16 degrees were actually under stress, so stress will be greater, of course, as temperatures increase and stress is also cumulative. So they may have experienced 20 degrees at the mouth of the river or in Hell's Gate and there may be some other insults and temperatures less than 20 degrees further up the system, might in fact be dangerous for these fish.

But the fact is they can migrate through 20-degree temperatures. If they are in reasonable shape, it's not unnatural for them to be exposed to these temperatures, but you certainly don't want them exposed to these temperatures for too long and your en route loss, that's not -- that's fish that don't escape to the spawning grounds, will increase as temperatures increase. Twenty degrees is -- yeah, I guess what is meant by this paragraph is 20 degrees is arbitrary. If we're

speaking for sockeye salmon it would be nice to see cooler temperatures throughout the Fraser system.

Q All right. So if all one was concerned about was sockeye salmon and it was doable, 18 degrees would be better than 20.

DR. MACDONALD: Absolutely.

Q Are there practical impediments, either associated with the infrastructure or the topography or the geography of this area that impact on the ability to achieve lower targets with the present infrastructure that's in place?

DR. MACDONALD: Yes.

Q I wonder if you could explain those to the commissioner, please.

DR. MACDONALD: Well, there's a limit to the amount of water you can release through the system, to begin with, so -- and I've already mentioned that the temperature of the water that's being released is often fairly close to 20 degrees as it is. So it -- yeah, there's an absolute limit. And sometimes I believe the STMP is doing its very best just to get to 20 degrees in some years, some situations.

Q Is there sort of a holding capacity of the system perhaps related to flood concerns that also impacts on the amount of water that can be released?

DR. MACDONALD: Well, yes, leaving sockeye salmon, then there's a plethora of other interests, stakeholders that have to be considered when it comes to releasing water any time of year in the Nechako but certainly in the summertime and I've talked to you about the Cheslatta system, about its limitations. There's limitations because people have built in the floodplains up and down the Nechako River, including Vanderhoof and, you know, you're walking a fine line when you're releasing water from the Skins Spillway into the Nechako, there are times when there can be too much water, as well, even in the summertime. In fact, some of the releases in the summertime are releases for safety reasons from the dam and not related to water temperature. I think the message I'm trying to make is it's very complicated and you're always on a knife edge as you're trying to manage it from the sounds of it.

Q And I take it given your explanation of the way

the system works, that any water release through the Skins Lake Spillway doesn't go through power generation whereas if it's diverted through the power tunnel at the other end it does?

DR. MACDONALD: Well, and maybe what you're implying is that the water's worth a lot of money and, yes, water that's released in the summertime, you know, creating an unnatural hydrograph is revenue lost because, of course, water is worth a lot of money when it goes out through the Kemano Dam, even if it's not being used to produce the aluminium. Maybe it's being used just to push into the grid it's, of course, valuable.

MR. McGOWAN: If we could go to our Tab 6, please. There's one other issue that's been raised that I wanted to ask you about.

Yes, perhaps we should mark that last document before we move on to it. I neglected to do that.

THE REGISTRAR: Tab 7 will be marked as 1849.

MR. McGOWAN: Thank you.

EXHIBIT 1849: Nechako Cold Water Release Facility (CWRF) Summary of DFO Position

MR. McGOWAN:

Q I'm looking here at an email exchange and I'm looking at the second email as we move down the page, which appears to be an email from you to Jason Hwang. Do you see that?

DR. MACDONALD: Yes, I do. Sorry.

Q Okay. And the commissioner is familiar with Mr. Hwang. He's been here before and will be coming again tomorrow. This is an email from you to him addressing several issues related to the Nechako watershed and I want to go just about six lines up from the bottom to a portion that you've italicized and this is what you say there:

> Temperature targets should not be blindly fixed from year to year but need to be tied (if possible) to conditions experienced en route in the ocean and Fraser River. In high stress years, due to ocean and/or Fraser River conditions, lower Nechako River temperatures should be sought.

I wonder if you can just expand on your thoughts that you're articulating in this email for the commissioner, please?

DR. MACDONALD: Yeah. I'm living in a perfect world. You've heard Dr. Hinch talk about some of the other issues and other parts of salmon's lifecycle and goes through other parts of -- to the oceans and the lower river, and you've heard me mention that stress is cumulative. There -- as we learn more about these fish, as we -- and as we can predict temperatures and conditions that these fish are going to be faced with at the various locations, there's -- we can essentially rank years, based on just how difficult a migration they're going to have. And as I say, in a perfect world, it would be nice to be able to dial the temperature in this portion of the Nechako, and portion of the watershed, the Fraser watershed where we know temperatures are historically very warm, it would be nice to be able to dial that temperature anywhere we wanted, based on what these fish have experienced in other parts of their migration and have a very flexible and sliding management program that would just, you know, be able to adjust its activity to the -- specifically to the year at hand. But it's an extremely difficult thing to do and, yeah, but I think it's still a good idea and it would be a nice thing to have.

Q Thank you. One of the issues that you raised was that the water being put into the system is surface water, so it may not be a heck of a lot difference in terms of temperature --

DR. MACDONALD: Yes.

Q -- than the water that's already in the Nechako.

DR. MACDONALD: Yes. Yes.

Q One of the other issues you raised was the necessity to charge the Cheslatta system and it takes some time for water to get from the Skins Lake Spillway to the Nechako.

DR. MACDONALD: Yes.

Q I understand that one of the solutions that has been considered to address perhaps both of those issues, is the possibility of a deep water cold water release facility at the Kenney Dam. Are you familiar with that issue and the consideration that surrounds it?

DR. MACDONALD: Yes. With the caveat that I'm not an engineer but yes, when I was in the midst of doing this analysis, it was one of the opportunities that was being examined and the idea would be to take cold water from the bottom of the lake, the bottom of the reservoir, and build a water release facility at Kenney Dam, which you remember I suggested -- told you has no water release at this time and release it essentially foregoing the use of the Cheslatta system, and pushing water out through the Nechako from the Kenney Dam. And we were asked with our modelling efforts to essentially -- is the STMP working and can we improve upon it by temperature control in the water and did a lot of analyses on this and the general thought was yes, you will probably be able to control temperature at Finmoore more carefully, more accurately and there's a possibility of getting it cooler but this was the entire program was couched in trying to save water. They called them freed-up flows. We call them freed-up flows, to use at other times of the year. And I've mentioned other concerns. I've mentioned the hydrograph is unnatural. Possibly the water could be released in the -- the water that was freed up could be released in the Spring instead of in the summer when it's normally released if you could release cooler water and less of it.

And our conclusions from our modelling was the actual amount of water freed up was going to be modest, probably less than most of the people that were considering it before they'd done the analysis realized. And so our recommendation was it's a lot of money, a lot of effort and if it's not going to be managed to suit sockeye salmon, it's going to be managed just to free up flows, it's probably not going to save a lot of flows and I had reason to believe that it might even be detrimental to salmon. And I'll go on to that now, if you want.

Q Certainly.

DR. MACDONALD: Okay. Because, keep in mind that the temperature target is Finmoore. Finmoore is above the Stuart. We've said the Stuart is generally warmer than the Nechako. So if we were able to achieve that 20-degree target with less water by releasing cooler water from another facility, we

would actually have less 20-degree water mixing with a warmer Stuart River which would make the Nechako River below the confluence of the Stuart warmer and that's where the Early Stuarts are. So in fact, what we did with our model, we carried on and we said well, we could adjust the temperature target at Finmoore to a lower number to ensure that the water that did mix with the Stuart was keeping -- was moderating the temperature below the dam, and that was just yet another reason why the amount of freed-up flows were going to -- well, not going to be as large as people thought, were actually going to have to specify from the department, was going to have to specify a lower target, which means more water would have to be released.

Do you want me to talk about why less water is -- there wouldn't be the freed-up flows? And get into the fact that, you know, cooler water warms more quickly at a faster rate?

Q Yeah. I think if you can sort of articulate for the commissioner just in a sentence or two the relationship between the flow and temperature and why less water would --

DR. MACDONALD: Yeah.

Q -- necessarily mean cooler temperatures.

DR. MACDONALD: Yeah. You would think if -- you know, there's enough water release in the reservoir to release ten-degree water for 30 days if you wanted, but ten-degree water is going to warm at a more rapid rate than, say 17-degree water. If -- just because of the temperature differential. And also, because you're releasing less of it, you're trying to free up flows, there's a lower volume and I've always -- already talked about the thermal mass and about how it's more difficult to heat up large amounts of water than it is small amounts. So you're releasing small amounts of cooler water. They heat more rapidly and you're going to have to achieve a cooler target at Finmoore anyways, the freed-up flows begin to evaporate - excuse the pun.

So it's -- that was our recommendation and we put it out there for criticism and it seems to have been accepted and people have -- I believe the issue of a cold water release is no longer being considered.

Q Okay. And the research that you conducted with respect to that is set out in one of the two papers we've already entered as an exhibit?
DR. MACDONALD: Yes. Although we -- the nuts and bolts of the model are coming out in a third paper, so --
Q Okay.
DR. MACDONALD: -- and that hasn't been produced yet --
Q All right.
DR. MACDONALD: -- or it's been produced but it's not accepted yet.
Q And that will reflect the --
DR. MACDONALD: Yeah.
Q -- the general tenor of the evidence you've given here?
DR. MACDONALD: Yeah.
Q Through your research and your involvement with others associated with consideration of this project, were you made aware of the approximate cost, recognizing that you're not an engineer?
DR. MACDONALD: Yeah, please.
Q Your approximate cost of deep water release facility.
DR. MACDONALD: It's what I've read. The cold water release, I understand, would cost upwards of $200 million and that's in dollars that are, you know, a number of years ago, so the construction costs have probably gone up and it doesn't necessarily include a whole bunch of additional side projects that would have to take place as well, like -- things like armouring the nine kilometres below the dam so that you didn't introduce a lot of material. Anyways, it's $200 million just to construct the facility with additional costs. These are dated numbers. I should point out, that my colleague, Jason Hwang, is going to be here tomorrow and I think he's trying to get up-to-date figures but --
Q Okay.
DR. MACDONALD: -- I'm ballparking it.
Q Yeah. I'm not suggesting that - and I think you've made it clear - the numbers you're giving are not given with any precision at all, but dated numbers of 200 million plus additional costs gives the -- will put it in -- give the commissioner a ballpark --
DR. MACDONALD: Good.

Q -- to appreciate what we're talking about here. One other consideration that I understand has been tossed around is the possibility of installing a facility at Kenney Dam but not a deep water facility, a surface water release.

DR. MACDONALD: Yes. That's correct, yes.

Q Have you given thought to the feasibility of that sort of a structure or addition?

DR. MACDONALD: Well, yes, I've given thought to it. I haven't done a specific analysis, at least it's not part of these papers, but you could just release surface water, much like you're doing at Skins Lake, only now from the dam and I mean, that has a whole bunch of interesting benefits and potential problems, risks as well. For one thing, you're going to be allowing the Skins Lake system to return to something more natural or possibly, because you can regulate the Skins system with the Skins Lake Spillway, you could, you know, create whatever you want there. You could -- you can manage that system in another way entirely, instead of using it as a conduit for the releases into the Upper Nechako.

So that certainly is a possible benefit and you will be, by releasing through the Kenney Dam, increasing the -- adding nine kilometres of Nechako River stream bed which is now out of action. You'll be adding that to the system. You'll have to be careful because there's a lot of sediment in there, particularly at the Cheslatta Fen. You don't want to just all of a sudden go racing down the system, but there's ways of managing that. So that's a possible benefit.

You'll also be creating, I think - now this needs further testing - but I think you're going to be able to create a system that can get water into your -- during the Summer Temperature Management Program enter water into the river more rapidly, more efficiently, and reduce the lag time that water spends going from Skins Lake to the -- to Finmoore, might be, say, four, five or six days. You might be able to reduce that by a few days. So it might make the system, the whole management program more efficient, which may allow you to save a little bit of water, as well. And by the way, you don't have to surcharge the Cheslatta, so you're saving all the water from

July 10th to July 20th, as well.

There's some hazards here though. At this point, it's quite clear that the Summer Temperature Management Plan, as it's run, is run very conservatively and in a precautionary manner and as a result, the mean temperature is -- most years is quite a bit below 20 degrees. And that's, I believe, because the system is being run in a manner that you don't want to exceed 20 degrees. It's like a one-tail test. You're not allowed to go over, but you're allowed to be as far under as you can be. And because of that, as a result, the temperatures at Finmoore, I think, tend to be quite a bit cooler.

If you came up with a more efficient system, we might actually be able to get much closer to those 20-degree temperatures. The actual mean temperature in any given year might, in fact, be a little bit higher. So we would have to consider that as departmental staff coming up with a management regime with the view to not allowing temperatures below the confluence from getting any warmer than they already are.

Q You haven't done the same type of detailed analysis of the potential viability of a surface water facility that you have for a deep water facility?

DR. MACDONALD: No. There would be some more -- I would feel more comfortable doing more research on that. Yeah.

Q So there's still some information to gather before you can determine where you'd land in terms of an opinion as to the advisability of that; is that fair? I don't want to mischaracterize.

DR. MACDONALD: I think I'm going to go out on a limb and say I think it's probably a good idea from a sockeye standpoint, but the devil is in the details on how it's managed, how it's run. If it's run for the benefit of sockeye salmon and we have to acknowledge that there's many other stakeholders here, but if it's run for the benefit of sockeye salmon in the middle of the summer, either a cold water or a surface water release can be beneficial. But if it's not, it could be worse, it could make things worse.

Q And do you have any sense of what ballpark we'd be looking at in terms of cost to develop that sort

of a facility?
DR. MACDONALD: Well, I checked into that and I believe the latest figure, and this is latest being in the last three or four years, was instead of 200 million it was 85 million or something along those lines. So it's quite a bit of a savings. Again, I'm hoping Jason's going to be able to give you up-to-date figures on that, but it's clearly going to be a lot less money. Yeah.

And there's other issues as well. I should have mentioned you could start generating hydroelectric power from the Kenney Dam, as well, which you're not doing at Skins Lake and recover some of the costs. I should have mentioned that.

Q And again, this is information sort of that you gathered from reading or talking to others?
DR. MACDONALD: Mm-hmm.
Q Just to put it in context.
DR. MACDONALD: It had nothing to do with our study.
MR. McGOWAN: Thank you. Mr. Commissioner, I have maybe another ten minutes of questions, if that. Would you like me to continue or would you like to take a break.
THE COMMISSIONER: We'll take the break now.
MR. McGOWAN: Thank you.
THE REGISTRAR: Hearing will now recess for 15 minutes.

(PROCEEDINGS ADJOURNED FOR MORNING RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: The hearing is now resumed.
MR. McGOWAN: Thank you. Mr. Commissioner, the last exhibit or document that I was referring to was our Tab 6, and I wonder if that could please be the next exhibit.
THE REGISTRAR: Exhibit 1850.

EXHIBIT 1850: Email from John Heinonen to Steve Macdonald re "Nechako monitoring program", June 6, 2006

EXAMINATION IN CHIEF BY MR. McGOWAN, continuing:

Q And if we could have Tab 9, the Policy and Practice Report, pulled up again, and specifically the table on page 71. Now, this is a list that purports to be a "List of small hydro projects in

the Fraser watershed as of September 2010", and I understand the source that was used by the Commission for this was a document which originated from BC Hydro regarding power projects with which BC Hydro has a contract in place. Can you offer any comment on whether we have produced a complete list of power projects in the Fraser watershed, Dr. Bradford?

DR. BRADFORD: I believe it would be worth reviewing the topic. The list changes constantly as new projects are being completed and put on line, and so I think it's worth inquiring and perhaps revising the list somewhat.

Q Okay. Can you offer any information as to whether there may be others that would be significant to sockeye salmon in terms of impacting on their habitat?

DR. BRADFORD: I don't believe so, no.

Q Are you aware, Dr. Bradford, of any independent power projects operating in the Fraser watershed which at present are impacting on sockeye salmon or their habitat?

DR. BRADFORD: No, I'm not. There's some on this list that are in the headwaters of systems that have sockeye in them. For example, Big Silver Creek, but the bulk of the impacts of these systems will be restricted to these headwaters well above sockeye habitat.

Q Okay. When we're talking about independent power projects, sometimes called IPPs, are we primarily talking about the run of river projects that remove water and divert it through a tunnel, and then reintroduce all or most of it back into the system?

DR. BRADFORD: That's the primary model. There are a few others, ones where a tunnel is bored into a lake, for example, and lake water is drained, so you're not diverting necessarily, but that's -- that's the primary model. You take advantage of some steep gradient stream reaches to divert water around those to generate electricity.

Q Okay, thank you. Dr. Orr, I wonder if you would like to address the Commissioner, please, with respect to any concerns you have either about presently operating independent power projects or potential ones which may be proposed for the future, keeping in mind our focus here of course

is sockeye salmon.

DR. ORR: Thank you. I do recall that there were some construction problems on one of the Harrison projects that were highly publicized last year, and some construction failures, and I'm not sure of the extent, or whether -- what the remedies have been on that one. I think one of the things that is concerning about IPP projects is they are dams and they are diversions.

It's sometimes a misnomer to call them small hydro projects. I know some of them proposed for some areas in British Columbia are as large as a nuclear reactor in terms of their output, so they're hardly small hydro. The Ashlu project, for instance, also diverts water for about seven kilometres in a pipe before it puts it back in the system, so some of them are quite large.

I don't know specifically a lot about these projects here, but the thing that has arisen lately is that, well, we seem to have this notion that all these projects are located way up in the upper regions of rivers above, you know, barriers to fish migration and things like that. But that game is changing. We've seen recently the proposals and the licence approvals for the projects that are in anadromous fish habitat. One recently that got a licence is Sedan Creek. It's a tributary of the Skeena above Terrace, and it does have coho and steelhead in it. So I think we're crossing a bit of a threshold. There's also a proposal for the Kokish River on Vancouver Island that has steelhead and coho in it, as well. So these projects are slowly creeping into anadromous fish habitat.

And the thing with IPPs is it's very difficult to assess the impacts. There's no planning process. There's no public input on the siting of these projects. The monitoring programs, while they may be okay, it's very difficult to figure that out because there's not the transparency you have with a BC Hydro water use planning process. And there are impacts from dewatering these systems that we really don't understand. So there's a lot of uncertainty around the impacts of these projects.

But the thing that does concern me is that, as a citizen, I don't know where the next one is

going to go. I don't know if it's going to go in anadromous fish habitat that might affect sockeye or not. So those are the concerns that I would raise at this time.

Q Thank you, Dr. Orr. Dr. Bradford, have you at DFO or others at DFO been involved in assessing potential impacts of independent power projects on anadromous fish, and specifically sockeye?

DR. BRADFORD: We do not have any research projects on that issue, as Dr. Orr mentioned. There are now the beginnings of relatively extensive monitoring programs on some of the projects. The Department Science Branch and Habitat Management has recently evaluated some guidelines for the development of scientifically defensible monitoring programs. So as this is kind of a new industry, it's anticipated that the next five to ten years we'll start to see monitoring results that hopefully will be able to give us a better idea of what the true impacts of these projects are.

Q Thank you. Dr. Orr, do you have anything else to add on the issue of IPPs?

DR. ORR: Well, the thing in monitoring is unfortunately once you know the effects, the project's already built. And so there's no recourse, you know, in terms of fixing the impacts. So the best monitoring program has limitations in terms of what it can prevent if the project is already in place.

And I think the other thing that will probably come up is the issue of flow guidelines. These are just guidelines that are, you know, required for these projects and how much water they leave right now. There's a very rigorous process based on mean annual discharge in terms of how much water fish needed for fish passage, for rearing, that were developed during the water use planning process for BC Hydro, and as far as I know, the same kind of rigorous process is not being applied to run of river guidelines around in-stream flows for fish.

Q Thank you. Dr. Bradford, Dr. Orr has raised a concern about the possibility of some of these creeping into anadromous fish habitat. Would your degree of concern about independent power projects become elevated were any approved to be constructed in sockeye watersheds in areas that

were not above the areas where they spawn?
DR. BRADFORD: I don't know what you mean by "degree of concern".
Q Would it cause you concern if an independent power project were approved to be constructed either below or at sockeye spawning areas?
DR. BRADFORD: Well, these projects create impacts in their systems, and they're different impacts of different fish populations. And so if the regulatory agencies place greater value on certain types of fish or organisms than others, then that would affect their decision-making process.
MR. McGOWAN: Okay, thank you. Mr. Commissioner, those are the questions I have for this panel. Mr. East for the Government of Canada will be next.
MR. EAST: Mr. Commissioner, Mark East for the Government of Canada. I have half an hour, 30 minutes, counsel for British Columbia have kindly given me an extra five minutes if I need it, although I don't suspect I probably will.

CROSS-EXAMINATION BY MR. EAST:

Q One thing I'd like to address first off, Mr. Commissioner, is a preliminary matter, is asking that aren't directly related to today's topic, but I want to take this opportunity of Mr. Bradford's appearance on this panel to ask him some questions about a document that Canada wishes to make an exhibit today. Perhaps if I can ask Ms. Panchuk to bring up Canada's document number 7, please.
Now, this is a document entitled "Annual variation in total Fraser River sockeye productivity", and which I understand there's a similar chart, Mr. Commissioner, in the Commission's October 2010 Interim Report at figure 2, page 124. And I just want to ask some questions of Dr. Bradford about this.
Dr. Bradford, are you familiar with this chart?
DR. BRADFORD: Yes, I am. I created it from a spreadsheet of data provided to me by the Pacific Salmon Commission.
Q And who was it in the Pacific Salmon Commission?
DR. BRADFORD: That would be a Mike Lapointe.
Q Mike Lapointe.
DR. BRADFORD: Chief Scientist.

Q And what does this chart represent?
DR. BRADFORD: It's similar to the plot that the Commission has used previously. On the vertical or "Y" axis is the ratio of number of sockeye salmon returning to the Fraser River, divided by the number of parent spawners that produced it. It represents all sockeye populations returning to the Fraser River amalgamated together, if you like. And the differences between this and the previous plot is that I have taken -- the previous plot was smoothed using a four-year running average, where this plot shows you the annual values. And so in any given year, the value that you have will be dominated by the largest sockeye populations, and it doesn't provide any information on the trajectories of individual populations.
Q And these numbers, are these representing the aggregates of all the sockeye, Fraser River sockeye stocks?
DR. BRADFORD: Yes, it is. It's the sum of all Fraser sockeye returning to the river.
Q So there would likely be variation as between the different runs and stocks?
DR. BRADFORD: Yes, and I believe the Commission has heard evidence on that matter.
Q And at the top right in red it says:

> Note: 2010 and especially 2011 are preliminary.

I assume that means the data is preliminary?
DR. BRADFORD: Yes, you're right. The years are well fixed in the calendar. My mistake there.
Mr. Lapointe has very kindly tried to estimate the productivities based on preliminary results, because this was produced at the end of August when the fishing season was still underway. So the 2010 data point, of course, is dominated by the largest returns that we had last year. But the numbers aren't completely fixed or firmed up yet. For the 2011 data point, that's particularly subject to revision because he was able to kindly make some approximations about the magnitude of the run and the composition of the run and the age structure of the run, which is quite important, and come up with that, that estimate. The

important thing is that in 2011 there are a number of five-year-old fish returning that are actually the older brothers and sisters of the four-year-olds that came back in 2010 and comprise a significant part of this year's run.

And so if I may, Mr. Commissioner, I would advise the Commission to return to Mr. Lapointe prior to the preparation of its report and perhaps get a final revision on those numbers, so that he will have new information in the next six months to enable that to be firmed up a bit more.

MR. EAST: Thank you, Dr. Bradford. Mr. Commissioner, can I have this chart marked as an exhibit, please.

THE REGISTRAR: Exhibit 1851.

EXHIBIT 1851: Annual variation in total Fraser River sockeye productivity, August 2011

MR. EAST:

Q And perhaps we can go to Canada's Tab 8. Sorry, maybe it's -- it's Tab 6. I'm sorry. And I believe there's three charts. Maybe go to the first one. And what document is this, Dr. Bradford?

DR. BRADFORD: This is a spreadsheet of data that Mr. Lapointe provided to me that was the basis for the figure that we just looked at.

Q So if you want to understand how those points in time on that chart, the previous chart, were obtained, this is the data you used?

DR. BRADFORD: That's correct.

MR. EAST: Perhaps if I could have this document marked as an exhibit, too, Mr. Commissioner.

THE REGISTRAR: Exhibit 1852.

EXHIBIT 1852: Fraser River Sockeye Salmon Productivity Information Chart, 2011

DR. BRADFORD: And if I may add, Mr. Lapointe provided the top figure on this panel, which has a red line on it, is the sort of -- has the smoothed running average figure. And so it's the most similar to the one that the Commission used in its previous documents.

MR. EAST: Thank you. So we marked this one as an

exhibit?
THE REGISTRAR: Yes, that was 1852.
MR. EAST: Thank you.
Q And then getting on to the topic of the day, perhaps I can start with going to Exhibit 1848, please, it's Canada's Tab 5. Exhibit 1848. That was -- it's one of the papers -- this one, thank you. Can we go to page 6, please.
And the reason I bring this up, and I just want to ask you some questions about this, Dr. Macdonald. And this is your paper that we marked as an exhibit earlier this morning, and it talks about the relevance, as I understand it, to summer temperatures, if you go to the beginning of the first paragraph, and it just simply states:

> Summer temperatures are particularly relevant during sockeye salmon migrations.

And I just want to get into this paragraph a little bit as an introduction to what I want to talk about. You talk here about the Early Stuarts and some of the other Nechako-related runs, and at line 114 it says:

> These temperatures are the warmest they will experience during their normal four year lifecycle.

And then I want to go down another -- skip a sentence and then to this one:

> The Early Stuart run has had historic runs in excess of 200,000 fish but has experienced an 84% decline in the last 15 years despite a reduction in harvest rate...

And that's a 2006 citation. Is that a trend that you've continued to see up until the present day?
DR. MACDONALD: Actually, I don't feel I'm qualified to analyze that. That was the data that Al Cass and the rest of the Department --
Q Right.
DR. MACDONALD: -- the rest of the Department sampled. But I mean, generally known that the last couple of years sockeye runs have rebounded a bit. But I couldn't put it in context with what I said

before.
Q I guess where I'm going with this is that based on what you say here, and I think elsewhere in your paper, would you agree that the temperatures and particularly high temperatures are particularly relevant to the survivability of these Nechako sockeye runs and particularly the Early Stuarts?
DR. MACDONALD: And by temperatures, you're referring to river temperatures?
Q River temperatures.
DR. MACDONALD: Yeah, absolutely. And the greater the exposure to the river temperature, you know, the greater the issue, I suppose.
Q And one thing you'd mentioned, you talk a bit about in-river mortality. I understand that high temperatures may have an impact on what we call pre-spawn mortality, as well?
DR. MACDONALD: Yes. Mr. Commissioner, you've probably heard Scott Hinch talk about both pre-spawn mortality and en route mortality. There's a -- we make a difference between mortality that occurs en route, before they reach the spawning ground, and the mortality that occurs on the spawning grounds. Essentially the females arrive and they don't spawn. That's pre-spawn mortality.
Q So when we're looking at the subject matter of today, and that's with respect to the hydroelectric facilities, the IPPs, groundwater extraction, is it fair to say that the relevance of these topics have to be understood in connection with some of these other synergistic impacts on sockeye salmon that we've had evidence about earlier, such as water temperature and water flow?
DR. MACDONALD: Yeah, absolutely. It relates back to the habitat that they experience.
Q And when looking at specifically at the 2009 run year, and this is where I'm going with this.
DR. MACDONALD: Yes.
Q Would it be fair to say that you couldn't look at hydroelectric facilities, for example, or these, the subject matter of today's hearings as the single primary -- single or primary cause of the 2009 decline, for example.
DR. MACDONALD: No, I would caution against that. I would caution against looking at any single event as a cause. We're dealing with an ecosystem,

which is a big network of interrelating factors, and anything could upset the balance.

Q Thank you. I'd like to talk a little bit about the -- a little bit more, Dr. Macdonald, about the STMP and some of the considerations around that. And to start, just as a follow-up question from this morning, were there sockeye in the Cheslatta Lake system, or upstream of the Cheslatta Lake system prior to the creation of the Kemano Dam?

DR. MACDONALD: No, not to my knowledge. They didn't get that far up.

Q Perhaps we can go to Canada's Tab 17, please. Now, there's a cover page, a letter to the Minister of Fisheries and Oceans, Gail Shea, but I'd like to go to introducing the document, which is the next page. And I'm sorry, I apologize for the poor quality of the PDF, but I think that was supposed to be in colour. And it's the Kenney Dam Cold Water Release Facility Interim Report, 2002-2007. Do you recognize this document, Dr. Macdonald?

DR. MACDONALD: Yes, I do.

Q And I just really want to go to the "Executive Summary", which is at page 30. And page 30 in Ringtail, sorry. I should say page 30 in Ringtail. That's great. And if we can go down to the bottom, where it starts with "In April 2008", and I just want to read this:

> In April 2008, the NES presented --

- and I believe that is the Nechako Enhancement Society -

> -- presented to the NWC --

- which is explained above as Nechako Watershed Council -

> -- a factual summary of all the technical issues, risks and uncertainties (construction of deep water intake and Cheslatta Fan sediment transport) that remain for a [cold water release facility].

And there's a footnote to this document. Is this document that we have here, is that -- is that the factual summary that we're referring to?

DR. MACDONALD: Yes, in this -- yes, it is.
MR. EAST: Perhaps I'll take this opportunity to mark this as an exhibit, please.
THE REGISTRAR: Exhibit 1853.

EXHIBIT 1853: Kenney Dam Cold Water Release Facility Interim Report 2002-2007 with cover letter from Henry Klassen, Nechako Watershed Council to Honourable Gail Shea, Minister DFO, December 3, 2009

MR. EAST:
Q So continuing on it says:

> Included was a discussion of the fact that ongoing work by DFO suggests that there may be a requirement to define new temperature criteria for that portion of the Nechako River downstream of the Stuart River confluence and that this in turn may result in little or no reed up water being available for downstream enhancement.

First of all, is that the work, this reference to the ongoing work by DFO, is that the reference to the two papers of yours, Dr. Macdonald?
DR. MACDONALD: I believe so, yes.
Q And this is essentially discussing some of the advice that you gave in those two papers?
DR. MACDONALD: Well, and countless talks.
Q Okay.
DR. MACDONALD: Lots out to the NWC and other people.
Q I'm interested in the statement that there may be a requirement to define new temperature criteria for that portion. Is that a reference to what you were talking about, about the location of the Finmore water temperature facility?
DR. MACDONALD: Yes, with great trepidation I open up that subject because it was a lot of gnashing of teeth, I'm sure, when it was decided on -- at the location. So I speak only just from an academic attitude. I have to appreciate that there's a whole pile of politics that goes into to trying to decide where the location should be. So with that caveat, one of the options might be to move the temperature location. And of course you would move it, Mr. Commissioner, you'd move it to below

the Stuart confluence, so that you were now taking into consideration the temperature in the portion of the Nechako that all of those sockeye experience, instead of just the ones above the confluence. And it would assist in -- doing something like that would assist in being very specific about the needs to control that -- the temperature in that portion of the -- the lower portion of the watershed. But it's fraught with difficulties.

And one of those difficulties is the management scheme that would arise would have to consider -- well, I mean, one way or another, regardless of if you were going to use a model similar to the model that's being used now to run the STMP, you would need to consider the Stuart River. Now, the Stuart River is unregulated and the Stuart River has a lake at the head of it. And that means that the management -- or (a) you can't manage it, it's unregulated, and (b) you're going to have to come up with some pretty sophisticated software to really do a good job of long-term -- getting long-term predictions. And that might just be insurmountable, or it might be possible, but it makes for a much more complicated management scheme.

So an alternative might be to continue using the Finmore location, but use the Finmore location as a target with an understanding that whatever's happening at Finmore is affecting the area down below the Stuart, and that you want to set your target at Finmore, such that it takes into account, you know, issues from the Stuart. And we tried to do that. And it's not published, it's not part of the exhibits here, but we have a paper and some analyses where we try to set new temperature targets that would be precautionary and would consider historically what we know the Stuart to do. But it's not a bad idea, but I do acknowledge that it's going to take a lot of -- a lot of work before we could actually get it into operation.

Q Thank you, that's helpful. I want to jump to another, a similar topic. Perhaps we can go to Exhibit 1849, please, and page 8. And this is a document that Mr. McGowan talked -- raised with you this morning, and there's something in here

that I just wanted to ask you about. If you go to the paragraph that starts with "Departmental experts", and on the fifth line down there's a sentence that starts:

> As requirements for migrating sockeye, juvenile chinook and spawning sturgeon are not mutually compatible; a plan to examine the water temperature issue will be developed in cooperation with Science and the Province in order to set out fish requirements.

Now, I believe we've heard some testimony this morning that the STMP was designed for the benefit of sockeye salmon. Can you talk a little bit about some of the other, I guess, biological interests that are present in the Nechako River and watershed that may be affected by these ideas.

DR. MACDONALD: And, yeah, and the sturgeon is probably paramount to some of those other biological concerns. When I began -- when we began this analysis that it was -- we had the Province talking to us about using some of these freed-up flows to create a more natural hydrograph because they felt that it might have some benefit for sturgeon. Now, not a lot was known about sturgeon at that time, and I don't think a lot more is known now. Except that the sturgeon are -- the sturgeon populations are drastically reduced from historic levels in the Nechako River, and it's felt that it's got something to do with their inability to spawn and/or the survival of the juveniles. There are some efforts with a hatchery to restock sturgeon into the -- into this area.

But one of the hypotheses was that if you could return the Nechako hydrograph to something closer to natural, in other words, a hydrograph that had a peak somewhere in the springtime associated with snowmelt, as it was historically, you might be giving the cue they need to actually -- to spawn, or you might be assisting the juveniles from finding the habitat they need to find at the correct time of year. So it's an issue of trying to create something more natural and seeing if it -- if it benefits these fish.

So that involved freed-up flows, because we can't create more water, in fact. Yeah, there's

the historic, last two years, a suggestion that there's less water in the Nechako watershed than there was in the past. We had to come up with the water from somewhere, and this led -- was one of the reasons for looking at possibilities of freeing up flows from the less natural hydrograph that's been created by the STMP. So that was certainly one of the possible benefits and it's one of the concerns.

Would you like me to mention the concern about cold water, even though cold water release is probably a dead duck right now? I mean, there is a possibility -- we were concerned about releasing extremely cold water into the upper part of the Nechako watershed, as well, because that would definitely without any question, lots of literature to support us, would have huge impacts on the ecosystem. So even if you could come up with a coldwater release that, you know, benefited sockeye salmon, you might be causing problems for bull trout, for rainbow trout that live in the area, insect production, things like that. So that was another consideration.

We've talked about the Cheslatta, the restoration and how we're concerned about just the magnitude of the changes that have occurred to the Cheslatta and how a change in the way the management program is run and where the water is released might affect that. We talked about flooding.

The point is, there's a large number of stakeholders that have an interest and some of those include, you know, fish that we're trying to protect, such as sturgeon.

Q Yeah, and I just want -- and so to sum up, there's a wide range of policy, economic and biological factors beyond the preservation of sockeye salmon that would have to be considered in these decisions.

DR. MACDONALD: That's correct.

Q Do you, it strikes -- it strikes me in this testimony and reading the material that managing the Nechako flows to 20 percent at Finmore --

DR. MACDONALD: 20 degrees, yes.

Q -- to 20 degrees Celsius is a fine art with some rather -- perhaps with some rather blunt instruments. And I'm wondering if you could -- if

you have the data and the ability to get the data that you need to be able to manage that system a little more efficiently. If you could talk about that.

DR. MACDONALD: A blunt object. The model that's used by Rio Tinto is actually a fairly sophisticated model, and in fact we duplicated the philosophy of that model when we produced some of our research. It's fairly sophisticated.

But I know what you're suggesting, and there was -- despite the interest in this area over 60 years, one of the things that struck me as we began to try to analyze these data, was just how difficult it was to get assurances that some of the data was of a high quality, and how difficult it was to get data from certain places that it would have been very nice to have data.

Now, I didn't expect the pioneers in the area to be running around putting in thermographs in the 1940s and '50s. That would have been nice, but that's not what I'm talking about. Early data before the activity took place would have been valuable, but it hardly exists. But there was cases where you would have three or four years of data from an area that you would really like to examine, and then the data collection would cease. Or you might have some data over a long period of time, but you weren't sure of its quality.

An example might be Isle Pierre, which is a location below Finmore and below the confluence of the Stuart, which would have told us a lot about the actual functioning of the Nechako River with the Stuart on the lower Nechako, as opposed to mixing models that I was creating to try to recreate it. Out of 49 years we had 19 years of data. Just a tantalizing amount of data, but really not enough to do a thorough analysis, and some of those data were not the sort of data that I had enormous confidence in.

For some years during the STMP, the Finmore data just stopped at August 20th. So we weren't, I mean, it would seem to me that it would have been wise from the very beginning to have data year round from Finmore. And that might have been that I just wasn't able to find the data, that it does exist, but a lot of energy went into looking for data.

So my recommendation, I guess, and I'm on my soapbox here, is that if we have an opportunity in the future throughout the Fraser system, for that matter throughout British Columbia, we need to put more time into the monitoring and the collection of some of the key habitat characteristics, such as temperature and flow, that we need. And we have them from some places, certainly Water Survey of Canada data is reliable, but there's other places where we just don't have the data that we need. There's not a lot of glory in collecting data, but people that want the information that's being presented to you today must realize that the people out there doing the data logger work and sampling and making sure the data is protected and in good shape are doing us all a great favour, and it's often overlooked.

Q Thank you. I'm going to give you now a rest, Dr. Macdonald, and I want to ask a few questions about the Bridge-Seton project. And if I may, Dr. Bradford, I just want to ask one thing I just want to close a loop on this morning. Perhaps we can go to the PPR21, paragraphs 123 and 124, and I think that's at page 51. Now, there was some discussion this morning, Dr. Bradford, about difficulties of adult salmon getting past the Seton Dam. I guess what was left unsaid was has there been any -- how significant are these problems with adult salmon migrating past the Seton Bridge Dam and for the smolts that come downstream, notwithstanding the difficulties you mentioned, have fish been able to get to the spawning grounds and back?

DR. BRADFORD: Yes, certainly there's been a number of studies that evaluated the stresses associated with migrating up through the fish ladder, finding the fish ladder and that sort of thing. But the runs have shown that Portage Creek and Gates Creek salmon runs have shown similar patterns in their trends of abundance to the other salmon stocks. So it's not a situation where a stock has become imperilled by the presence of that dam. And in the case of the downstream migration, I think the recent actions to not generate at night, I think has reduced the mortality down to very low levels. So I don't think that again it's a situation where they're causing the runs to be imperilled.

Q And at paragraph 123, and the reason I raise this, there is a reference to a 2008 study, and I'll just read it:

> ...a 2008 study raised concerns that the tailrace may still attract and delay sockeye, even under guideline dilution conditions.

And in the previous paragraphs there's discussion about what you had testified to, about diluting the water to allow fish to be able to smell their way up to the dam. And it talks about:

> As this finding was based on a small sample size, the authors recommended further research to follow up on the results.

The next paragraph then in a little more detail, and I just want to explore a little bit about your thoughts on the work that was done.

> If sockeye successfully pass the tailrace and enter the Seton River, they must then travel five kilometres to the Seton Dam and ascend the fishway before migrating through to Seton Lake. The 2008 study found that 20% of adult fish re-released downstream of the dam (i.e., fish that had prior experience entering the fishway) failed to traverse the fishway a second time.

And I just want to stop there. So as I understand it, 20 percent of the fish that had ascended the fishway were trapped on the fishway, were they, how did the -- what happened, how did that study work?

DR. BRADFORD: Right. I think there's a more recent study just come out that's similar in nature. But basically the researchers, these are the UBC group, were able to capture fish at the top of the fish ladder, so they've already migrated up the Seton River and up the fish ladder, and then at that point they take them, they implant them with a tag that sends out a signal, takes some measurements of the fish, and then put it in a container, truck it back down and let it go again, and it has to of course to go through this whole

process a second time.

And we're learning that the handling of migrating salmon for tagging studies, telemetry studies and that kind of thing, always stresses the fish. And so you have to always be very careful about interpreting these results, because you're asking a fish to go through it a second time after it's been poked and prodded. And as Dr. Macdonald mentioned, the issue of cumulative stress during this very stressful time could influence the study -- well, what the fish end up doing, and then consequently affect the conclusions of the study.

So if I may, on the previous point, regarding the tailrace, I think they found that some of these fish went right down to the Fraser River and had difficulty finding their way back up. And what the issue really, and it's very difficult to unravel, is how much of that was due to the fact that they had already made it through successfully but then had been handled and set back, essentially, and it may have been too much for them.

Q And I guess to leave it, just to be fair to the people doing the study, did they -- they at least raised some issues that perhaps merit further study, would you agree?

DR. BRADFORD: No, and I think that's appropriate. Yeah, they recognize, everybody recognized that these handling issues are severe in some cases.

MR. EAST: Those are my questions, Mr. Commissioner.

MS. CAMPBELL: Mr. Commissioner, I'm Karen Campbell, and I'm here on behalf of the Conservation Coalition. And I see I've got 35 minutes allocated, so I'll just get started now.

CROSS-EXAMINATION BY MS. CAMPBELL:

Q One of the issues that we talked about quite a bit already is the issue of water flow. Ms. Panchuk, I'm wondering if you could bring up Conservation Coalition document number 1. It's a glacier modelling study by Stahl. And I'd like to turn to page 11 of it, paragraph number 42. So this is a study that's been completed and one of its conclusions is that:

> The model results revealed that the Bridge Glacier is significantly out of equilibrium with the current climate, and even when a continuation of current climate is assumed, the glacier area decreases by 20% over the next 50 to 100 years.

Dr. Orr, I'm wondering if you might be able to comment on the specifics of this study and how glacier retreat could impact Fraser River sockeye.

DR. ORR: It might be hard to make that complete of a connection on glaciers. But I think the point here is one of the things we were talking about today is temperature and water stress, and we were talking about it in a bit of a static sense. We've seen the Fraser River warm up, and Dr. Macdonald is certainly the expert on that, but something in the order of almost two degrees in just a couple of decades. But we're also seeing because of climate change, which is the culprit fingered in this paper, a shrinking of glaciers, which then decreases stream flows into important sockeye systems like the Bridge River, and this presents a lot of uncertainty around the availability of water and what it might also do to temperatures over the next little while as these glaciers continue to shrink. So the point is it's just not a static situation.

And at the same time that these -- you know, these glacial-fed rivers are shrinking, there's increased competition for water, as we've heard, for industry, for, you know, Alcan, for development, for agriculture and for ranching, so we just have to keep all these things in mind in terms of the big picture.

MS. CAMPBELL: Thanks very much. Can we have that document marked as an exhibit, please.

THE REGISTRAR: Exhibit 1854.

> EXHIBIT 1854: Stahl et al, Coupled modelling of glacier and streamflow response to future climate scenarios, 2008

MS. CAMPBELL: Thank you.

Q I'd also like, on the theme of thermal stress, I know that the Commission has heard about some of the effects of climate change through Dr. Hinch.

There is a document that we'd also like to introduce. Ms. Panchuk, could you bring up the Conservation Coalition document number 2, please. It's a study from the Global Change Biology Journal by Dr. Hinch. Dr. Orr, are you familiar with this work?

DR. ORR: I am.

Q Do you agree with the conclusions in this study that the survival of adult migrating Fraser River sockeye will decrease as the climate warms?

DR. ORR: I do.

Q Do you think that there's any other conclusions in this study that are important to Fraser River sockeye?

DR. ORR: Yeah, I think -- I think there are some important conclusions here, and one of the things that Dr. Hinch has really -- and his colleagues have really started to unravel is the issue that not all sockeye are created equal. I think he's shown that very, very clearly with Chilko sockeye. He calls them the super sockeye of the Fraser River with the largest bodies, the largest hearts, and they have probably the highest temperature tolerance of any of the sockeye. So what he's -- he's finding, and he started unravelling this during the last review of sockeye disappearance. In 2004, of course, we lost 1.3 million sockeye en route and in-river, and he presented a lot of evidence at that time to the review panel, that suggested thermal stress was the culprit in a lot of this loss. But he's really accelerated his research and that of his -- you know, helping his graduate students along, looking at stock-specific tolerances to temperature differences.

And so just a few minutes ago we saw a graph on productivity, for instance, on how things have rebounded in productivity in 2010. But you have to keep in mind that that rebound was caused mostly by one stock, the Adams River stock. And, you know, if we're really paying tribute to the Wild Salmon Policy in trying to preserve the diversity of all these fish, all these stocks of sockeye in the Fraser River, you know, we can't just consider averages, and that are brought up by certain robust stocks of sockeye. And we have to look at, you know, the survival based on all these stressors of the full suite of sockeye coming back

to the system.

So I think Dr. Hinch has portrayed that very well, and he's even taken us a little bit further and shown that some of these fish can actually recover a bit when they go through a cold water fusion area like a lake, and then -- and come out of it the other end on another river.

Q So you're of the view that a one size fits all approach to salmon recovery is not the way to do it.

DR. ORR: No, it's not going to -- it's not going to get us there and it's inconsistent with the goals of, you know, the Wild Salmon Policy in terms of preserving genetic diversity.

Q Thanks very much. Another one of the issues that Mr. McGowan touched upon a bit was the issue of groundwater. And I'm wondering, Dr. Orr, if you might be able to comment on some of your scientific work on groundwater issues in and around the Fraser.

DR ORR: Well, we're mainly neighbours in terms of science research. And so we've been able to work with some experts around the Fraser basin, we've spent quite a bit of time working with Dr. Diana Allen, who's a groundwater expert at SFU, and one of her graduate students, and we were able to get some money from the Fraser Salmon and Watershed Program to look at the importance of groundwater -- sorry, groundwater to cooling streams and improving flows in a couple of small rivers in the Abbotsford area, that actually flow in the Nooksack River, so not into the Fraser. But we did some support of the research that Dr. Diana Allen did, and what she found was that one of these systems had riparian cover, so shade over it, and the other one had groundwater influence, and their research found that the groundwater was far more beneficial in terms of cooling the stream than the riparian habitat. So that was an important study, and I think --

Q Where was this work done, sorry?

DR. ORR: This was done in a couple of small streams in the Abbotsford area.

And the other research that we've helped support has been First Nations-driven research, Shuswap Nation in particular, but working with several other First Nations. And they got very

concerned when DFO biologists in Kamloops area started documenting thermal stress on chinook in the Coldwater River, and they also, the biologists there, looked at stress on juvenile fish. And what this biologist found, Richard Bailey, was that these -- he saw juvenile coho with their noses poked in the gravel in the river systems there, and they were poking their nose in the gravel where the groundwater was welling up from, you know, from below, and so the groundwater connected to the streams. And he figured that the thermal stress was such that this colder oxygenated water was the only thing keeping these coho alive.

So several of the First Nations through funding of the Fraser Salmon and Watershed Program again have been studying the habitat selection of juvenile coho salmon, and they have found it correlated with groundwater infiltration into the Nicola system in particular in the Fraser. So we've supported that in kind and financially over the years.

Q And so in terms of the synergistic look at things, if we've got water losses in other parts of the system, the importance of groundwater goes quite up, quite high up in terms of where we should be looking at (indiscernible - overlapping speakers).

DR. ORR: Absolutely, and we've heard a lot of testimony today, you know, from the other panellists on the importance of groundwater. It is really the key to resilience of the salmon habitat. And resilience, you know, in the simplest sense is just how close the system is to crossing a threshold where it's not likely to get back, and it's usually into a degraded state. So the groundwater that, you know, we do know in those systems, as Dr. Macdonald has described, keeps the temperatures and flows moderated year round. It doesn't change in its temperature very much, and so it's really important in both the winter and summer.

But right now, it's under a huge amount of stress because there's no protection for groundwater, and there's -- because all the surface water is taken already in those systems, people are now drilling wells right next to streams in these bedrooms of the salmon, and

extracting it with absolutely no regulation going on and how much they're extracting, and it's actually imperilling the link between groundwater and stream flow and temperature right now.

Q So is there any groundwater regulation in British Columbia right now?

DR. ORR: At a very basic level, for extremely large extractions, I believe I mentioned before. I think the threshold now is 75 litres per second, and there's a few experimental areas where they've looked at, you know, getting community governance structures in place trying to protect groundwater, but I don't know how far those have gone. But right now there's no regulation to licence groundwater extractions, and that is being considered in the ***Water Act*** modernization, although I just do not know where it is at this point.

MS. CAMPBELL: So on that note, I'd like to go back to the documents, and I realize I forgot to ask to have the Hinch report entered as an exhibit. If we could do so, please.

THE REGISTRAR: Exhibit 1855.

EXHIBIT 1855: Martins et al, Effects of river temperature and climate warming on stock-specific survival of adult migrating Fraser River sockeye salmon (*Oncorhynchus nerka*), 2010

MS. CAMPBELL: Thank you.

Q And I'd like to turn to Commission document number 16, which is the British Columbia's ***Water Act*** Modernization, and it's a policy proposal for a ***Water Sustainability Act*** for the Province. And on page 9 of that document, there is a part on policy direction number 3, which is to regulate groundwater use in British Columbia. And the gist of this is that the Province is proposing that:

> Groundwater extraction and use will be regulated in problem areas and for all large groundwater withdrawals...

Dr. Orr, as a biologist, I'm wondering if you could comment on whether this policy proposal would be adequate for protecting Fraser sockeye?

DR. ORR: I've already commented publicly on this in opinion pieces in the *Vancouver Sun*, so I'll be consistent. There has to be blanket coverage, and it can't just include problem areas and for extremely large groundwater extractions. We've spent a bit of time talking about cumulative effects, and, you know, the cumulative effects of many wells, especially around streams and in water stressed areas is going to add up to a very large problem. So we've been advocating, Watershed Watch and others, have been advocating for consistent groundwater protection, licensing of all groundwater wells that are drilled in British Columbia.

MS. CAMPBELL: And I'd like to ask that this document be marked as an exhibit, as well, and I'll be referring to it again in a moment.

THE REGISTRAR: Exhibit 1856.

EXHIBIT 1856: British Columbia' ***Water Act*** Modernization, Policy Proposal on British Columbia's new ***Water Sustainability Act***, December 2010

MS. CAMPBELL: Thank you.

Q I'd like to talk a little bit more about the in-stream flow and the environmental flow issue. Dr. Orr, is it our understanding that in-stream flows are tracked and monitored in the Fraser River at all?

DR. ORR: Only at the sites that have had water use planning in a consistent way, the BC Hydro sites. But I know there is some monitoring at the IPP sites, although I'm not privy to those data, so I don't really know how effective the monitoring is. In terms of stream flows, there are some river gauges around. You know, we have river forecasting, as well. So there is some monitoring, but it has a lot of holes in it.

Q And at this time there is, to your understanding, the public doesn't have a good understanding of the flow levels in the Fraser River?

DR. ORR: Well, I think the issue is more -- not necessarily our ability to understand it, it is our ability to control those flow levels in these systems, and especially I raised concerns before about IPPs. You know, those are just guidelines

that I understand are negotiated quite a bit between proponents and regulatory agencies, and in fact there may be some agreements to extract more water if there's more mitigation promised for a certain project.

So right now we have some guidelines that are available, and guidelines aren't necessarily the most rigorous way of protecting in-stream flows.

Again, we learned a heck of a lot during the water use planning process on how you actually provide flows, based on mean annual discharges, and the various life history needs of fish, including spawning, rearing, passage, things like that. That's the kind of system that would give a lot more rigour to protecting water in streams, you know, the proper stream flows for salmon. But we do need to go beyond that, as well, and we need to go to environmental flows, I think, instead of just looking at stream flows. And that includes wetlands, it includes charging aquifers, it includes looking the ecosystem as a whole and we are just nowhere near that at this point.

Q I'd like to take us to Conservation Coalition document number 17, which is the Watershed Watch Salmon Society Brief on ***Water Act*** Reform. Dr. Orr, you know this document?

DR. ORR: Yes, I do.

Q I'm wondering if you might be able to comment on some of the issues that you're trying to address in the recommendations that the Watershed Watch Salmon Society made to the B.C. Government for ***Water Act*** reform, as they related to Fraser sockeye.

DR. ORR: The two particular issues, I believe the ***Water Act*** reform now has seven themes which I'm not going to go through all those themes. The two themes that we're particularly interested in are in-stream flow needs for fish, in particular, or environmental flows as I've just expanded on, and more adequate groundwater protection.

The ***Water Act*** is 100 years old. It doesn't consider environmental issues. And, you know, it's antiquated. Give a lot of credit to the Province for going through a lot of consultation around how to reform the ***Water Act***. We don't know exactly where it is at this point, but we do need to get into this current century. The laws in

British Columbia are antiquated with regards to protecting flow needs for fish. Fish have no rights to water whatsoever in British Columbia at this time.

So we need to give more consideration, and we've limited our comments to better protection provision of in-stream flows, adequate in-stream flows so that fish can be sustained in all river systems, and the protection of groundwater, recognizing its critical value to salmon. It's harder, quite frankly, to prove the value of groundwater to sockeye, except in some of these systems that we've heard about, like the Stuart system. But in terms of the full suite of salmon, we need to do a much better job at licensing and protecting groundwater.

Q And so one of the issues that you've talked about in this brief is the issue of the in-stream flow guidelines, and I'm wondering if you can --

DR. ORR: Correct.

Q -- give a sense of what some of your recommendations are to strengthen the in-stream flow guidelines.

DR. ORR: Yeah. I think we need some regulations instead of guidelines. I've struggled with guidelines for all kinds of habitat protection, protection against aquaculture impacts over the years, and guidelines are guidelines. Self-regulation is an uncertain thing to actually work, and I think we need more rules, hard and fast rules about what kind of flows we should be providing for environmental services, and that goes beyond just the fish themselves.

There needs to be more transparency, the kind of transparency we had with the water use planning process, and we had very rigorous technical committees that met. And I'm not saying that the technical committees providing advice, and I think there is one for DFO, aren't doing their job, but we just don't know. The water use planning process had a technical committee with First Nations technical advisors on it. It had a water use planning advisory team that had federal, provincial and BC Hydro biologists, and when they had a problem on entrainment or in-stream flow needs, they put their heads together, they did reports, they were passed around to all the water

use planning tables, as guidance on how to set flows in the various systems, and they had rigorous reports based on mean annual discharge. Far more transparent rigorous process, and we're not seeing that applied outside of the water use planning process in British Columbia right now.

Q Great, thank you. And I note the time, so I've just got one more question before the break. Do you know when the ***Water Act*** modernization began?

DR. ORR: I'm not sure when it began. I know when the genesis, you know, the genesis I do recall probably about five years ago standing on the banks of Musqueam Creek out in the Musqueam Reserve when the Living Water Smart Program was announced. It was certainly something that Gordon Campbell, the Premier at the time, was pushing. And he promised a vision of water laws to include some of the environmental issues that we're talking about today, and that morphed into the ***Water Act*** Modernization Program where we revisited the ***Water Act***. So I think the consultation and the planning has been going on for three to four years on that right now.

Q So you've been working for quite a number of years to help strengthen the ***Water Act***.

DR. ORR: Quite a number of years, quite a few consultations, quite a few briefs, quite a few meetings with colleagues, and also with government. And at this point again we're in the dark as to where it is, and there's been several delays in putting it into legislation.

MS. CAMPBELL: Mr. Commissioner, I see the time, and I can continue now, or I can pick up after.

THE COMMISSIONER: No, that's fine. Thank you very much.

MS. CAMPBELL: Thank you.

THE REGISTRAR: The hearing will now adjourn till two o'clock.

(PROCEEDINGS ADJOURNED FOR NOON RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: The hearing is now resumed.

MS. CAMPBELL: Good afternoon, Mr. Commissioner.

CROSS-EXAMINATION BY MS. CAMPBELL, continuing:

Q I think I'm going to pick up pretty much from where I left off right before the break. At that time we were looking at Conservation Coalition document number 17, which is the Watershed Watch brief on the ***Water Act*** reform.

Dr. Orr, we'd talked just a little bit about the gist of what you have said you'd like to see in a reformed ***Water Act***. I'd like to go to page 4 of the document, and in the middle of the page, the part where it begins, "Serious Gaps in Public Participation Exist," in this brief your organization has said that there's:

> Serious gaps in public participation exist [regarding] in BC's water management framework:

Including lack of public participation opportunities that exist elsewhere, low participation in appeal processes, and that because:

> As groundwater is not licensed, there are only very minimal opportunities for public participation in the rarely used environmental assessments of major projects.

Dr. Orr, there are situations where you would have provided input to decisions that would be made in and around the Fraser River watershed if you had been provided some notice?

DR. ORR: Absolutely. Water river projects, there was a fairly large one proposed for the upper Pitt River which is obviously an important sockeye tributary in the Fraser River, and we didn't have much input in the siting of that project, or potential siting of that project or a lot of the other ones.

I think we have no say whatsoever now in terms of groundwater extraction. There are lots of concerns with the status of how much water is -- sorry, the status of aquifers in the lower Fraser and how much water is being extracted from the aquifers and there's really not much public participation in that.

The Run of River projects, again, I guess it's Bill C-30 that the government came up with which limits the right of the public to object to or even have much say in the siting of major projects like Run of River projects, so those are some of the concerns.

Appeal processes, we've made comments on many environmental assessments of major projects over the years and it feels like a futile exercise sometimes, because these projects are never turned down, and they're never fully evaluated either. One of the real shortcomings is cumulative effects assessment of major projects. It just doesn't happen to any kind of rigorous degree. We've been so frustrated over that.

We've actually had some workshops with First Nations, like Sto:lo First Nation, on how to actually improve cumulative effects assessment in the planning of Run of River projects in their territory. So some people share the lack of public participation frustration that we've sort of outlined in this document.

MS. CAMPBELL: Great. Thanks very much. Could we please mark that document as an exhibit as well?

THE REGISTRAR: That's Tab 17, 1857.

EXHIBIT 1857: Nowlan and Orr, Brief on BC Water Act Reform - Submission to Province of BC on Water Act Modernization, April 30, 2010

MS. CAMPBELL:

Q I'd like to talk just a little bit more about IPPs or Independent Power Projects.

MS. CAMPBELL: I'm wondering, Ms. Panchuk, if you could bring up Conservation Coalition document number 10.

Q Dr. Orr, you touched on this already. This document, are you familiar with it?

DR. ORR: I am.

Q It's a letter that you received from DFO regarding the Kokish River project. I realize that the Kokish River is on Vancouver Island, but I'm wondering if you might be able to provide some comments on your sense of what this letter is telling you?

DR. ORR: It sheds light on the problems with the -- the way that these projects are licensed and

mitigated, I suppose, the process. Mainly, an IPP project is put forward, it's reviewed by provincial biologists and they use flow guidelines that have been developed. There is, from what I understand, talking to some of these biologists, some negotiation back and forth on what those flows should be. In general, they're probably not quite as robust as I've already said we've seen in Hydro water use planning process based on the life history needs of fish.

But I think this letter illustrates a couple of different things. First, our frustration in seeing projects now being located in anadromous fish habitat. Again, the traditional understanding from a lot of folks was that these projects are located above the upper reaches of rivers, and although there are downstream effects which when you start putting a bunch of projects in the upper parts of rivers, which we still don't have a good handle on, the immediate concerns are manifested several times over when you start locating projects in anadromous fish habitat.

But we appealed to the federal regulators on this one for a specific reason: Because they have a role in suggesting mitigative measures, or ways of trying to deal with some of the known or potential impacts from these projects. In this particular project, there was a plan that we did review that was put forward by the proponent where they were going to try and recreate some flows that they thought would help fish in the system. But we talked to some provincial regulators on this one and they didn't believe that those flows could be recreated because there wasn't sufficient storage above the dam to recreate those flows.

So we just put the onus back on the federal regulator in this one and asked them if they could actually mitigate the kind of damage that this project was likely to have. To this point, I don't believe that they're able to do that, and so we just wanted to put that on record, because it's a common problem. Mitigation is quite often ordered for habitat damage, and I do believe in terms of DFO's no net loss policy -- which is an amazing policy, it's a great policy, but it's just not working and we heard that from testimony in the past as well.

Q Given the approach that DFO's taking in the Kokish River situation, are you confident that risks to Fraser River sockeye would be mitigated if a similar project was to proceed in the Fraser?

DR. ORR: Not for a similar project. But again, I said earlier that we just don't know what's being planned in a lot of these projects. It's very difficult to figure out. There's no planning process, so I can't go to some master planning agency and they can't tell me where these projects are going to be located, whether there's sensitive areas, whether there's any way of making sure projects aren't located on specific and sensitive streams or rivers, or whether there's not a clustering of projects in a certain area, which is another concern.

So it's very difficult to sit here and say that we can deal with these kind of projects adequately when there's no planning process whatsoever in British Columbia.

Q I think you've spoken about this already, and I know you've got some experience with water use plans in the B.C. Hydro context. Do you think that a similar approach would be useful for IPPs?

DR. ORR: Absolutely. When we did the recommendations for clean energy development with some other NGOs, we talked about the need for a planning process, and it would certainly increase transparency. It would increase public trust. It would allow us to set aside certain areas that need to remain special, just like Norway has done for parts of its coast, from salmon farms.

Those kind of planning processes need to happen and there needs to be public participation and transparency in the whole process. Right now, there's none of that.

MS. CAMPBELL:

Q I've got one last document that I'd like to bring up and it's Conservation Coalition document number 8. It's the Recommendations for Responsible Clean Electricity Development in B.C. Doctor, are you familiar with this document?

DR. ORR: Right, I think I just sort of gave it away.

Q Yup, you did. What was the goal of the groups who signed onto this document, in putting it together and sending it to the government?

DR. ORR: Well, I think the goal was try to bring a

little bit of sanity into the development of clean energy in British Columbia, and I don't believe any of the groups that signed it are opposed to clean energy development, but they want to know where these projects are going to. They want to know that they're put in with the least amount of damage.

I'm a salmon conservationist, so there is some alarm when you start diverting dozens and dozens of rivers, and many hundreds have been actually prospected for development of Run of River power in British Columbia.

But again, people wanted some say in advancing this document and where they're placed. They wanted to make sure there was a technical process in place. They wanted to make sure that there was a need for energy. For instance, we're paying very high rates for those projects for export for surplus power, and there wasn't any indication at that time that that was actually needed.

So there wanted to be -- there was a request to make sure that there was a need for this. I know that California was looking at importing a lot of the power that was developed in British Columbia, but they eventually decreed that it wasn't green power, so they abandoned that plan.

So trying to get a little bit of transparency, some planning, some democracy in the process for development of power. Maybe there's some areas where wind power, for instance, or geothermal power is a better source, better mix, and it has less impact on wild areas and wild fish. But that kind of process is not in place in British Columbia

Q Thank you. And, Doctor, are you opposed to independent power projects?

DR. ORR: Not at all.

MS. CAMPBELL: I'd like to mark that last document as an exhibit and I have just been reminded graciously that the previous document, the Kokish River letter has also not been made an exhibit, so if you could mark that as well, please.

THE REGISTRAR: Well, your Tab 10 will be 1858, and Tab 8 will be 1858.

MS. CAMPBELL: Thank you very much.

EXHIBIT 1858: Letter from Antcliffe to Orr, Kokish River and DFO's approval of diverting water from anadromous fish habitat, Aug 25, 2011

EXHIBIT 1859: Suzuki Foundation et al., Recommendations for Responsible Clean Electricity Development in British Columbia, Dec 17 2009

MS. CAMPBELL: My time is almost up. I just have a couple of more really quick questions and then I'll be done.

Q Dr. Macdonald, you've identified that the Fraser River is warming. Do you see these warming trends continuing?

DR. MACDONALD: Yes, there's evidence that these warming trends will continue.

Q Under what circumstances do you think these warming trends might change and stabilize?

DR. MACDONALD: Oh, that's an enormous question.

Q I'll ask a more specific one. Is there a federal climate change program that you know of that might make a difference to the situation?

DR. MACDONALD: You're getting out of my area of expertise, I'm afraid.

MS. CAMPBELL: Right. Thanks very much.

Q Dr. Bradford, what might happen to the Early Stuart sockeye if groundwater was no longer flowing in the region?

DR. BRADFORD: Well, clearly, the incubating eggs in the gravel will be at peril of freezing solid in that part of the world if they weren't irrigated by groundwater.

Q Right. Thanks very much. And, Dr. Bradford, or perhaps Dr. Macdonald, we've talked a bit about how surface water withdrawals are expecting (sic) in-stream flows. Does DFO have access to provincial water licence databases?

DR. BRADFORD: Personally I've never accessed them, so I can't comment.

DR. MACDONALD: I believe we do, though. I believe we do.

Q And are they helpful in your work?

DR. MACDONALD: Oh, I haven't used them either.

MS. CAMPBELL: Okay, great. Those are all my questions. Thank you very much.

THE COMMISSIONER: Thank you, Ms. Campbell.
MR. PROWSE: Mr. Commissioner, Cliff Prowse for the Province of British Columbia. I believe I have 20 minutes, and I won't take longer than that.

So, I'm sorry, but I want to -- Mr. Lunn, can we look at Exhibits 1851 and 1852, please?

CROSS-EXAMINATION BY MR. PROWSE:

Q I'm sorry, I'm not sure which witness spoke to these. Dr. Bradford.

I guess the first question I have is if we look at Exhibit 1852, if you look at the second page, the graph that's highlighted on the bottom is the same as Exhibit 1851; is that correct? It came out differently on my copy.

DR. BRADFORD: Okay. From a very --
MS. PANCHUK: Microphone, please.
DR. BRADFORD: I'm sorry, my apologies. The other exhibit is the single graph.
Q Yes.
DR. BRADFORD: Okay, yeah, that is -- I'm sorry, that is in -- I produced it. I believe it's in the first tab labelled "Total Fraser with labels 2011 update" near the bottom. So I've clipped that out of the spreadsheet and put it into the other single page.
Q All right. And the smooth copy you refer to, is that -- can you show us that one?
DR. BRADFORD: On the spreadsheet - not that one, the other file - and if you could go to the top, the panel with the red line is the smoothed one.
Q All right. And so essentially, the smoothingness (sic) ends up with a northeast tilt starting in 2008, I guess.
DR. BRADFORD: That's correct.
Q And that's on Exhibit 1852. And I guess it's probably good at this point to re-emphasize, as you did in your earlier evidence, that particularly -- the results for 2011 are particularly preliminary?
DR. BRADFORD: They're preliminary. The final number will probably change a little bit.
Q All right. So then the question for me becomes what do we learn about -- what's the significance of that northeast tilt in the last two years? What's happening there? Can you explain why we're

seeing that? How good is this news or how bad is this news or is it too soon to tell, or what would you say about that?

DR. BRADFORD: I would characterize it as perhaps an increasing trend. My preference would be to use the other figure which shows just the annual values.

Q Right. Maybe you should explain why that's your preference?

DR. BRADFORD: Because it really shows individual years, and when you smooth things out, you sometimes create a pattern that's different from the actual data. So I think it's important to keep an eye on the actual data.

So if we were to turn to the other exhibit -- I'm sorry for the --

MR. PROWSE: It's 1851, Mr. Lunn. That's not Mr. Lunn today. Sorry.

DR. BRADFORD: I think perhaps a point that's useful is that, for example, in 2010, the return, we heard a lot about the large number of salmon that returned last year. But in terms of productivity, it's really just similar to the long-term average. It wasn't exceptional, but there was a large escapement in 2006 so you had a lot of parents, and then reasonable productivity. Those two together added up to a larger run, as we heard, dominated by the late Shuswap run.

MR. PROWSE:

Q And in 2011, presuming we have a different composition -- are you aware of the composition of the 2011 returns?

DR. BRADFORD: Yes. The fish coming back this year, there's a significant proportion that are five years old, as I mentioned, that are the brothers and sisters of the large 2010 run. Most of the fish returning in 2011 were born, if you like, in 2007 and, as you can see on this figure, that was a particularly weak year, and so there's a relatively small number of spawners that came back to the Fraser River that year and spawned, and you have modest productivity, and that gave rise to the returns that we had this year.

Q I had some indication that there was a further increase in the expected return, just in the last -- probably since the 1st of September. Do you know if that is reflected in these figures or...?

DR. BRADFORD: No. This was created about the 31st of August. You know, these forecasts of abundance at this stage of the year are quite an art, and so I think it's worth waiting till the dust settles.

Q Yes. Again, I don't want to over-generalize particularly on the 2011 year. Sorry, did you tell me what sort of -- what are the different runs that sort of reflected to the -- are reflected in the 2011?

DR. BRADFORD: I apologize, I don't think I was finished that. There's a large number of fish returning to the Harrison River, which we've heard has been a run that's increased in abundance in the last while. There's a large contribution of fish to Chilko Lake and an expectation of some of the Late runs which are really just coming in now.

Q All right. Which are the Late runs that we would expect to be coming in now in this year?

DR. BRADFORD: There's some fish returning to Adams Lake or the Shuswap -- Adams River, I'm sorry, Birkenhead River, Weaver Creek.

Q All right. This is a question I know I should know the answer to, but I'll ask it anyway. So why are we talking about productivity rather than some version of the total return, the net return?

DR. BRADFORD: Well, productivity is a surrogate for survival, which is a way of thinking about the environment the fish are facing during their lifecycle. So we're talking about periods in which survival is good and periods in which survival is poor. The recruits per spawn are indexed, that's plotted here, is a way of thinking about survival. So this is the kind of information you might want to look at if you're thinking about how the environment has changed over the years.

But the abundance of fish coming back in any given year is a function of how many parents there were, their survival, and of course the fishery takes out fish before they return to spawn.

Q Maybe I'll ask you a question about research. First of all, I'm not sure -- Dr. Hinch had been involved with Dr. Miller's work, and I can't recall whether you're involved in any of that work.

DR. BRADFORD: No.

Q So there's questions about where we should be

focusing our research, and as I understand it, you were primarily in fresh water; is that correct?
DR. BRADFORD: Correct.
Q On the other hand, we're talking about the life of the salmon and they are pretty dramatic in the extent of the territory they cover over time, and so there is a thought out there that you really need to study them from, as they say, the cradle to the grave in whatever salmon terms that translates to. So the proposal that I wanted to suggest to you is that - and this is not on behalf of the province but is on behalf of a particular individual - is that there could be a recommendation to do a multi-year systems juvenile fish health sampling along the Fraser River, sockeye salmon migration route, from freshwater to the Hecate Strait. So my question is does that kind of a proposal make sense to you from your perspective?
DR. BRADFORD: Certainly. I was a participant in the 2010 Pacific Salmon Commission workshop, which I think has been entered as evidence here. One of the conclusions that we reached in reviewing the evidence was there's a desperate need for a linked research program that would look at the lifecycle of the salmon and be able to provide information on how conditions in one life stage would affect a subsequent, to follow the cohort in a coordinated manner so abundance, health, the environment they are exposed to, as opposed to a more piecemeal and ad hoc process where different places are studied at different times, that sort of thing.
Q And would you agree that it would be desirable that specialties to be involved should include histopathology as well as ancillary specialties such as bacteriology, parasitology, virology and gene micro-rays, et cetera?
DR. BRADFORD: Yeah, there's probably some other "ologies" too, but the idea is that you have a complete picture of the fish health at different life stages, and you know there's energetics, growth, feeding, as well as just the sort of consideration of pathogens and disease.
Q All right. So those would be some of the other ologies that you refer to?
DR. BRADFORD: That's right.
Q What do you say about having the process as open

as possible so the public can come, visit and observe the sampling, at least where practical, along the freshwater part of the migration with regular updates on finding?

DR. BRADFORD: I've always felt that the salmon are a public resource and I'm a public servant, and the public should be involved to the extent it wants to be.

Q Now, I wanted to talk to you about a cost estimate, so I want to suggest to you that such a program would probably cost about $500,000 per year, and I think includes sampling, particularly in the ocean, which usually costs more than the analysis. Does that seem like a ballpark that you could imagine such a program could do, including those other ologies that you think should be involved?

DR. BRADFORD: It might involve at least that. It really depends on how you do the accounting on the ship time, who pays for the ships, 'cause that will consume a lot of money. It depends how far offshore you want to engage in that sampling.

Q All right.

DR. BRADFORD: It would be significant dollars.

Q I don't know whether you can comment on that, but the suggestion is that for a system as large as the Fraser River, this would be very reasonable. Can you comment on that?

DR. BRADFORD: Which is the "this"?

Q The survey with all the ologies from the cradle to the grave.

DR. BRADFORD: Something that's doable, is that kind of what you're --

Q Well, the question is whether it's reasonable to take that on. It's a reasonable level of expense in terms of the potential results you would get.

MR. McGOWAN: Well, I think that -- Mr. Commissioner, I'm not sure whether it's appropriate (indiscernible - no microphone) the question in terms of -- if what he's asking is from a public policy perspective --

THE COMMISSIONER: Mr. McGowan, you're not at the microphone.

MR. McGOWAN: I'm sorry. I'm just suggesting that I'm not sure it's appropriate to put that sort of a public policy question to the witness. If he wants to ask whether the number which has been

proposed is a reasonable estimate of what it might cost and the witness is able to answer, I don't object to that. But whether it's reasonable to conduct this sort of an assessment given the resource that's being looked at, I suggest it's not an appropriate question.

MR. PROWSE: I'll withdraw that question, Mr. Commissioner.

Q In the reports that we're going to discuss on Monday and Tuesday, there's this comparison of fish population studies with rocket science, and the reviewers of that report engaged in a healthy debate as to whether that was appropriate or not. Can you comment on that? I guess you're a modeller, correct?

DR. BRADFORD: I think the comment was something like "fish science, it's not rocket science, it's harder," or something along those --

Q I think that's it.

DR. BRADFORD: Yeah, and I think the rebuttal I heard was that fish scientists could never do rocket science, and so it's just envy.

Q I don't think as a fish scientist, I'll ask you to engage in that debate. But I guess the question is how hard is it? I think the further comment that the person who's stuck with the comment was that you're dealing on an annual basis with a whole bunch of different factors, any one of which can change in a year, and all of which combine in weird and interesting ways so that you get spikes like 2009 and 2010 without perhaps having the best handle on why those spikes are there.

DR. BRADFORD: It's true. I think it's worth looking in context in fishery science, the notion that the abundance of fish fluctuates wildly from one year to the next used to be called the "fundamental problem" in fishery science and perhaps originated in the early 1900s when the Norwegians were looking at the wild variations in herring returns to their fjords. And an extensive effort has gone on over the years in oceanographic surveys to try and understand why the survival of fish from one year to the next would vary, and without a whole lot of success.

So from a management perspective, it's something you just have to deal with. It would be nice to understand but, more importantly, it's how

do you manage in the face of that uncertainty, and that's really the -- we may never solve these problems.

MR. PROWSE: I think those are my questions, Mr. Commissioner.

THE COMMISSIONER: I think just before you sit down, Mr. Prowse, I wonder if I could just go back and have Dr. Bradford just come back to the question you asked.

Doctor, I don't want to say this is verbatim, but I think either you or counsel talked about the desperate need for research based on lifecycle analysis, but given the last question or the second-to-last question you were asked about, the fact that the environment is not static, it's changing. Can you just explain to me, in that context of studying lifecycle, so from the fresh water to the marine areas, how that would be from a scientific perspective, a manageable or doable construct?

DR. BRADFORD: I think the idea is rather than sort of a piecemeal approach to studying different facets of the lifecycle was to go to a place, for example Chilko Lake, where we have a longstanding monitoring program and begin at the lake with the young fish, and - there has been some work on this - track them through the various parts of their lifecycle and stay with those fish as long as possible and come to understand, perhaps, that in a year when the zooplankton population in Chilko Lake was particularly weak, the smolts that go to sea that year might not be as well-nourished or be vulnerable to a disease or something along those lines. That might manifest itself in poor ocean survival.

Unless you have information on all those stages and be able to link those things together, you're always fishing a little bit in the dark. So it's helpful to integrate more, I think, the research agenda and tie the different life stages together.

THE COMMISSIONER: And if I could just ask while Mr. Prowse is on his feet, he didn't ask the question - I think Ms. Campbell did - but to the extent that you would do that kind of research, would you have to have access to all provincial records relating to the examination of the fish at a

particular stage where those records might be of assistance?
DR. BRADFORD: Fish health records you're referring to? Certainly. But I'm not sure that there are any for wild Pacific salmon.
THE COMMISSIONER: Dr. Macdonald?
DR. MACDONALD: May I just add something that may help with the question. While you're integrating all these portions of the fisheries lifecycle, we shouldn't forget that we have to integrate the habitat at each of those stages as well. I think that's probably understood, but it's very important that we're not just studying fish. We're studying the whole ecosystem.
THE COMMISSIONER: Thank you.
MR. BURSEY: I'll be brief. David Bursey for Rio Tinto Alcan. Our questions have been covered, so we have nothing further.
THE COMMISSIONER: Thank you very much. I'm sorry, thank you, Mr. Prowse. Ms. Gaertner is --
MS. GAERTNER: I think I'm next.
MR. McGOWAN: You are.
THE COMMISSIONER: Thank you.
MS. GAERTNER: Mr. Commissioner, I'm going to ask questions a little bit out of my order just to pick up on the last question that you asked.

CROSS-EXAMINATION BY MR. GAERTNER:

Q I think the first set of questions I'm going to direct to you, Dr. Bradford, and if either member of the panel want to chip in, they can, of course. I heard this morning succinctly you described, or one of you described, that the relationship between water flow, temperature and snow packs was complex. But it, in an evolving unpredictable world, it's not only complex, it's unpredictable. Would you agree with that?
DR. BRADFORD: Yes, to a degree.
Q I mean, you described a few years over the last few years, and they weren't consistent. Our look to the past isn't always going to tell us what's going to happen in the future at this point in time, especially when we take into consideration climate change.
DR. BRADFORD: Okay, I get your question now, yes. The future is difficult to predict in these matters.

I think I was thinking that we know a lot more about the physics of water and snow, at least I'd like to think, than we do about fish sometimes.

Q But the unpredictable nature of it is that we don't know what the temperatures are going to be like in the next two to five years necessarily, and we don't know what the snow packs is going to be like in the next two to five years, and we don't know when it's going to start melting and we don't know how fast it's going to melt or any of those types of things.

So we do have a complex system that we're trying to understand, and it's not static.

DR. BRADFORD: True.

Q It's evolving, right?

DR. BRADFORD: True.

Q So I want to take you to Tab 16, which regrettably I let you know about very recently, but I'm comforted because you're the lead author, and so I don't think I'm taking you by surprise. This is a paper that you and Mr. Higgins and Korman and Sneep have just completed; is that correct?

MS. GAERTNER: Could I have that marked as the next exhibit?

THE REGISTRAR: Exhibit 1860.

EXHIBIT 1860: Bradford et al, Test of an environmental flow release in a British Columbia: does more water mean more fish, 2011

MS. GAERTNER:

Q Now, I was fascinated by your question, "Does more water mean more fish?" But more particularly, for the Commissioner's benefit, I want to take you through some challenges that you were talking about in this paper, but also, more particularly, the adaptive management responses to those challenges, because the proposition I'm going to put to you and talk with you about is that how we deal with these evolving changes is in an adaptive management model, that the best way of moving forward is to ensure that managers and technical groups reflect a wide range of opinions and ideas, and that we test those on the ground. Is that a fair proposition to start with?

DR. BRADFORD: Sure.

Q All right. So let's start with page 1 and 2 of this article in which you say:

> ...the environmental benefits of in-channel flows are difficult to predict with accuracy or precision. Some of that uncertainty is attributed to shortcomings of the tools or models used for evaluating flows.

Do you agree with that?

DR. BRADFORD: Yes.

Q All right. And then you said later on at page 2, you say:

> The tools used to predict the environmental effects of instream flow recommendations often have poor or unknown reliability.

On problem is that there is:

> ...a lack of testing of the assumptions of the models or predictions that they make.

Do you still agree with that?

DR. BRADFORD: Yes.

Q Now, for these reasons, in the Bridge River system, which is what you're describing here, and particularly the Bridge River flows which were historically a matter of a fair bit of disagreement amongst First Nations there, B.C. Hydro and the Department of Fisheries and Oceans, correct?

DR. BRADFORD: The disagreement -- the dam was built and designed not to release any water, much like the Kenney Dam we talked about, but it did have an old hole in it, and a decision was made to start to release water, and the question is how much.

Q All right. And with the Bridge River flows, that was a valley that the St'at'imc people used to call the Valley of Plenty. It was a valley that had been the home of many salmonoids and a valley that they very much depend on, correct?

DR. BRADFORD: That's correct, and unfortunately the best habitat for fish is under the reservoir.

Q Exactly.

DR. BRADFORD: Yes.

Q And so the options weren't many, were there?

DR. BRADFORD: No.
Q And at page 1 of this report, the bottom of the summary, you say:

> We question whether biotic responses to flow changes can be predicted reliably with currently available methods and suggest --

You go as far as suggesting.

> -- that adaptive management or the use of decision tools that account for the uncertainty in the biotic response is required for instream flow decisions when the competing demands for water are great.

Still agree with that conclusion?
DR. BRADFORD: Mm-hmm.
Q Can you confirm that this was precisely the approach that you used to review the 13 years of data that related to the increased Bridge River water flows?
DR. BRADFORD: Yes.
Q And can you confirm, as you summarize at page 2 and 3, that there were divergent views found not only at the managerial level but also at the technical level as to how you would address the Bridge River flows?
DR. BRADFORD: Yes, there are different views about how much benefit in terms of fish you would accrue from releasing a certain amount of water.
Q I'm going to take you now to page 13 and 14 which are your conclusions, and in fact, one of the things you concluded after looking at the 13 years of data was that the assumption that returning to what might have been a more natural hydrograph wouldn't necessarily be better for the existing fish environment; is that correct?
DR. BRADFORD: Yes.
Q And so the use of a natural -- and I want to take you particularly to this sentence in your conclusion. Keep going down the page to the paragraph that begins, "The use of...".

> The use of the natural flow regime as a template for environmental flows has an intuitive appeal and certainly has merit

where a precautionary approach is warranted owing to a lack of site-specific information.

I'm going to stop you there for a second. In the Bridge River system, you had a fair bit of -- you had 13 years of data and you were dealing with a changed environment.

But where you've got small streams where continuous irrigation is the primary use, and climate change may be having a direct impact on that flow, that precautionary approach would be applicable, right? The approach that you try to maintain a natural flow regime.

DR. BRADFORD: That's correct. My comments are in the Bridge River, we're dealing with a highly manipulated situation. We used to have a very, very large river. Now the water is all used for power production, so we're sort of creating a new environment.

But in the situation you're referring to where there may not be detailed information to be able to predict the effects, you would tend to rely on the natural as a template.

Q And that would be the precautionary approach in fact.

DR. BRADFORD: Mm-hmm.

Q Yes?

DR. BRADFORD: Yes.

Q Thank you. And then at the end of page 14, when you're talking about options for addressing these types of situations, you make these distinctions. You say either have a detailed understanding of the populations processes to refine the predictions, something like the Bridge system where you've got lots of information, correct?

DR. BRADFORD: Correct, it's very unusual.

Q

Or site specific monitoring as an adaptive management context will be needed for effective water management decisions when the cost of errors are significant.

Correct?

DR. BRADFORD: Correct.

Q And so what are you saying there?

DR. BRADFORD: Well, it really suggests that if you're in a situation where the values involved are not

great, then you may be able to prescribe a flow regime based on these various tools and be comfortable with that. But otherwise, where values are significant in water and environment, energy and environment, then we really need to keep close tabs on what goes on after you -- you'll use some method to predict what flows would meet your objectives, and then there's a need to keep track of what's going on in the environment if there's a need to make corrections, because what we've argued in the paper is that these tools aren't that great.

Q Okay. We're going to return to that in a little bit. Let's keep going with the structured decision-making for a moment. Can I take you to...

MS. GAERTNER: Oh, should I mark -- I have marked that as an exhibit? Yes, okay. Now I need to go to First Nation document Tab 9 -- Tab 8, sorry, my mistake.

Q Now, that may or may not be an agreement you're specifically familiar with, but you're aware of the agreement that was reached between the St'at'imc and B.C. Hydro including specifically around the Bridge River flows?

DR. BRADFORD: Yes.

Q And I want to take you to what's pdf pages 203 to 227. The first one is Schedule 5, and just for the record, that's Schedule 5 to something called The Relations Agreement, and I'll have Mr. Higgins answer more questions about that tomorrow, so you can rest assured I'll get him to do the background on that, Dr. Bradford.

But I want to take you to this, because both Schedule 5 and the next schedule are exactly what you used, in fact, to get to these Bridge River flow regime conclusions and then the test flows, right? You used an adaptive management decision-making framework.

DR. BRADFORD: Yes. It obviously began in '96, the work, and the discussions occurred during that period of time, but it is articulated in this document.

Q I want to take you -- and primarily, the reason -- you know, we talk about adaptive management a lot in the last year on various occasions, but it's often difficult to put it onto the ground. Would

you agree with me on that?
DR. BRADFORD: It's extraordinarily difficult, yes.
Q And in many ways, given the distrust and all the conflict that went on, this is a good news story, isn't it?
DR. BRADFORD: The benefits are both for fish, in the sense that we have a lot of detailed data to understand what's gone on in relation to the flow, but I think a very significant benefit is a tool for engaging all the stakeholders, because you get engaged, you have data that comes, you discuss, you work together. It's a very long-term process. The experiment itself ties people together and I think that has huge benefits for stakeholders.
Q All right. Can I go to page 2 and 3 of that document? Actually, keep going. The steps for the structure decision-making is found at page 4. And there you have it. I know it's only a six-step process. You confirm that it's a lot more difficult to implement than it is to describe it, but it's clearly an iterive (sic) process where you've got First Nations, the Department of Fisheries and Oceans - in this case B.C. Hydro, a proponent, or stakeholders if the situation was broader - evaluating the context of the question, setting objectives, determining alternatives, estimating the consequences, evaluating trade-offs and selecting one, and implementing and monitoring; is that correct?
DR. BRADFORD: That's the process, and it was also the process used for water-use planning.
Q Well, water-use planning as it related to the Bridge River system?
DR. BRADFORD: Well, that -- obviously there's a difference in terms of the stakeholders involved, but that was the attempt at least.
Q I think, again, would you prefer that I defer my questions on the Bridge River water-use planning process to Mr. Higgins?
DR. BRADFORD: If there are technical issues you want to get into, that would be --
Q Process issues.
DR. BRADFORD: Process, probably Mr. Higgins would be a broader perspective than myself.
Q Now, what happened at the end of this process and the application of this process is that there's been an agreement that the lower Bridge River flow

regime is going to be tested over the next while; is that correct?
DR. BRADFORD: Yes.
Q And that testing is now going to also be monitored and reviewed in the context of this decision-making structure; is that correct?
DR. BRADFORD: Yes. As I mentioned, this started back in '96, and so it's more of a continuation of something that started some time ago.
Q But you'll agree with me you now have St'at'imc agreement on this.
DR. BRADFORD: True.
Q And that's a significant agreement at the table, isn't it?
DR. BRADFORD: Yes.
Q And in fact, this decision-making structure is intended to include their value systems and their approaches and the things that are important to them also.
DR. BRADFORD: Yes, and I believe it has occurred.
Q Yes, they're moving forward on that.
DR. BRADFORD: Yes.
Q Would you also agree that this is a valuable approach when identifying specific stream and flow regimes throughout the salmon migratory route that would be of benefit for the long-term sustainability of Fraser River sockeye?
DR. BRADFORD: Certainly, with the caveat that it is extremely demanding on the people, and so there may be a limit to how many of these processes the province could engage in. So that would be the caution there.
Q So we need to streamline those processes and make sure they're effective.
DR. BRADFORD: As I mention in the paper too, it's a question of determining whether values at stake presumably meet some test or some threshold where you engage in a process like this.
Q But you'll agree with me that without using those processes, we often end up in conflict and that we often have people very unsure whether their concerns and interests have been included at either the technical or at the management level.
DR. BRADFORD: It's very different than the command-and-control approach the would be used in a pure regulatory framework.
Q Thank you. Okay, now I'm going to jump from that

for a moment. I've just got a couple of details that I want to get on the record as it relates to groundwater and stream interactions, and then some of the climate changes.

MS. GAERTNER: So if I could have this marked as an exhibit before I moved forward?

THE REGISTRAR: Exhibit 1861.

EXHIBIT 1861: St'at'imc (PC) Settlement Agreement, May 10, 2011

MS. GAERTNER: Now, I didn't call up the second schedule -- perhaps if you're going to mark them both together, that's just fine. I can go in more detail with Mr. Higgins tomorrow on that.

Could I go to First Nations Coalition's Tab 7, please?

Q Now, Dr. Orr, this is a question first of you. Do you recognize this report?

DR. ORR: I do.

Q And was Watershed Watch and the Walter Duncan and Gordon Foundation part of the production of that?

DR. ORR: Yes, that's correct.

MS. GAERTNER: Could I have that marked as the next exhibit?

THE REGISTRAR: Exhibit 1862. (Exhibit previously marked).

MS. GAERTNER:

Q Now I am open, either this is a question of Dr. Bradford or Dr. Orr, it doesn't -- you guys can figure it out. But can you confirm for us that the contribution of groundwater to surface water sources is influenced in part by surface geology?

DR. ORR: Yes, of course.

DR. BRADFORD: Yes, it is. I apologize for that.

Q I have to start --

DR. BRADFORD: I apologize for that.

Q That's okay. That's a given. It's the style of the question we get to ask here.

So I'm going to go to page 3 of this report. It says that in some areas of B.C.'s interior, it can contribute up to 60 percent of the surface water sources. Groundwater can contribute up to 60 percent of surface water sources. Is that consistent with your understanding?

DR. BRADFORD: Perhaps Dr. Macdonald might --

Q So if I go to the bottom of page 3.

DR. MACDONALD: Well, it has - as you just asked a minute ago - it has a lot to do with the geology. There's, I believe, streams in Ontario where it's much less, where it's -- yeah, here we are --
Q So according to Smith --
DR. MACDONALD: -- right here --
Q Right.
DR. MACDONALD: -- silt and clay soils. I would agree with that.
Q That's right. You'd agree with that?
DR. MACDONALD: Yes, but 60 percent is probably a good estimate.
Q Thank you. And then can you confirm that when the surface geology of the stream is largely sandy soil, the interaction between groundwater and surface water is generally greater?
DR. MACDONALD: I'm probably getting a little bit out of my area of expertise. It's an area that I have enjoyed reading, but I haven't done a lot of research in this area. The more porous the soil, the more likely there is to be movement of water through that.
Q And sandy --
DR. MACDONALD: Through that soil.
Q Sandy soil is found in many of the streams in the Fraser watershed; is that correct?
DR. MACDONALD: Yes, as you go further north, there's a lot of glacial lacustrine deposits from old lakes, and so it's maybe a little less fine, but that's a huge generalization, really. Soils on the coast tend to be less well developed, more porous, so the Harrison area would probably have soils that are more porous than, say, the Takla area where I have a little bit of experience in some of the soil work.
Q So this problem -- now, a problem or not, it's not really a problem.
DR. MACDONALD: It's the way it is.
Q It's the way it is, is a reality for us as to why it is the groundwater and the relationship between groundwater and surface water is an important component of the Fraser watershed for salmon.
DR. MACDONALD: Well, yes. But regardless of the soil, it would be an important component, yes, absolutely.
Q But given the soil, it is important.
DR. MACDONALD: Yup.

Q Okay. One more detail. Sorry, guys, I just got to get some of these details on the evidence.

So I wanted also to take you to page 8 of that report. We've talked about it and, Dr. Orr, you've mentioned a couple of times about the effect of pumping wells next to streams. There's a quote on page 8 of this report, right after section 4 there:

> A pumping well affects the stream by reducing groundwater levels creating a gradient that captures some of the surrounding groundwater flow that would have otherwise discharged as base flow to the surface water. When pumping rates are sufficiently high, declining groundwater induces flow out of the surface water into the aquifer.

Would you agree with that description of --

DR. ORR: Yes.

Q And would you agree that if we don't watch this, if we don't watch the rate of pumping that occurs, this is precisely one of the problems that we may face?

DR. ORR: It's potentially a very huge problem considering the population growth in that area.

MS. GAERTNER: Have I had this marked as an exhibit?

THE REGISTRAR: Yes, you have, 1862.

MS. GAERTNER: All right. No one's jumping up, so I must be okay for time.

MR. McGOWAN: We're doing fairly well for time, Mr. Commissioner, and if Ms. Gaertner needs a few extra minutes, I certainly don't have a problem with that.

MS. GAERTNER: Thank you. That's a very unusual moment in the history of this inquiry, and I'm totally grateful for it, absolutely grateful for it.

Q A couple of more details, one of which is around sensitive streams. I'm aware, through reading the PPR and otherwise, that there are about 15 streams designated as sensitive streams under the ***Fish Protection Act*** in 1997 with only five in the Fraser watershed. Is that your working knowledge, Dr. Orr?

DR. ORR: It is from reading the report, yes.

MS. GAERTNER: And First Nation Coalition's Tab 12 at page 37, this is the Auditor General's report in

B.C.
MR. McGOWAN: I apologize for interrupting. Just before we go there, the last exhibit which I believe Mr. Giles indicated was going to be assigned Exhibit number 1862, I believe it may already be Exhibit 747. Just to avoid the possibility of duplication, perhaps we should --
MS. GAERTNER: Oh, okay.
MR. McGOWAN: -- just check and see if my information is correct.
MS. GAERTNER: Sorry.
MR. McGOWAN: It has a very similar name on the list.
MS. GAERTNER: Let's check. Looks like we've got the same exhibit. Sorry, Mr. Commissioner.
THE REGISTRAR: It appears the title is just worded a little differently, but it looks like it's the same. So 1862 will be withdrawn.
MS. GAERTNER: Thank you. And the record -- and what was that exhibit?
THE REGISTRAR: That's the Review of the Groundwater Salmon Interactions in British Columbia Watershed Watch.
MS. GAERTNER: And, for the record, what exhibit is that?
MR. McGOWAN: It's 747.
THE REGISTRAR: It's 747.
MS. GAERTNER: Thank you. Now, if we go to First Nation Coalition's Tab 12. These are pages of the Auditor General's report and, in particular, at page 37 of that report, it refers to the sensitive stream allocations, and at the bottom of it, the Auditor General says:

> To date, that list has not been expanded even though many other streams would likely qualify. The ***Act*** also provides for the development of "recovery plans" for sensitive streams, but no current provincial efforts are underway to develop those plans.

Dr. Orr, perhaps I'll get you to comment on this, and if anyone else would like to add to it, please do.
Do you agree that we need to more closely look at the potential of sensitive streams within the Fraser watershed for the purposes of identifying areas that might be sensitive for

salmonids?
DR. ORR: I would certainly agree, and I think that the list is quite old and needs some updating, and there needs to be some oversight on where these recovery plans are as well.
Q And would you agree that the adaptive management approach that I was discussing earlier with Dr. Bradford might be useful for both identifying and prioritizing these streams?
DR. ORR: Absolutely.
Q Now, one thing I wanted to ask about climate change, there's been a fair bit of questions already asked and commented on this, but given the historic allocation of water for irrigation and industrial uses, can we anticipate that the already existing licensing regime could create new and unanticipated impacts on salmonoids including Fraser River sockeye salmon?
Dr. Orr, I'll start with you.
DR. ORR: Sorry, maybe you can just clarify. The existing licensing system...?
Q Given the historic allocation of water for irrigation and industrial uses along the watershed --
DR. ORR: Absolutely.
Q -- and given the changes in climate change, can we anticipate that the historic allocation - never mind the new ones - could have new and unanticipated impacts on Fraser River sockeye and on salmonoids in general?
DR. ORR: Absolutely. And there's already an over-subscription of surface water licences in so many areas in British Columbia. You just have to go -- we did a tour of the Merritt area once for a workshop that was looking at water issues and talked to some of the ranchers, and they clearly acknowledged the conflict of -- you know, their demands were trying to get three crops of hay off, for instance, versus maintaining some fish, and they figured if they had to give any water back, they couldn't get as many crops off.
So this is only going to be exacerbated by climate change and the kind of decreased flows that we've already seen in some of the evidence.
Q Dr. Bradford, would you agree with that?
DR. BRADFORD: Yes, I would.
Q Dr. Macdonald?

DR. MACDONALD: Yes, I would.
MS. GAERTNER: Thank you. Now, the next -- oh, let's have that marked as an exhibit.
THE REGISTRAR: Exhibit 1862.

EXHIBIT 1862: BC Auditor General, Salmon Forever: An Assessment of the Provincial Role in Sustaining Wild Salmon, 2004-2005

MS. GAERTNER: I'd like to go to Tab 10 now, of our documents. This is a rather large report that I'm not going to have time, nor is it on topic, to take you through all of this. Are all of you familiar with this report?
DR. ORR: I've seen it.
DR. MACDONALD: I've seen it too.
DR. BRADFORD: I'm not familiar with it.
MS. GAERTNER: Okay. You're saved from questions then. Could I have this marked as the next exhibit?
THE REGISTRAR: Exhibit 1863.

EXHIBIT 1863: Morris et al, Changing the Flow: A Blueprint for Federal Action on Freshwater, Gordon Water Group, Feb 2007

MS. GAERTNER:
Q Now, I want to take you to a couple of recommendations specifically in this report. This is a broad-range report that talks about many things as it relates to the federal action around water, and I'm going to talk with the regulators tomorrow a little bit more about it. But there is an interplay, of course, between science and management, and I want to take you to page 30.
MS. GAERTNER: Oops, it's 31, I think. It's action number 6. There you go. If you could highlight that one, "Mainstream Climate Change into Water Policies" is the action item that's suggested and, in particular:

Integrate strategies for adaptation and mitigation into all aspects of freshwater management—as well as providing strong standalone actions, this blueprint should be viewed as a comprehensive no regrets strategy for responding to the impacts of climate change on water.

Would you agree that that's a useful recommendation for implementing into British Columbia as it relates to the Fraser watershed?

DR. ORR: I think so.

DR. MACDONALD: Yeah, I don't see a problem with that. It's fairly general.

Q Sure. Dr. Bradford?

DR. BRADFORD: I don't know what it means.

Q So let's -- I mean, it's interesting that you say that because --

DR. BRADFORD: And I don't mean to be trite, but I don't know what --

Q No, I know. Let's go there.

DR. BRADFORD: -- a comprehensive "no regret strategy", I have no idea what that refers to.

Q So let's start with the first one.

> Integrate strategies for adaption and mitigation.

So when I read that, and I thought about the questions that I've just asked you earlier about the Bridge River system, we've got an adaptive approach to looking at climate change, looking at the options that we have on the ground, and we've got to mitigate that into the future. We've got to make changes as it goes into the future. We've got to watch climate change.

So that's just one example. If I then pull it into industrial use, or if I pull it into irrigation purposes, it's all the same, isn't it? We've got to look at this at an adaptive level, and we've got to be comprehensive in looking at it.

DR. BRADFORD: I agree. Adaptation and climate change often means the ability to change with the change in climate. I think in adaptive management, we're talking about learning and then making changes, so there's maybe a little bit different use of not quite the same word.

But again, I think the key is learning and being able to change as conditions change.

Q And so one step further, the key is to make sure you've got a group of people learning so that they can work well together and adapting together.

DR. BRADFORD: Oh, I would agree with that, yes.

MS. GAERTNER: All right. So let's go, then, to action 13. Sorry, there's many actions, but I was trying to make sure I picked the ones that related to science and management interplay.

Q Now, IFNs or In-Stream Flow Needs in that, and so action 13 is:

- Provide support to provinces and territories to establish effective instream flow programs that determine IFNs [Instream Flow Needs]. Provide guidance on legal/institutional reforms that may be necessary to reallocate water resources to meet those needs.

- Define an effective federal role in maintaining [these] IFNs and partner[ship] with provinces...to develop clear mandates and roles for interjurisdictional bodies...

Would you agree that that would be useful in the Province of British Columbia and as it relates specifically to the Fraser watershed?

DR. BRADFORD: I will say that there is a process within the ***Water Act*** modernization for developing Instream Flow Needs and the Department of Fisheries and Oceans at a national level is working on processes for Instream Flow Needs. A lot of that was triggered by the discussions around the Athabasca River.

So I think that's recognized, yes.

Q And you'll agree with me that we may have to seriously look at reallocating.

DR. BRADFORD: That's not a science issue, but that might be an --

Q If we --

DR. BRADFORD: -- outcome of a process.

Q If we were specifically trying to, in a precautionary way, look after Fraser River sockeye or Fraser River salmon, we're going to have to seriously look at reallocations.

DR. BRADFORD: Well, that, in the structured decision-making process, you're evaluating different options, and an option that might need to be evaluated would be reallocation, and it would of course affect various stakeholders and values within that context.

Q Does anybody else have anything to add to that?

DR. MACDONALD: Well, I think I'm just agreeing with Mike. That might be something that spins out of the process, but until you've gone through the process, you can't really tell what's going to spin out of it.
Q It would be a useful option to be considering?
DR. MACDONALD: Absolutely, yeah, people have to be open.
MS. GAERTNER: Thank you. All right. I'm just going to finish up, Mr. Commissioner, with a couple of details. I need to go to Tab 11 of the First Nations Coalition's documents.
Q Dr. Orr, do you recognize that document?
DR. ORR: I do.
Q Could you tell us what the effort was that went into this document and why you did it?
DR. ORR: We talked a little bit about it already. The ***Water Act*** is 100-year-old piece of legislation that doesn't really consider environmental needs or fish. There was an offshoot from Living Water Smart program and a commitment to modernize the ***Water Act***, and we felt that we needed to talk to a bunch of groups, organizations out there. We did have a couple of First Nations at a workshop that we had as well. Unfortunately it wasn't quite as well attended by First Nations as we would have liked.

We felt that we needed to make some statements on what was at risk, in terms of British Columbia and water issues, and that included things like governance, but also the natural ecosystem. We decided that we would put together a document on some recommendations on ensuring we had clean safe water, we had proper governance. We had Instream Flow Needs met, and issues like that.

MS. GAERTNER: All right. Could I have that marked as the next exhibit?
THE REGISTRAR: Exhibit 1864.

EXHIBIT 1864: Statement of Expectations on Reform of the BC Water Act from BC Nongovernmental Organizations, Dec 2009

MS. GAERTNER: And then if I could go to our Tab 15.
Q Dr. Orr, you're familiar with this letter also? You were copied on this letter?

DR. ORR: I am.
Q And this letter is the St'at'imc Chiefs counsel's response to the previous exhibit that we just talked about; is that correct?
DR. ORR: That's correct.
Q And if you go to that list that's set out at the front page where they identify a number of important issues related to water reform, you'll agree that all of those, all five of those, are issues that do have an effect on Fraser River sockeye or salmonoids in general in the Fraser River system.
DR. ORR: I would absolutely agree.
Q And having worked with First Nations in a number of consultative processes, would you also agree that this is an excellent summary of the kinds of issues that are of concern to them?
DR. ORR: It's an excellent summary and it's also a representation that we've seen with talking to many First Nations, that they would like more say in what's happening in terms of water.
Q And in fact, you've heard on many occasions that another issue that they have that's left outstanding for these tables is First Nations rights to water.
DR. ORR: Absolutely.
MS. GAERTNER: Those are all my questions, Mr. Commissioner.
THE REGISTRAR: Did you want to mark the last tab?
MS. GAERTNER: Yes, please, absolutely. Thank you.
THE REGISTRAR: Tab 15 will be marked as 1865.

EXHIBIT 1865: Letter from St'at'imc Chiefs Council to Terry Lake, Minister of the Environment Re: The Water Sustainability Act, March 15 2011

THE COMMISSIONER: Thank you, Mr. Gaertner.
MR. McGOWAN: I'm going to suggest the afternoon adjournment, Mr. Commissioner.
THE COMMISSIONER: All right.
THE REGISTRAR: The hearing will now recess for ten minutes.

(PROCEEDINGS ADJOURNED FOR AFTERNOON RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: The hearing is now resumed.
MS. GAERTNER: Mr. Commissioner, we have enough time to even be kind enough to have me clear the record on one thing and ask one remaining question.

One thing I wanted clear was that I needed to put on record that the First Nations Coalition, which includes the Upper Fraser Fisheries Commission, which includes First Nations who very much rely on the Nechako Watershed, did not have the technical ability through this process to critique the options and the situations around the Nechako situation, and so for that reason our questions -- we did not have any questions on this matter, but the lack of questions cannot be interpreted as an agreement or understanding or confirmation of the options that are there. I just needed to put that on record.

CROSS-EXAMINATION BY MS. GAERTNER, continuing:

Q But I did want to say that of course with my eyes here I'm going to be reporting back to my clients, and I wanted to go to Exhibit 1853, if I may, which is the Nechako Watershed Council Report that we had in earlier. And at page 3 of the report, of the Executive Summary -- hopefully that I've got the right page number. Sorry if I'm going to take too long. Keep going.
MR. EAST: Page 30.
MS. GAERTNER: Is it page 30?
MR. EAST: That's where the Executive Summary is.
MS. GAERTNER: Oh, it's right at the end. I'm sorry. I'll just ask the question while Ms. Panchuk is finding the conclusion.
Q But what I understand is that it relates to the second option that's now being considered that you've talked about that needs a lot of work, the committee decision will need to have around a water release facility, will need to be revisited, but we would also need to find a project proponent and more money would need to be to be found, even for the second project. Is that correct?
DR. MACDONALD: So let's clarify. The second project you're referring to is the surface water release?
Q Sorry, yes.
DR. MACDONALD: Yes. So it's a release from Kenney Dam, Mr. Commissioner, but it's the surface water

release, which would be a less expensive option. So your question then was is...

Q It's as I understood the report, and if the executive summary, you still have to keep going, the next page.

DR. MACDONALD: You need to realize, I didn't write this report. My material was used to make --

Q Okay. Well, let's see --

DR. MACDONALD: -- up this report.

Q -- see if you can agree with this and if not, it seems to stand for itself there.

DR. MACDONALD: Yes.

Q But it seems that they have to go back to the committee to revisit the cold water release facility, but even if they agreed to do the water release facility, that a project proponent is required and more money will need to be found, because the commitment from Alcan would not be sufficient; is that correct?

DR. MACDONALD: I think you'd better ask Jason this question.

Q Okay.

DR. MACDONALD: I do know that the $50 million that is on the table from Rio Tinto requires another proponent. It could be a person off the street, but it requires money matched from somebody else.

Q All right.

DR. MACDONALD: So...

MS. GAERTNER: Sorry, I'll ask the question tomorrow, then.

MS. SCHABUS: Mr. Commissioner, Nicole Schabus, counsel for Sto:lo Tribal Council and the Cheam Indian Band.

CROSS-EXAMINATION BY MS. SCHABUS:

Q I'm just going to put my first question to the whole panel, and I'd like you to comment specifically on the interconnectivity of surface and groundwater flows, and just to put it a little bit in context, especially in highly hydrologically active areas like lakeshore, river deltas, riparian areas, flood plains. So if you could comment on the interconnectivity of surface and groundwater flows.

DR. BRADFORD: Well, I think we've spoken earlier on how the relationship between groundwater and

surface water depends a lot on the geology underlying the water bodies. That's obviously important. I can give you an example, Cultus Lake, in the Fraser Valley. The sockeye salmon spawn along the beaches of the lake, but the eggs that are laid in the gravel along the beaches of the lake rely on groundwater coming up through the gravels. And so that's a good example of how the connection between the groundwater and surface water is maintaining the sockeye population.

Q So one of the things is it actually helps with temperature control, but also with oxygenating the water, right?

DR. BRADFORD: Both of those are correct. The ground -- sometimes groundwater does not have a lot of oxygen if it comes from depth, and so it depends.

Q Correct. So the point I want to further discuss with you is that when you are dealing with developments, for example, and changes to river flows, or also developments in the riparian area, it's important to study the geomorphology of the river and those highly complex interconnected dynamics between the surface and groundwater flows?

DR. BRADFORD: Certainly, if the development or whatever activity has the potential to impact the use thereof them, yes.

Q Now, if you are therefore dealing, making decisions regarding highly hydrologically active areas, and salmon habitat in this context, the best approach, would be and you'd agree, that would be to have an integrated land and water management planning process that looks at the impacts that land use and also water management have respectively?

DR. MACDONALD: We talk about pathways of effects, and we talk about impacts. And I think that's what you're alluding to, and it's essentially, you know, a motherhood statement. You need to understand these pathways. You need to understand the ecological processes that interrelate with these pathways in order to fully understand and therefore manage properly that system.

Q And inform your decisions, right?

DR. MACDONALD: Yes.

Q So as scientists, you would want to see such an integrated planning process. I now want to take

you to the reality of decision-making when it comes, for example, to riparian areas or flood plains, which are some of those highly hydrologically active areas.

DR. MACDONALD: As scientists, we are one spoke in the wheel of these integrated planning processes.

Q Sure.

DR. MACDONALD: We need to know our place in these things. We basically are providing the information on which these things should be based for them to work.

Q And that's the context in which I was putting the question to you, as scientists informing the decision-making. But when it comes, for example, to the reality today, when it comes to ***RAR*** or flood hazard assessments, a lot of this has now been downloaded to municipalities, you are aware of that. And my question to you as scientists is are you concerned about the lack of actually, like, taking into account those complex dynamics in decision-making when it comes to ***RAR*** and flood hazard approvals.

DR. MACDONALD: I mean, I'm always concerned that we manage with not enough information. There's always -- you never ask a scientist if they want to do more research, they always will answer yes. But I have to be somewhat defensive about the ***RARs*** because they are based on our best science at the time they were produced. We did our -- the Department and the Province got together and went back and forth and it was -- talking about adaptive management, it was basically an adaptive process to produce those. I know they're controversial. I know you can always find science that would point to certain aspects of the ***RAR*** that are wrong, but the process in which they were produced was a correct scientific integrated process. And they should remain adaptive, and they should be changed if they're not working. And that was part of -- they're kind of a living regulatory process, and that's the way they were intended to be.

Q Did I see Dr. Orr's hand go up?

DR. ORR: Yeah, I think you're referring to the fact that there can be some, you know, some politics involved in some of the decision-making, and I think we did hear testimony on gravel extraction

from the Fraser. Dr. Church and some of his colleagues showed that there were no flood-related benefits in some reports, but that was still how, you know, the gravel extraction was justified. So those kind of -- those kind of situations happen quite frequently in some of these decisions.

Q But what I actually want to take you to also in this context is that the decision-making has been downloaded and the reality that you will be aware of as scientists is that you are less and less involved in this decision-making that is being downloaded to the municipal level, and actually a lot of these complex analysis regarding the interactions of groundwater, surface water flows, et cetera, and now is being taken into account when making decisions regarding those habitats today.

DR. ORR: I would say you're probably correct on that.

Q Now, Dr. Orr, I think you refer to it as increasing thermal stress that the salmon are under, and it's my understanding that groundwater can -- is key to help reduce that or keep that in check.

DR. ORR: Certainly not as important when the fish first enter the Fraser and they start encountering some higher temperatures, but I think we're mainly talking about it in some of their natal streams where the sockeye are spawning. It's quite important in terms of maintaining temperature and flow and year round.

Q Now, in light of the oversubscription of water licences for surface waters that we've heard about, and you're also aware of the increased use of surface waters, including for agriculture and also now the mining industry, including in the headwaters, I am putting it to you and I'm asking you as scientists how this causes you concern if you want to have a management approach that protects ecosystem values, salmon species, where conservation is the priority.

DR. ORR: I guess I was pointed to, here. Yeah, there's certainly a lot of concern been raised amongst salmon conservationists in terms of the number of surface water licences and the conflicts that that engenders in terms of providing enough water for fish and environmental flows, and that's not going to go away any time soon. We're hoping

some of those could be resolved through ***Water Act*** modernization, but you can imagine that there's not a lot of people that are particularly happy with the concept or potential of having their water licences clawed back. And I know some cases were being looked at in terms of how often they were used, et cetera, et cetera, but I think it's a really large problem that we're probably not going to grapple with in any sufficient way.

Q But, gentlemen, I think you would all agree that the current approach that we are dealing with of water licensing actually not protect those ecosystem values, salmon species and make conservation a priority.

DR. ORR: I would agree.

Q I'm putting it to the rest of the panel.

DR. BRADFORD: Well, I think there's some significant changes in the proposed ***Water Act*** that you can discuss with the policy folks tomorrow.

Q I'm just asking about the current -- I don't want to cut you off. I was asking about the current approach that is currently in place. That doesn't give the necessary priority to ecosystem values and conservation.

DR. BRADFORD: I think as Dr. Orr has stated, there aren't provisions for environmental benefits in the ***Water Act***, and that's true.

Q Now, Dr. Orr, your organization, Watershed Watch Salmon Society has worked together with indigenous peoples in the Interior and along the Lower Fraser on ground and surface water issues, correct?

DR. ORR: That's correct.

Q And as such you are aware that First Nations shared the concerns regarding the importance of our groundwater to maintaining groundwater levels and quality and also maintaining salmon stocks?

DR. ORR: And they've demonstrated a high level of concern, from my experience.

Q And you actually know of specific examples where First Nations have worked together with biologists and made observations based -- *in situ* observations and *in situ* protection measures, studying the importance of groundwater and ID'ing sources of groundwater in the Fraser using thermal imagery?

DR. ORR: Yes. They certainly used advanced science techniques, and they also brought in traditional

local knowledge and ecological knowledge.
Q Yeah, and that's the point that I was hoping to discuss with you, and of course the panel can chime in, as well. This integrated work actually points to the importance, and you would agree with the importance of integrating traditional knowledge to ensure *in situ* protection of water resources and also salmon stocks?
DR. ORR: Absolutely.
Q And can you expand on that to the extent to which this *in situ* knowledge and traditional knowledge is important in terms of establishing baselines and also finding the problems and getting to the bottom of them?
DR. ORR: Well, the traditional knowledge is important in terms of, for instance, you know, when fish are first using certain habitats, when they leave certain habitats, you know, and it brings some cautionary measures in. I know the first fish ceremony that is common in British Columbia is based on tradition that minimizes risk in terms of over-harvesting fish. So certainly there's a lot of history of the health of salmon populations in certain areas, and that's been integrated in some of these studies, as well.
Q And just looking at the other gentlemen on the panel, just when it comes to the importance of traditional knowledge and *in situ* conservation and protection could you briefly comment on that?
DR. BRADFORD: I agree, my experience has been more in the Yukon Territory, but where we've relied on people in the watershed to help us with our work, we can't be everywhere, but people that live in the watershed certainly have much finer knowledge of things going on there.
DR. MACDONALD: And my direct experience comes from the Stuart-Takla area where we worked with the native groups in the area, and, yeah, similarly, I mean, it's certainly to collect local knowledge and to have people involved from many disciplines, including I suppose the industry, as well. We incorporate the industry into our project. The whole idea being if we're doing the research that's going to develop regulations, it's good that people who are going to have to follow and use those regulations are involved on the ground floor.

Q And, Dr. Macdonald, you talked about in terms, I think, of Western science, you were talking about the lack of availability of data about some of the specific --
DR. MACDONALD: Yes.
Q -- river system, but again, speaking and working with indigenous peoples in the area, they obviously could provide you with longer-term knowledge and knowledge about -- *in situ* knowledge that could help you determine some of that information.
DR. MACDONALD: Yes, we weren't well equipped, and I speak for myself, well-equipped to access that knowledge, but I recall many times, this is back in the 1990s, attempting to extract that knowledge and get First Nations involved to do that. And we recognize the value of it. But also, we involved the First Nations groups in setting data loggers and establishing temperature recording sites, as well, and because people are there on the ground close to the sites, it was an ideal situation.
Q So you would agree that's exactly the field where you can actually help implement this more integrated management on the ground, there's a lot of growth potential for that.
DR. MACDONALD: It gets people working together, that's true.
Q And it also helps protect the resource.
DR. MACDONALD: You can't manage what you don't understand.
Q Now, Dr. Orr, you've spoken about a workshop, a cumulative effect workshop with a specific focus on IPPs. That was held in January 2010, it was actually - I just want to clarify - it was organized in collaboration with the Sto:lo Tribal Council, correct?
DR. ORR: That's correct.
Q And one of the things that you did generally, not just specifically focusing on IPPs, I'll take you there in a minute, is looking at the building blocks for what would constitute a more integrated or cumulative impact assessment in Sto:lo territory based on Sto:lo values, correct?
DR. ORR: That's correct.
Q And you identified key concerns by Sto:lo people, right?
DR. ORR: That's right.

Q And some of the first concerns that were raised were actually water, in terms of water quality, temperature, flow, and it was actually described as mother earth's blood?
DR. ORR: I'm trying to recall mother earth's blood, but I know that there was a large concern for water and in particular a lot of the folks who were at the workshop had little creeks in their backyards that they were very concern about.
Q I was taking the wording from your report, actually.
DR. ORR: I had forgotten it.
Q But that, along, water and fish were actually ID'd as key concerns and people were also clearly aware of the interrelation of the wellbeing of the fish with having sufficient water flows and good water quality, right?
DR. ORR: That's right, and that's where we did have traditional knowledge and we tried to sort of meld a little bit with Western science, where the term quite often is valued ecosystem components, and we're looking at those in terms of cumulative effects assessment.
Q And you also talked about the need for further research and further integration of traditional knowledge, correct?
DR. ORR: Absolutely.
Q And one of the concerns that was also identified was the effects of high voltage electricity on fish?
DR. ORR: I believe that was raised. I'm not sure how much weight it did actually get in the workshop.
Q But you'd agree that that is actually an issue that should be further studied?
DR. ORR: Well, certainly there is relationship between electricity and fish behaviour, so I suppose it is something that could deserve some more study.
Q And also another issue that I wanted to take you to, and that requires further study is independent power projects, and that was something that indigenous peoples in the Lower Fraser and generally wanted to see more work done on?
DR. ORR: Yeah, and one of the impetuses for the workshop from Sto:lo Tribal Council was they were being besieged by applications and they didn't know how to handle it. They were looking for some screening processes to assess these projects and

whether they're -- you know, they could deal with clustered applications, things like that, so...

Q And one of the things that your organization did is actually develop a tool kit, how to work together with indigenous peoples and how to work with their concerns to actually help protect water resources including groundwater.

DR. ORR: Absolutely. And we did a companion document on legal tools for First Nations for protecting water, as well.

Q That's the "Fish out of Water" document?

DR. ORR: That's correct, yes.

Q And in that it points actually to the importance of working with indigenous peoples on those issues because they have standing and constitutionally protected rights, and can use those to raise those concerns where there is often not other regulatory tools in place.

DR. ORR: Oh, absolutely. I mean, and it was predicated on the very close link between water and fish and priority, you know, to fish, the s. 35 rights.

MS. SCHABUS: Thank you, those are all my questions.

MR. McGOWAN: I believe Mr. East may have a question or two in re-examination.

MR. EAST: Mr. Commissioner, Mark East, Department of Justice.

CROSS-EXAMINATION BY MR. EAST, continuing:

Q Just one follow-up item, and I'd like to call Exhibit 1858 back on the screen, and some questions for Dr. Orr. Dr. Orr, I believe this is the letter, as I understand it, it's a letter from -- if you go to the second page, and it's a letter from Bonnie Antcliffe, Regional Director of DFO's Ecosystem Management Branch to you; is this right?

DR. ORR: That's correct, and it's my understanding that she's fairly new in that role.

Q And in fact if you go to the first page at the very top, the date stamp on this letter is August 25th, 2011, so less than a month ago.

DR. ORR: Very recent.

Q And I just, without -- I certainly don't want to put words in your mouth, but as I understood your testimony, you're citing this letter, which relates to a river system that's on the Island,

and not in the Fraser system, as an example of your disappointment with the Department of Fisheries and Oceans failure to require mitigation measures for this facility, for this proposed facility?

DR. ORR: No, that's not quite correct.

Q If I can ask you just to clarify that testimony.

DR. ORR: Sure. I mean, the first disappointment was that we were talking about projects located in anadromous fish habitat. But the issue here was questioning the ability of any agency to suggest or prescribe mitigation that's going to be effective in this system. There's many cases where we describe mitigation actions around run of river projects that we just have no idea whether they actually have worked or not in trying to restore some function, you know. It's a trade-off, you know, so you may lose some function in the river and they're trying to restore it somewhere else.

But the question on this one was whether DFO could actually mitigate the impacts on this, based on proponents' actual proposal to mitigate these activities, and that includes recreating flows when it was our understanding that there wasn't enough stored water to actually recreate these flows.

Q And then perhaps then we can go to the third paragraph. When this initially is on the screen, we can only really see the first two paragraphs. And I just want to go to the third paragraph, and this is Ms. Antcliffe's words:

> We recognize the sensitivity of the fisheries resources in the Kokish River watershed and have been working with the proponent, the Province of [British Columbia] and the Kwagis --

- I probably have that pronounced incorrectly -

> -- First Nation on appropriate mitigation measures including redesigning and relocating components of the project and developing instream flow requirements to reduce potential impacts on fish and fish habitat.

Now, you would agree that there was a process and discussion underway to actually develop in-stream, or mitigation measures. I guess your point is that you have some questions about whether those could be adequate.

DR. ORR: That's correct.

Q The second point I want to make here is in the second line it says:

> It is important to note that the environmental assessment process for this project has not yet [been] concluded, and no impacts have been authorized. If such an authorization is granted it would require a stringent monitoring program to ensure that flow requirements are met and that impacts are as predicted.

I guess my question for you is this: Would you agree that this project at least, there is a process underway in which the concerns that you, and I suppose others may have with respect to the proponent's proposition with this IPP, can be assessed and is being evaluated.

DR. ORR: I wouldn't know that from this letter, and I did raise concerns earlier that it's very difficult to see the details of monitoring programs for IPPs. We've asked many times, and if you want to look at the word "rigorous", that has to be defined, as well. I would define rigorous based against the BC Hydro water use planning process, and the 15-year monitoring program for the Coquitlam River, which I am a participant. That's a rigorous process, and I don't believe that anything that we are seeing on IPPs, although it's very difficult to figure that out, comes anywhere close to that.

Q Well, then, maybe we can go to the last paragraph, because it says in the second sentence:

> If [Watershed Watch Salmon Society] has any technical comments --

- and it sounds like you probably do -

> -- on the potential impacts to fish and fish habitat or the potential mitigation measures

on the Kokish River Hydroelectric Project or any other proposed hydroelectric project, we encourage you to submit them to DFO and the BC EAO for consideration in the environmental review process.

So my question for you is, is it not true that there is a process for you to bring your concerns to the table, make, raise the questions and concerns you have with respect to the monitoring of this or other processes, and to ensure that your interests and the interests of your constituency are brought to the table.

DR. ORR: There is a process and we've used it in the past on commenting on applications for several other projects, very time consuming. Sometimes those letters that we send are four pages long, and the response we get and the assurance we get makes me wonder if it's worth the effort to do it.

Q But the process is in place for this?

DR. ORR: There is a process in place, although I would judge it as being very non-responsive to the real needs of the world out there around the environment.

Q You would agree with me that no decision has been made as a result of this ongoing environmental assessment process?

DR. ORR: And that's why we wanted to get our concerns in early before the decision was made.

MR. EAST: Thank you.

MR. McGOWAN: Yes, Mr. Commissioner, just a couple of questions in re-examination.

RE-EXAMINATION BY MR. McGOWAN:

Q I'd like to start with you, Dr. Orr. In response to some questions to Ms. Gaertner, you used the term "oversubscribed" with reference not to a specific stream, but speaking generally about the issuing of water licences. I wonder, first of all, if you could just explain what you mean by the term "oversubscribed"?

DR. ORR: Sure. It's probably best to consider on a watershed basis, but in some areas there's more water is allocated in licences than is actually available in the hydrograph of the -- you know, in actually in the amount of water that's available

in the system in terms of rainfall or stream flow or something like that.
Q Are there particular streams or rivers or tributaries in the Province of British Columbia with which you have particular concern about oversubscription?
DR. ORR: From what I've seen, it happens in many, many systems, especially in the Interior, I think where there's more thermal stress and higher temperature impacts on fish, it's probably more of a concern. And many of the Interior streams around the Kamloops area I would have those concerns.
Q Are you speaking of the Nicola?
DR. ORR: The Nicola would be one, sure.
Q Okay. The Nicola Valley is one that often comes to mind when the term -- when people are talking of oversubscription; is that fair?
DR. ORR: That's one that has come up several times, yes.
Q Okay. Are there any sockeye runs which migrate through or return to the Nicola area?
DR. ORR: Well, there's certainly sockeye in the Shuswap River, in that general area, but not the Nicola itself.
Q Many of these -- with respect to the areas where oversubscription is a concern, are you able to offer any comment on whether those are primarily related to streams or rivers which are not frequented by sockeye, at present? Not looking forward to the future, because we (indiscernible - overlapping speakers).
DR. ORR: Most of the concerns that we've raised in the past and have heard in the past have been for salmon other than sockeye, mostly chinook and coho, I would say, and steelhead to a degree, as well.
Q Okay, thank you. To be fair, you have raised some concerns with respect to the possibility that future allocation and global warming may combine to create problems in areas frequented by sockeye. Is that a fair summary?
DR. ORR: Sure. And, you know, when you take a watershed approach, something that happens upstream can be promulgated downstream, as well.
Q Thank you. Dr. Bradford, I want to turn and ask a question to you. There were some questions put to you about flow regimes in the Bridge River, and

substantial alteration to the flows from historic natural flows. Prior to the damming of that, was there a sockeye run of any significance that used the Bridge River, to your knowledge?

DR. BRADFORD: I don't think so, but there aren't a lot, there are only -- there isn't a large leak in the system that would lead you to believe there would be a large sockeye population, but there has been sockeye return to the Bridge River, so there may have been a river type population in there. But I don't believe it was a significant one.

Q Thank you. Dr. Macdonald, I had one question for you, just a brief one. There was some questions put to you about if one were to consider proceeding with surface release facility at the Kenney Dam, one would need to find money, and you made some reference to a $50 million fund. Were you referring to the Nechako Environmental Enhancement Fund?

DR. MACDONALD: Yes.

Q And is it your understanding that that's $50 million, or perhaps somewhat less than that if some has already been spent, that's available from Rio Tinto Alcan for expenditures on environmental enhancement related to the Nechako on a matching basis if somebody else puts up an equivalent amount?

DR. MACDONALD: That's my understanding, yes.

MR. McGOWAN: Okay. And, Mr. Commissioner, Mr. Hwang, who is coming tomorrow, may have some further information on that. Those are my questions in re-examination for the panel

THE COMMISSIONER: Thank you very much, Mr. McGowan. I want to thank Dr. Orr again, Dr. Macdonald, and Dr. Bradford again for attending and for providing your evidence. We're adjourned then until tomorrow morning at 10:15; is that correct?

MR. McGOWAN: Yes, 10:15 tomorrow morning, Mr. Commissioner.

THE COMMISSIONER: Thank you very much.

THE REGISTRAR: The hearing is now adjourned until 10:15 tomorrow morning.

(PROCEEDINGS ADJOURNED TO SEPTEMBER 16, 2011 AT 10:15 A.M.)

I HEREBY CERTIFY the foregoing to be a true and accurate transcript of the evidence recorded on a sound recording apparatus, transcribed to the best of my skill and ability, and in accordance with applicable standards.

Susan Osborne

I HEREBY CERTIFY the foregoing to be a true and accurate transcript of the evidence recorded on a sound recording apparatus, transcribed to the best of my skill and ability, and in accordance with applicable standards.

Pat Neumann

I HEREBY CERTIFY the foregoing to be a true and accurate transcript of the evidence recorded on a sound recording apparatus, transcribed to the best of my skill and ability, and in accordance with applicable standards.

Diane Rochfort