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.

Tuesday, April 19, 2011

**Tenue à :**

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

le mardi 19 avril 2011

## APPEARANCES / COMPARUTIONS

| | |
|---|---|
| Patrick McGowan<br>Jennifer Chan | Associate Commission Counsel<br>Junior Commission Counsel |
| Mark East<br>Charles Fugère | Government of Canada ("CAN") |
| Tara Callan | Province of British Columbia ("BCPROV") |
| No appearance | Pacific Salmon Commission ("PSC") |
| No appearance | B.C. Public Service Alliance of Canada Union of Environment Workers B.C. ("BCAUEW") |
| David Bursey | 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. | 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") |
| Don Rosenbloom | Area D Salmon Gillnet Association; Area B Harvest Committee (Seine) ("GILLFSC") |

**APPEARANCES / COMPARUTIONS, cont'd.**

| | |
|---|---|
| No appearance | Southern Area E Gillnetters Assn.<br>B.C. Fisheries Survival Coalition ("SGAHC") |
| Christopher Harvey, Q.C. | West Coast Trollers Area G Association; United Fishermen and Allied Workers' Union ("TWCTUFA") |
| No appearance | B.C. Wildlife Federation; B.C. Federation of Drift Fishers ("WFFDF") |
| No appearance | Maa-nulth Treaty Society; Tsawwassen First Nation; Musqueam First Nation ("MTM") |
| No appearance | Western Central Coast Salish First Nations:<br>Cowichan Tribes and Chemainus First Nation<br>Hwlitsum First Nation and Penelakut Tribe<br>Te'mexw Treaty Association ("WCCSFN") |
| Anja Brown<br>Crystal Reeves | 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);<br>Adams Lake Indian Band;<br>Carrier Sekani Tribal Council; Council of Haida Nation ("FNC") |
| No appearance | Métis Nation British Columbia ("MNBC") |

**APPEARANCES / COMPARUTIONS, cont'd.**

| | |
|---|---|
| Tim Dickson | Sto:lo Tribal Council<br>Cheam Indian Band ("STCCIB") |
| No appearance | Laich-kwil-tach Treaty Society<br>James Walkus and Chief Harold Sewid<br>Aboriginal Aquaculture Association<br>("LJHAH") |
| No appearance | Musgamagw Tsawataineuk Tribal<br>Council ("MTTC") |
| No appearance | Heiltsuk Tribal Council ("HTC") |

**TABLE OF CONTENTS / TABLE DES MATIÈRES**

**EXHIBITS / PIECES**

Vancouver, B.C./Vancouver (C.-B.)
April 19, 2011/le 19 avril 2011

THE REGISTRAR: Order. The hearing is now resumed.
MS. CALLAN: Callan, C-a-l-l-a-n, initials T.E., appearing on behalf of Her Majesty the Queen in Right of the Province of British Columbia. I expect I'll be a half hour.

CROSS-EXAMINATION BY MS. CALLAN:

Q You'd agree that population growth, solid waste, wasterwater, contaminants and non-indigenous species are unlikely the causes for declining populations of sockeye from 1990 to 2009?
A I'm going to access that very last table in my document as a summary. Pardon me, you said, population, land use?
Q I said, population growth, solid waste, wastewater, contaminants and non-indigenous species.
A Have a low interaction with sockeye habitats and the risk of their loss, yes.
Q And you'd agree to this because each one of these elements have remained stable over time while the sockeye were decreasing?
A I would say that each one of those issues, not necessarily remaining stable, have been dealt with either through regulatory structure or some approach which has allowed them and their potential interaction and effect on sockeye habitat and habitat use to remain relatively stable, or at least not be an association which would drive a decline of sockeye numbers.
Q Can you tell me about the habitat protection strategies that are being used for British Columbia sockeye salmon habitats?
A I don't know if I'll do them justice at all in terms of their extent or their approach, but I certainly can tell you with which ones I've had experience, if that's okay?
Q That's perfectly fine.
A And at a first level will be the ***Fisheries Act***, s. 35 and, in some parts, s. 36. The association with loss of fish habitats and, in this case, the

review of projects which might have implications of having or losing habitat associated with the project's development and/or changes through operations of projects which might have implications on changing habitats. That sort of regulatory structure is enforced by a number of agencies and looked at by the more junior agencies, if I can call them that, groups like the regional districts and the municipalities, as one of the major regulatory approaches used to at least protect habitat and understand the ramifications of its destruction.

The second is the ***Water Act***, with a number of sections through the ***Water Act***, which is a ***British Columbia Water Act***, rather than a federal fisheries act. And associated with that are a number of issues in riparian areas and in streams that allow for permitting associated with changes in those corridors that provide pretty strict regulatory structure in terms of what can and cannot be done and how it should be dealt with. That's a second one.

On the larger scale, there's a number of policies and management guidelines and best management practices that are embedded in, but most of the people working in the world on land and near rivers deal with those are -- are land guidelines, best management practices from the Province and the Federal Government, a number of guidelines, and again, I won't do those well -- service unless I'd had a compiled list, but there's numbers of them.

Then, within more local jurisdictions, where there's land and land development issues associated with water courses from riparian areas, we'd find in place things as simple -- for example, the City of Burnaby has a fairly rigorous erosion and sediment control bylaw system that allows for -- doesn't allow for, it's actually monitored and audited when projects are developed.

Similarly, the Metro Vancouver, at a larger regional district level, has best practices and environmental policies that are in place, and approaches.

So that's a sort of distribution of those kind of things.

Q Okay. And you'd agree that these habitat

protection strategies used in the Lower Fraser appear to be effective at supporting sockeye habitat conservation?
A I'm not sure that there hasn't been a change. I think that the implications of the changes in sockeye habitats in the Lower Fraser have not had a population level effect.
Q You'd agree that large industrial and infrastructure project impacts are low because sockeye residence is limited to the upstream migration?
A I think you're going to have to rephrase that question a little bit, please.
Q Okay, if we could turn to page 42 of your report.
A I'm sorry?
Q If you could turn to page 42 of your report.
A Yes.
Q And you'd agree that you say:

> Duration is low in the lower Fraser River because residence period is limited for most sockeye using the river as a migration corridor.

A Yes.
Q Okay. So then would you agree that the impacts are low because the duration is low?
A In most cases both migratory -- migrating adult salmon and migrating juvenile salmon do not spend an awful lot of time there.
Q Okay.
A There are certainly some holding areas that adults used, and that's getting into the details, again, about specific races or subpopulations of the Fraser, but at the population level, looking at the larger characteristics, adults migrate through that area; juveniles migrate downstream out of that area.
Q Okay. And would you agree that the magnitude is low because there's been limited project development adjacent to sockeye habitat?
A I would preface that with saying recent project development, yeah, over -- certainly over the last two decades has been lower than in the past.
Q Okay. So then you'd agree that that's the period of 1990 to 2011?
A 2010, yes.

Q Okay. And you'd agree that agriculture and forestry do not interact with key sockeye habitats?
A They do interact with key sockeye habitats in certain areas, but their rate of land use in those areas has declined relative to, again, a pre-1990 period. So there is interaction, but it certainly isn't, as we go through at the population level, isn't going to be the association which drives a change in the numbers of sockeye salmon through the Fraser.
Q Okay. So you would agree, though, that agriculture and forestry activities in the Strait of Georgia, specifically, and the Juan de Fuca Strait do not interact with key sockeye habitats, though?
A Their interaction is limited.
Q Okay. And that there's little or no evidence to suggest that the indirect effects, i.e. runoff quality from these land uses, are negatively impacting water quality in sockeye habitats?
A Relative to the period before 1990 --
Q Okay.
A -- there is not a change that explains the dramatic declines in the population level of sockeye.
Q Okay. And in your report you assigned a low risk to wastewater effects on sockeye salmon? Page 62 should help.
A Again, what I suggest is that there's been regulatory controls on liquid wastes, which have, through many of the wastewater treatment systems that we looked at, had, relative to the pre-1990 period to the post-1990 period, those regulatory structures have been improved, that the water quality characteristics in most cases, with the exception of what we were speaking about, about PBDEs, yesterday has, in fact, remained the same if not, in some cases, improved.
Q Okay. Can you describe the improvements that have occurred in the last two decades with respect to liquid waste disposal?
A I won't be able to describe them all, but certainly the characteristics and the trend is upgrades, for example, in Lions Gate wastewater treatment plant in terms of its ability to treat volumes of water, the types of water it's treated,

how much sludge is developed, the characteristics of the biological oxygen demand of that sludge, the total suspended solids that's both removed and put into the environment, those kind of characteristics. And the only reference I can really give you is on Map, I think it's, 9-A or 9-B.

And so when we've -- we've illustrated these findings over at least the 10-year period, what you're saying is, you know, fairly consistent levels of tons per year, which is a concentration, a measure out into the environment that these wastewater treatment plants again, you know, using this sort of information and the general discussion that you find in the wastewater liquid wastewater management planning through Metro Vancouver, which is one of the documents I cite a number of times, they indicate stronger regulatory function and a compliance through the British Columbia regulatory structure, too.

Q Okay. And that's the total tons are relatively consistent?

A Tons per year, that I'm looking at and one of the insights certainly show that, you know, there's some variation, but it's limited to less than -- certainly less than 10 percent annually.

Q Okay. So because of population growth, then the average per person is actually decreasing?

A I'm not sure about how those numbers relate. Certainly the number -- the volume of water in terms of billions of litres, has been increasing, of course, and that's just the nature of people flushing toilets and showering every day, and so that amount of water has enhanced, but it's, again, the measure that they use that that's distributed that was accessible to us suggests the number, or at least the concentration of material being put in the environment has been attempted to remain the same.

So with that, Iona -- Iona has, in fact, expanded its wetland capacity to hold more sludge, treat more water in different processes. There's been upgrades to Annacis Island from a tertiary -- from a primary to a secondary treatment, which removes a lot more material in different ways. And so the characteristics of those sites have improved and have been improving, and that

certainly is an ongoing effort from many agencies' perspectives, including groups like the Fraser River Estuary Management Program as initiatives to drive those changes in certain ways.

So we were, again, looking at population-level characteristics and indicators that represented large change that might have implications on the habitats that sockeye use and their potential for loss or degradation of those habitats. And so from that driven opinion what we found was, in this case, we weren't certainly seeing liquid waste as one of the drivers for that decline and change.

Q And you'd also agree, though, that the duration of interaction with sockeye is limited because they're moving through that area in their upstream and their return to -- and their downstream migrations?

A With the exception of what we spoke about in river type, Harrison or river-type sockeye from the Fraser that the general understanding that we've developed and in fairly detailed review of information, was that these animals are moving through those portions of the Lower Fraser River and the estuary fairly quickly. Similarly, with the exception of some of the adult races, I'll call them that, that that move through the Lower Fraser River, most of them migrate fairly quickly through those areas, so their exposure through duration is probably not particularly long.

But these are pretty sensitive animals. They've got good snouts for smelling things. I mean, that's how they're finding their rivers of origin in the first place. So I think, if I were swimming in there, I would certainly perceive changes in my environment and move out of those areas fairly quickly, and there is evidence that supports that certain notion for sockeye, particularly, when you look at the examples of how adult sockeye migrate through Alberni Inlet and Barkley Sound, with all sorts of historic issues there.

Q Okay. If you could turn to Exhibit 736, which is Tab 5 of Commission Counsel's book. And if you could turn to page 20 and look at Table 2. Do you have it in front of you?

A Yes.

Q Okay. You'd agree that there have been net habitat gains in riparian habitat?
A Based on Harper and Quigley's results to the mid '90s, that certainly is an indication on this table, yes.
Q Okay. And with respect to riverine off-channel habitat there's also been a net gain?
A There it indicates there's a minus 138.
Q No, no, that's in-channel. I'm asking about off-channel.
A Sorry, there -- yes, it indicates some change there. Again, we don't know the characteristics of these projects, where they are, where they're not.
Q Okay. But you would agree that in riverine off-channel there has been, according to Harper and Quigley, a net gain of 16,106 metres squared?
A That's what they're indicating in Table 2, yes.
Q Okay. And with respect to lacustrine habitat, there's also been a net gain, according to --
A Lacustrine, lake habitats, they're, again, indicating a positive estimate, yes.
Q Okay. And additionally, with estuarine, there's also been a net gain according to Harper and Quigley?
A Yes.
Q Okay. Now, if you could turn to Exhibit 667, which is Tab 4 of Commission Counsel's book, and turn to page 348, and if you look at Table 4, you'd agree that the balance, according to Harper and Quigley, is a net gain of 600,776 square metres?
A Across all of Canada in the projects that they reviewed, this is what Table 4 indicates, yes.
Q And in this chart you'd also agree that almost all of the categories of various habitats have also shown a net gain?
A That's certainly what this table seems to indicate, yes.
Q Okay. Now, you'd agree that some of the -- there are some issues with the Harper and Quigley papers, and that would include Tab 3 as well, which is 737, Exhibit 737?
A I'd agree there's lots of issues associated with this audit in terms of the information that's provided and the characteristics that it provides, and then the species of fish that it addresses in

terms of habitats and characteristics.
Q Okay. And some of the criticisms might be poor reporting or follow-up and the short-term nature of monitoring?
A Those are some of the characteristics, yes.
Q Okay. If we could now turn to Exhibit 738, which is the Beamish paper, and if we could turn to page 2, well, the 2 that's actually not the second page in the report but 2 on the bottom, which is -- yeah, that's the right one. Do you agree with the following quote:

> The environmental forcing that resulted in the poor sockeye salmon returns in 2009 was probably caused by a combination of large, early flows from the Fraser River, strong winds blowing up the strait, followed by a period of relatively weak winds. High freshwater discharge combined with winds that confine the brackish surface waters within the strait appear to have affected the stability of the surface mixing layer. Analysis shows that the spring of 2007 was highlighted by an estimate of mixing layer depth that was the shallowest in 30 years, most likely resulting in...reduced production of the preferred food for juvenile Pacific salmon.

Do you agree with that statement?
A I certainly agree with many aspects of that statement. There are some parts, again, the devils are in the details on some of the characteristics in terms of the mixing layer depth and its representation of the information that Dr. Beamish has presented here. But, in general, I would support that -- the statement about poorly developed plankton producing layer is fairly fundamental, yes.
Q Okay. And where is plankton, normally?
A Zooplankton, as opposed to phytoplankton, those are the two characteristics. Phytoplankton are autotrophs. They're algae, green algaes, blue algaes, diatoms. Those are normally produced in what's called a photic layer, and the photic layer is just simply the transparency. So when you go to a glacial lake you can only see through it at a

certain depth because the light cannot penetrate.
When you go to a place like Great Central Lake, the light penetrates to 15 metres, because it's a very clear lake. In the ocean, that changes fairly dramatically with the Fraser plume, the characteristics into the Strait of Georgia, different algae blooms, but normally that layer, it transitions over the summer as nutrients become available and changes in depths, it's about the top 15 metres or so that phytoplankton might inhabit.
Sorry for the long explanation.

Q No, no.

A As you extend into other species and get to larger zooplankton that are more like fish in terms of their ability to move, euphausiids will migrate throughout the water column. Mysids and other, larger, plankton species - krill, that we call them - move up and down the water column continuously, and they're in almost 100 metres of water.
But the preferred kind of layers in this mixing layer, which doesn't happen so frequently in the Strait of Georgia, is usually around the 10 to 15 metres, and the best example of that is when you -- if you go out salmon fishing and you're looking at your depth sounder and you see those kind of dense layers, not of fish, but just dense layers of stuff, that's usually the plankton layer that's of focus and discussion here.

Q Okay. So you'd agree, then, that the plankton that sockeye salmon eat is in the top 15 metres of water?

A Certainly is the -- seems to be what they eat. They're fairly diverse in the nature of the things that they do eat, so...

Q Okay. And is there any distinguishment between smolts, frys and adults in that regard?

A Adults aren't feeding in the Strait of Georgia, at least certainly not as they get closer to the Fraser River. Fry, certainly the work by Beacham suggests that they have a fairly decent diversity of things that live in the surface water column.
Smolt sockeye tend to be in large schools and look for those aggregations of plankton and fish and jellyfish, and anything else that they can find, and so they're in those sorts of layers,

generally, yes.
Q Okay. All right, can you define in your words what bioaccumulation means?
A In my words, bioaccumulation. Again, I'm not an expert in this area. My understanding of it is if I eat too many donuts that I will get a layer of fat that accumulates around me. The bioaccumulation part of that is if there's something bad in the donuts it may just settle in my waistline and not be moved out of me particularly easily or quickly.
Q Okay. So what I'm trying to get you to agree to is that basically in a food chain everybody's eating different levels. So the bottom of the food chain is ate by the middle of the food chain, and the middle of the food chain is ate by the top of the food chain?
A The analogy of Arctic hares eating grass and foxes eating Arctic hares, yeah. I mean, each of them eat their sort of levels and they've got their preferred sets of prey. What makes salmon very unique and a very interesting species is their behavioural plasticity it's kind of called, their ability to sort and sample their environment to figure out what's going on.
Q Okay. So then with bioaccumulation, if there's something bad in, in our case, the plankton, and the middle of the chain eats and then the top of the chain eats, it can magnify and the top of the food chain will have a higher concentration of that particular substance than the plankton?
A Those that eat, for example, let's say a hake eating lots and lots of sockeye smolts and there's something in the sockeye smolts, that will accumulate, if it's that type of chemical or agent in the hake a lot more, yes.
Q But the key factor in bioaccumulation is you have to eat something bad. It doesn't apply unless that plankton -- there's something bad in the plankton?
A There's that association, absolutely.
Q Okay. And you'd agree that PDBEs (sic) are in the benthic layer or at the bottom of the ocean?
A I'd agree that the works supported by Johannessen and the work I supported yesterday by deBruyn and a number of others indicate that the wastewater treatment plants and where those products are

mostly deposited are deposited into the sludge first, and the interface to that are organisms that usually eat or use the interface of the sediments much more readily, yes.

Q Okay. So then, for sockeye salmon, because they're eating in the top 15 metres of water, this issue of PDBEs (sic) is really not an issue?

A I ranked it low because of the duration that they use these environments and the potential that the food webs and the trophic levels that they're interacting with in eating have a lower exposure to those sorts of chemicals than others might.

Q Okay. And you'd agree that sockeye, smolts and fry are not at the top of the food chain as well, they're in the middle of the food chain?

A In the ocean they're certainly a lower planktivore they're called, so a plankton-eating fish; they're not a piscivore, in many cases, although they do eat small larval fish and other fish.

Q Okay. And adult sockeye are not feeding when they're doing their up-migration as adults to the Fraser River?

A Dr. Hinch could probably talk of that topic a lot more than I can, but my understanding is very soon upon entry into the Strait of Georgia they're stopping to feed -- stopping feeding.

Q Okay. So then it's fair to say sockeye are not in contact with PDBGEs (sic) in a significant way; is that a fair statement?

A Through their food. I'm not sure, in terms of gills and water quality and straight digestion and uptake of water, I don't know how that influences them and how they're going to accumulate those sorts of materials.

Q Okay. And PDBEs (sic) do not have the same types of environmental effects as PCBs or other persistent or organic compounds?

A That I do not know, and my assumption is, from the general literature that we were speaking about yesterday, was that, in fact, they are considered one of those legacy types of contaminants and are consistent with those other ones.

Q Okay. And the decision to ban PDBEs (sic) would be a federal decision; is that correct?

A I do not --

MR. McGOWAN: I'm not sure the witness is well suited to respond to that.

A I do not know that answer.
MS. CALLAN: Okay.
Q Are you aware of any studies which indicate what a lethal dose of PDBE (sic) is on sockeye salmon?
A I do not know.
Q Okay. And if we could turn to Exhibit 741, which is Tab 2 of Canada's documents, and if you could turn to page 6, and look at Table 2, would you confirm that this table, the column called total PDB -- PBDE at surface outlines the measurements of PDBEs (sic) at various areas in the area, or are you aware of that or not?
A I think, and this is my interpretation, so I'm not sure of the answer yet, but I will take the interpretation, again not being an expert in this, looking simply at these results, that this associates directly to Figure 6 on the next page, and in that figure, if I were to look at that, and I'm not sure if these things are relating or not, but is certainly the concentrations and the approach that they're using here suggests that the distribution of PCBs and other bits in the environment, PBDEs, certainly show a distribution much more around the outfall of, in this case, Iona than other areas, and that was GVRD-3.
Q And just moving onto my last subject, and there's only a couple questions left, would you agree that sockeye do not spawn in gravel in the mainstream of the Fraser River?
A Maps 3, particularly, in our results suggest that all the literature and all the information that we searched indicate that they're not using those areas as preferred spawning areas --
Q Okay.
A -- in the main stem of the Fraser River --
Q Okay.
A -- below Hope.
Q Now, with the exception of the Harrison River, sockeye generally only use the gravel reach as a migration corridor?
A The gravel reach as defined within the Fraser River?
Q That's right.
A I wouldn't say "only" use it that way. As we spoke yesterday with Federal counsel, they certainly have a portion of their life history as river-type fish that use a lot of those areas.

Q Okay.
A And again, we -- not talking about what portion of the Fraser population is using it, but they are using those as for river-type -- Harrison river-type sockeye, river-type sockeye throughout the Fraser as sensitive environments.
Q Okay. So you'd agree that of all of the sockeye stocks the Harrison River sockeye stock is the stock that's most likely to be affected by gravel mining?
A I would make that general assumption by the types of habitats that they use, but I do not know if that association is possible right now.
Q Okay. All right. And you would agree, though, that the Harrison River sockeye are increasing in number?
A That was not under debate, but I didn't understand the characteristics or the information that Dr. Beemish had used in his paper to make that clarification. I think Dr. Peterman will be much better suited to speak of that issue.
MS. CALLAN: Okay, thank you. Those are my questions.
MR. LEADEM: Leadem, initial T., appearing as counsel for the Conservation Coalition.

CROSS-EXAMINATION BY MR. LEADEM:

Q Just picking up on that last theme, Dr. Johannes, the gravel removal, as I understand it from the mainstream, or the main stem of the Fraser could actually create fish traps; are you aware of that phenomenon?
A Not really, no.
Q All right. You're not competent to answer that one way or another, are you?
A I wouldn't say I'm not competent to answer that, I'm saying that I don't have the information in front of me that gives the annual characteristics of those areas and what a fish trap might involve in terms of how it works, hydraulically or functionally.
Q Okay. I want to examine with you your -- the statement of work which I find in Exhibit 735, beginning at page 94. And I wanted to make sure I understood some of the objectives and the scope of the work that you had undertaken. Under the Objectives 2.1, you were to describe historical

trends and development activities in the Lower Fraser and the Strait of Georgia that impact sockeye habitats. And you chose to limit your work to a period of time from 1990 to 2010; is that right?

A I'm sorry, you're talking about page 94?

Q Page 94.

A Objective 2.1?

Q Yes.

A Yes, I defined the area of interest during the first statement, which is the background, during the period of decline, which is defined as the 1990 period onwards.

Q Okay. And that's why you chose that timeframe reference; is that correct?

A I did not choose that timeframe.

Q Under the scope of the work, you were to prepare a habitat inventory for sockeye habitats in the Lower River below Hope and identify human activities that could affect them, that was 3.1; is that correct?

A Yes.

Q You did not quantify any habitat inventory for sockeye in the Lower River, did you?

A The scope of work for 3.1 suggests I prepare a habitat inventory.

Q Right.

A Which is what we have done.

Q All right. Did you quantify that in terms of square metres or how large that was?

A As we spoke about yesterday in fairly extensive detail within my methodological section I indicated the limitations for trying to do that --

Q Right.

A -- sort of approach.

Q So the answer is, "No," you did not -- you weren't able to quantify it because of the limitations of the work and the time available to you; is that fair to say?

A I would say it's more the limitations of the information.

Q You also, in your evidence, I think to Commission Counsel yesterday, suggested that because you did not have data associated with water flow that you left water flow out of the calculations for sockeye habitat; is that -- do I have that right, or have I got that completely wrong?

A I think we were speaking about water extraction --
Q Yes.
A -- and the use of water licensing information to define what water extraction was about.
Q Right. You would agree with me, would you not, that water flow and how much water is actually in the Fraser River is actually very critical in terms of the habitat of salmon, and particularly sockeye salmon, would you not?
A Agreed, yes.
Q Now, under 3.2 scope of work, you were to analyze the Fraser estuary development, including the impacts of larger vessels, for example, oil tankers. Did you actually look at oil tankers going into the Fraser and the risks of oil spills and what effect that may or may not have upon sockeye?
A At the populate -- to answer that question, yes, we looked at the shipping census information over the period that we've examined here, and within that characteristic there is tonnage for bulk cargo, other cargos, including oil. From those characteristics, what we wanted to do was, again, look at indicators over time, a time period which had suggestive issues associated with declines and were there changes dramatically in terms of the characteristics of shipping volumes and movements and tonnage and those characteristics.
So within that, certainly we looked at that. In terms of individual incidents of oil spills or those issues, again, we were looking at the population level characteristics of the sockeye population.
Q Yes, I understand that you come down to the population level. You don't deal, for example, in your report with biodiversity or conservation units, you're primarily concerned with the overall population of the sockeye, are you not?
A I'm afraid spatially and the characteristics of the study area certainly moved us in that area fairly quickly.
Q Getting back to the oil tanker question that I had earlier, did you try to parse out from your tonnage of shipping what portion of that was attributable to tankers that had oil in their hulls?
A Within the shipping census information from Stats

Canada, that information is available.
Q All right. Do you know what portion of that it is? Could I find that somewhere in your report?
A No.
Q All right. The proposed expansion of Vancouver Airport Fuel Delivery Project, I did not see that anywhere in the confines of your report. You are aware, of course, that the Vancouver Airport Fuel Facilities Corporation is proposing a large superport for jet fuel to go to YVR; are you not?
A I'm aware of that project, yes.
Q All right.
A But as scope 3.2 indicates, that suggests, for example, oil tankers and expansions, and the key part about the Vancouver Airport Fuel Delivery Project and any of those projects that are happening now, are -- there's two parts to that, and the emphasis, again, is as we could achieve this, we wanted to first and foremost make sure we understood the characteristics of the sockeye habitat use - sockeye habitat use - where they're using those environments, where they were, where they weren't, and that certainly framed the conditions of looking at these other components and these indicators. It was an independent process, of course.

Now, the larger projects that are happening immediately right now, again, the implications of those projects and their development on declining sockeye population, those are not direct associations, or at least I wouldn't infer that as being a direct association.
Q So the short answer is that you chose not to include information about the Vancouver Airport Fuel Delivery Project that's currently underway in Richmond; is that right?
A I didn't say that. What I did say was, we looked at major projects and the major projects inventory.
Q Yes.
A And if this project is under review or under construction or development, or if it has a large environmental assessment certificate, then it would have been included in our data system.
Q And was this particular one included in your data system, to your knowledge?
A It's not at the stage, yet, to be included in that

system, yes.
Q It goes on to suggest, as an example, that you look at development of bridges and damage from dredging. Did you, for example, take into consideration the twinning of the Port Mann Bridge, the Gateway Project?
A Yes.
Q Okay. And Golder and Associates is actually involved in that project, is it not?
A We have been, in the past, involved in that project through the environmental assessment certificate process, yes.
Q Now, under 3.3 on the next page, page 95, you were to describe human activities in the Strait of Georgia and identify those which could negatively affect sockeye salmon, and you were to evaluate coastal zone protection zones related to shoreline development, shipping, aquaculture and oil tanker traffic.

I did not find anywhere in your report any reference to aquaculture. Did you actually choose not to include that, or what happened with the aquaculture aspect of that?
A Aquaculture was not included in this report. It's being included in another report.
Q All right. So you were advised not to include it, but yet, you would agree with me, that because aquaculture is a possible -- may possibly negative effect sockeye salmon, it ought to have been included in a review of Fraser River sockeye habitat in Lower Fraser and the Strait of Georgia, because there are aquaculture facilities in the Strait of Georgia, are there not?
A Similarly, there's log-storing facilities in the Lower Fraser, and that was included in another chapter, also. So I believe the Commission is handling that through a series of technical reports. They thought the topic material that we were covering in chapter 12 was fairly sufficient.
Q Now, a number of persons had commentary with respect to reviewing your report, well, three, actually, and I'm going to take you there, next. The first one is Dr. Rick Routledge, and he's a professor at Simon Fraser University; is that correct?
A Yes.
Q And he's an expert within the field of habitat,

salmonid habitat, is he not? You would recognize him as an expert in that field?

A Yes.

Q If I can ask you to turn to page 100 of his report, under item 1, he says the following:

> The authors have paid insufficient attention to the quality of the evidence that they have pulled together. At times, this is critically important. For example, much may be learned through a careful examination of the rearing and migration biology of the river-type sockeye salmon that spawn in the Harrison River whose 2009 returns were remarkably strong in comparison to other populations in the Fraser watershed.

It goes on to say:

> The report cites three references to support their conclusions regarding rearing habitat, use of the Fraser estuary and near-shore marine area, and subsequent marine migration routes. Some of the supporting information is remarkably weak,

and it goes on to site an example from the west coast of Vancouver Island:

> The authors need to probe for such weaknesses and provide a more careful assessment of the basis for the conclusions that they draw.

And your response to that is contained at page 101, where you say that you've:

> ...attempted to address the concerns listed above and revised and augmented the attached report where possible.

Now, the difficulty I have with trying to follow the exchange you may have had with Dr. Routledge is that I don't have the draft, so I'll have to assume that when you received this that you somehow incorporated Dr. Routledge's comments within your report; is that right? Is that what

happened?
A Oh, absolutely. The draft that Dr. Routledge has was a very early draft and we, certainly within the review process that was embedded here, wanted to make sure that they had an opportunity to comment early so that we could do a lot of revisions to the report.
Q Going back to his comment where he says the report cites three references, are there more than three references in your report to support your conclusions regarding rearing habitat, use of the Fraser estuary, and near-shore marine area? We talked about two of them yesterday, the Harper and Quigley studies.
A Those are not the references that he's citing. It's the Levings, Whitehouse reference --
Q Right.
A -- those characteristics. Harper has another reference up the Fraser. So yes, we certainly went through to make sure that we explored and looked at as many references as possible.

The inference of that discussion is associated with, again, what -- how many fish might use estuaries in areas of the Lower Fraser, and I indicated we did not do -- it's certainly never going to be a comprehensive bibliography or review of the literature, but it was exhaustive. And so in that context, if there are only three or four or five or 10 references available for that area, we certainly have found them and used them to the best of our ability.

Our inability to comment further on the characteristics of that habitat use is the deficiencies of the information that exists, and certainly one of the recommendations that we make is in support of additional work there.
Q Yesterday, when you were discussing the Harper and Quigley studies with Commission Counsel, you also referred to another report by a fellow called Kistritz; is that right?
A Yes.
Q And that's something that you relied upon in arriving at your conclusion that there's been an actual net gain of habitat over the -- from major projects over the last 20 years or so. So that was one of your sources, was it not?
A It was a discussion item that we used to talk

about the characteristics and evolution of compensating for habitat losses, and we provided the example of Kistritz where he only looked at information until 1993.

Q Yes.

A And that information, itself, suggested that, as we go on to strongly point out, the learning curve associated with restoration and compensation of the technological advances made in it is very important when characterizing what's a gained habitat and what might not be a gained habitat. That's the way we've used that reference.

Q I want to show you that reference that you have in your -- that you included in your bibliography and you referred to it in cross-examination, and it's a report by Mr. Kistritz, entitled, Habitat Compensation, Restoration and Creation in the Fraser River Estuary. The subtitle on it, Are We Achieving a No-Net-Loss of Fish Habitat? You're familiar with that paper, are you?

A Yes.

Q If I can ask you to turn to the abstract, which is at page vii of that paper, I don't think I need to take you through the whole report, but there's a couple things I want to draw to your attention. It references the fact that:

> ...all compensation, restoration and creation projects undertaken in the Fraser River Estuary between 1983 and 1993.

So that's the time reference, so it only includes three years of the time reference that you, yourself, used; is that right?

A Yes. It's still indicative of a program, though, for habitat compensation.

Q Right. It goes on to say that:

> Data were summarized to determine whether we are achieving a no net loss (NNL) of subtidal, mudflat, marsh and riparian habitat in connection with habitat compensation. With respect to subtidal habitat, the [No Net Loss] Principle has generally not been applied. Nevertheless, 90 [hectares] of shallow subtidal, mudflat/sandflat has been lost on Roberts Bank.

That's the big superport on Roberts Bank, located near Tsawwassen; is that right?
A It doesn't indicate where that habitat loss is in the abstract here, but Roberts Bank does include the ferry terminal and T2.
Q Right. And then it goes on to say:

> The [No Net Loss] Principle has not been achieved for mud/sandflat habitat because a number of compensation projects did not adequately replace lost mudflat. Compensation for the loss of brackish-freshwater marsh has been successfully achieved; however, a net deficit exists for saltmarsh. The NNL Principle has not been achieved for riparian habitat.

And then it goes on to say:

> Several habitat restoration and creation projects have resulted in a net gain of habitat in the Estuary.

And you read that report and that report formed the basis of some of the conclusions, or the conclusion that you reached in your report regarding a net gain; is that correct?
A No.
Q All right. Why is it not correct?
A It is not correct because this report very clearly shows that - that doesn't very clearly show - it certainly shows that the real evolution of this part of habitat sciences, in terms of how you plant an eelgrass, how you plant a saltgrass, how you actually make it grow, the whole technology of doing these things effectively was evolving, strongly evolving. And as we indicate in the report, '86 was the time when the no net loss habitat policy was imposed and the characteristics of that, again, was the evolution of that development as a management tool and approach.
So what Kistritz shows is this learning and the realization that we are losing habitats and we're trying to do something about it. It may not be as effective as we so chose or wish, but it's developing and evolving, and that's a good first piece of work.

It led nicely to the audit that Harper and Quigley, Quigley and Harper developed, and it certainly leads to the final recommendations and the recommendations that they're providing here on the abstract. You know, those -- most of them are fairly consistent and useful right now, even many years later. They show that we still need to work on this and we still need to keep our thumb on that issue and evolve the practice of doing this well and understanding what we're losing and what we're gaining and how we're doing it.

Q Well, I agree that we need to keep on top of it. Before I leave this report, I wanted to just reference that there's a two to one ratio that usually is applied for marsh habitat, in other words, that if you take away one hectare of marsh habitat you usually should replace it with two hectares; are you familiar with that concept?

A That's the general concept that's applied. Two to one is the gain to loss.

Q Right. If I could ask you to look at xii of the Kistritz paper, under the heading, Habitat Compensation, the second full paragraph, under that heading begins:

> The typical habitat replacement formula applied by DFO to the Fraser River estuary is as follows:
>
> > For marsh habitat, a ratio of 2:1 is requested such that twice the area of the same type of habitat is replaced as is lost or damaged. This replacement ratio takes into account the time period required for a productive marsh to develop and the risk involved in successfully achieving this goal.

So you're aware, of course, that there's a lag period between the time that you actually have the new habitat and the time that it becomes effective as habitat for a fish, correct?

A Yes.

Q And the risk involved in successfully achieving this goal is that when you're putting in new habitat a lot of it tends to get washed away, particularly if you're dealing with the Fraser

River with high water flows; is that right?
A There's lots of consequences that may not work -- allow it to work. One of them is the lag time. One of them is events or conditions that are unknown or undeveloped. It takes a bit of time for these things to effectively operate. And again, this was developed and based in a period where the science was just evolving.

We do a number of references in the text that talk about some of those characteristics and some of those issues. One of the approaches that tries to and attempts to deal with this lag time, as you expressed it, is something called habitat banking, and we've seen the Port Metro Vancouver and Metro Vancouver, itself, and in association with the Fraser River Estuary Management Plan, attempting to bank habitats in all sorts of ways.

Now, whether all of this is effective and whether this provides a ratio of gains to losses that is meaningful and useful is unknown to me at this time.

Q Did you take into consideration, in your calculation of habitat as being a net gain, this marsh ratio habitat of two to one; did you factor that into your consideration?
A No, not generally, no.
MR. LEADEM: Might this be marked as the next exhibit, please?
THE REGISTRAR: Exhibit Number 743.

EXHIBIT 743: Habitat Compensation, Restoration and Creation in the Fraser River Estuary, dated 1996, by Ron Kistritz

MR. LEADEM:
Q Going back to the commentaries and the critiques of your reviewers, I want to go to another one, and staying with Dr. Routledge's comments and the same page, number 2, he says, under 2:

The authors conclude that the sojourn time and migration route of juvenile sockeye salmon in the Strait of Georgia depend on food availability and such physical conditions as salinity and temperature. They also produce interesting and potentially valuable maps. However, the methodology

leading to these maps is inadequately explained. Furthermore, they do not appear to have investigated the potential for any time trends in these phenomena that might explain the decline in Fraser River sockeye returns leading up to 2009. (I am also not confident that their assertion regarding the importance of copepods in the diet of juvenile Fraser sockeye salmon is accurate.)

Did you address that bracketed portion in your report or are you sticking to your hypothesis that the copepods - I can't recall the species that you looked at specifically that seemed to be the predominant species that sockeye like - did you take that -- factor that into consideration, or are you still of the view that it's the copepod production that's responsible for the decline?

A Copepods are certainly one indicator, but we went to a lot of detail to explore this issue, and I appreciate Dr. Routledge's comments there a lot. He's a very smart fellow. What we did to address that was we went back to food availability and food preference literature and Preikshot - I have a copy of the paper with me right here - does an exploration of sockeye habitats, or sockeye food preferences and use of prey items. And so we characterized that that much better than we had originally, in part to -- the draft that we submitted was incomplete in some of those areas, and so we were still requesting information and data to actually explore that issue and trend. And so that evolved to be Map 12-B and 12-C that explore that whole kind of characteristic of food and use and abundance of characteristics.

In the end, after requests for information, what I was able to get was, in fact, euphausiids in a variety of copepods, a number of species involved in both calanoid and cyclopoid copepods that are in the environment that might be used.

Q Did you not do work, yourself, on copepods and food production with salmon? I can't recall if that was the topic of one of your studies.

A I don't think it was illustrated in my C.V., but I have actually done some of that work.

Q All right. Now, going to the commentary of Dr. Reynolds, which follows on the commentary of Dr.

Routledge, you know Dr. Reynolds is a professor, also, at Simon Fraser University, correct?
A Yes.
Q And you would recognize him as an expert with respect to salmonid species and this particular area of salmonid habitat analysis?
A I'm not sure about that.
Q Okay. If I can ask you to turn to page 103 of your report, under item 5, it says:

> Long-term monitoring of habitat quality, based on a statistically defensible and biologically meaningful design,

would help to improve our understanding of this subject area; you would agree with that comment, would you not?
A I've made that assertion yesterday and, yes, we've spoken about that already.
Q Okay.
Q All right. And then under 6, it says:

> Please provide any specific comments for the authors.

And then:

> See below comments.

And I don't find any of those comments anywhere in this report. Did you, in fact, include them, or was this inadvertence on your part not to include these comments on your report?
A I actually don't recall the extent of Dr. Reynolds' review. His was fairly simple in terms of what was there. I obviously have not added a comment in there.
Q All right. I'm just wondering whether Dr. Reynolds made some specific comments that assisted you in the preparation of your report or not, and it's unclear, from my reading of this, whether we're missing some information or whether it was provided to you and just through inadvertence was not included in your report. Can you answer me that?
A All I can answer -- well, I don't know the exact details of that, it certainly was a couple months

ago, but what I will say was Dr. Reynolds, as along with Dr. Routledge, as along with Dr. Rosenau's comments, were very helpful, very, very helpful indeed. And it certainly was a forcing - not forcing - asking our team to be much more contentious or much more descriptive in terms of how we develop the effects and the effects-like approach.

Q Finally, if I can look at the -- well, before I leave that, I just have a little niggling question. Presumably, you have a work file that you used in providing this report consisting of drafts and so forth, and I'm wondering if I could ask you to go back to that work file, and if there are, in fact, some specific comments that Dr. Reynolds provided to you that we don't have, I'm going to ask you to provide those to Commission Counsel and eventually we can have them. Can you do that?

A I don't know the answer to that. I don't know what -- I haven't got my (indiscernible - overlapping speakers) --

MR. LEADEM: Mr. Commissioner, I'll just leave it as an outstanding request. I'm sure your counsel will address it.

Q Finally, we have Dr. Rosenau's comments, and you're familiar with Dr. Rosenau's work, are you not?

A Some of Dr. Rosenau's work, yes.

Q Right. And you would consider him to be qualified to be able to comment upon some of the drafts of your report; is that correct?

A He provided insightful comments, yes.

Q And he's qualified to do so, right?

A I believe so.

Q Now, he says, in number 1 under his comments:

> The primary strength of the report is the comprehensiveness of the issues. The primary weakness of this report is that because the authors covered so many topics, and over such a wide geographic area, they are dealt with in a relatively superficial way.

I'm just going to stop there. Would you agree that because there was such a big piece of pie that you had in front of you that you couldn't,

within the timeframe that you had available to you, that you had to deal with it in a relatively superficial way; you could not do this in any great depth, could you?

A No, I don't actually agree with that because, again, as the comment says, as you've raised them, and as some of the reviewers have commented, they wish to see certain components. For example, the Harrison River-type sockeye is an ongoing kind of component and issue, and yes, it would have been nice to explore that as a case study example specific to the report, but again, we're dealing with broad scale population-level issues. And this resolves itself as looking at that same broad level scale indicators that associate back to that and that larger issue.

I think it -- well, I'm an author on this, I think we've done a reasonable to good job at doing that.

Q But isn't one of the weaknesses of this report is that you've approached it from a population level, and if we go down to the conservation unit level to take into consideration biodiversity, that you really don't address the conservation units that are in the Lower Fraser, such as Weaver Creek, such as Cultus Lake, right? You don't examine those specifically, do you, in the confines of your report?

A The other reports in the series do do that, and no, that wasn't necessary to deal with that. We we're dealing with habitat issues, the association with habitat. And so the specific focus on Cultus, Harrison, others, those were explored in terms of their use of habitats and their characteristics for sure. In terms of the distinction and definition of a conservation unit, its characteristics over time, as you see from the technical report series, there will be authors that deal with the specific nature of the freshwater issues, the migratory issues of the adults, the population dynamics, all those characteristics.

So this one set into a place where we were looking at broad-level indicators and their association and influence.

Q But you could have taken a look at Cultus Lake sockeye, for example, and looked at the habitat

requirements of the Cultus Lake sockeye, which are well known and well documented, you could have looked at Weaver Creek sockeye, and you could have documented that as well, right?

A Which we, in fact, did in Appendix 3. So starting at page 107, Harrison Lake and Lillooet spawning habitats. Page 108, Harrison Lake, Lillooet rearing habitats. Page 109, Chilliwack/Cultus Lake spawning habitats. Page 109, Chilliwack/Cultus Lake rearing habitats.

Q Right. And I find that descriptive indication to be valuable, but you don't, then, relay that description of the habitat that's used for some of these creeks and some of these conservation units and relate to what human interaction might be impingent upon that habitat, do you?

A Yes, we do, and that's why it's characterized within Table 2 in every single one of those table components as Lower Fraser watersheds, and that characterizes that study area portion as we spoke about with federal counsel yesterday.

Q Well, you don't quantify it to the extent that we can't take any -- we can't apply a numerical analysis to the quantification of this habitat. We don't know how large it is, what area it encompasses, do we?

A As we have, you and I, have just spoken about, quantifying the extent of that habitat is very difficult at this time.

Q All right. And you've been involved in that specifically with respect to Strategy 2 of the Wild Salmon Policy, have you not?

A Specifically with Harrison Lake and the Fraser River stocks, no.

Q So your work is more generally applied throughout the province, rather than specifically focused upon Lower Fraser?

A This component study that's outlined in my C.V. was a small study to develop a monitoring strategy for habitats under the Wild Salmon Policy.

MR. LEADEM: Mr. Commissioner, I note the time. I'm almost finished, and if you would like a break, I would like a break --

THE COMMISSIONER: That's fine.

MR. LEADEM: -- if I could do that.

MR. REGISTRAR: The hearing will now recess for 15 minutes.

(PROCEEDINGS ADJOURNED FOR MORNING RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: The hearing is now resumed.

CROSS-EXAMINATION BY MR. LEADEM, continuing:

Q Prior to the break, Dr. Johannes, we had been looking at the reviewer's comments from Dr. Rosenau, and I want to go back to number 1 that we have been examining together. After the commentary about being "dealt with in relatively superficial way", Dr. Rosenau says:

> ...some of the things that may have happened earlier on, say in the 1970s or 1980s, and had a lag effect (say, the large-scale sand removal in the lower river, forest harvest in the 1970s and 80's, which may have not impacted the spawning streams for two decades) are not dealt with because the things that they really looked at were from...1990 and onwards.

Does Dr. Rosenau have a valid point there, that there's a lag effect from some of these things that happened earlier in the time period that might have impinged upon the time period that you focused upon?

A That would inevitably result in the change in the numbers and the characteristics of the adults returning to spawn. Ultimately, that's the indicator. That's what so wonderful about an anadromous species like salmon is they're on their cycle of generations that renew each time. So they are a complete demonstration of their environment.

Q Right. So, in other words, even though you looked at 1990 to 2010, because that was the period of decline, perhaps we should have cast our sight further back to see if there were any of these lag effects from over-forestry or from sand removal or things of that nature. Isn't that what Dr. Rosenau was saying there?

A He's suggesting that that might be important in this case because we're looking at, again, population level indicators and response of the

population to those indicators.

I don't know if I agree with that approach. That would suggest, then, we need to go back pre-settlement. We need to go back to when Hell's Gate -- and the collapse in the Fraser in terms of the landslide, all those sorts of issues. Again, it's point of reference and point of focus. The point of focus in terms of what is associated or effect or interactive with the decline of the Fraser salmon stocks, and that's reflective of the last twenty years.

Q But Dr. Rosenau isn't saying, well, let's go back to the Hell's Gate slide in 1914 or whenever it may have occurred. He's saying let's go back a decade or so earlier and see if there's some residual lag effects that have happened to the habitat there to cause this decline from 1990 onwards. Isn't that what he's saying?

A I don't agree with that, just those periods, then.

Q All right.

A I mean, because the lower Fraser diking happened till the 1950s, and when you read Dr. Rosenau's commentary here, he deals with understanding about diking issues, and so those -- absolutely, they have consequences. There's no doubt about there's loss of habitats all over the place. But are those necessarily associated with declines in salmon over the last two decades for Fraser sockeye? That's the question.

Q Under item 6, Dr. Rosenau says:

> Comments are provided in an attached appendix to these review pages. They are comprehensive and detailed.

Once again, I looked for those comments from Dr. Rosenau in this report; I could not find any, so I will leave that also with you, and with Commission counsel, as an outstanding request that, in due course, those detailed comments from Dr. Rosenau be provided to counsel at this inquiry.

MR. LEADEM: It looks as though we might even have them in hand, Mr. Commissioner.

MR. McGOWAN: Yes, Mr. Commissioner, I've just been handed what I understand to be a complete set of the comments provided by both Drs. Reynolds and Rosenau and I'll provide a copy to my friend

forthwith.
MR. LEADEM: All right. I'm content to move on and if necessary, anything that might arise I can perhaps ask one of my learned colleagues, Mr. Rosenbloom or Mr. Harvey or Ms. Brown to address those in their questions.
Q Now, I wanted to go back to basically what I hear you saying in terms of the synthesis of your report is that if you examine the population of sockeye with the emphasis on the population aspect of sockeye, and if you examine just the effect from major projects - with the emphasis on "major" - in the last twenty years, that it's your opinion that there's been demonstrated a net gain of habitat for that population of sockeye. Is that -- do I have that right?
A I cannot demonstrate a net gain in habitats by the information that I have right now. As I suggested before, all indications support both some learning, in terms of restoration/compensation works, the regulatory structure that imposed on these kind of projects, and other projects like them, and the association to our general understanding of the habitats, and the habitats that sockeye use suggests that there hasn't been a change. I can't assert one way t'other (sic) whether it's been a gain or a loss.
Q Okay. So there are a couple of assumptions in your conjecture there, and one is that the regulatory structure, of which you are aware, the assumption is that it's been applied correctly and that it's being applied efficaciously; in other words, it's working. Isn't that one of the assumptions that you make?
A Yes, it is. And the recommendations that I move onto suggest, associated with that assumption, are fairly focused in terms of how you address that assumption.
Q And similarly with respect to the learning curve, as you call it -- and I would agree with you that in terms of the learning curve, in terms of project development, we're much further ahead on an evolutionary sense now than we were back prior to 1990. Companies that are proposing developments in the lower Fraser are much more knowledgeable about environmental effects of their projects. That's, in effect, what you're saying,

correct?
A I think there's been an evolution. I think it can be improved.
Q Right. And one has to then consistently monitor those projects to ensure that developers are in fact doing a proper and right job when they say that they're restoring habitat. Isn't that a fair statement as well?
A It is one of the recommendations that I support, and the framework for which you do that, the transparency of the information and the approach used, the science that is used to set standards and guidelines, the approach, all those things, as we well know, can be improved.
Q And in reality, it's really not possible for us to say, either you or me or anyone, that there's been a net gain of habitat for sockeye or a net loss of habitat for sockeye because we really don't know the numbers. We really don't have the core data that we need to be able to definitively say, yes, there's been a net gain or, no, there has not been a net gain or, yes, there's been a net loss. We don't have those numbers, do we? We're really operating a little bit in the dark, aren't we?
A That's a statistical quantitative analysis on a qualitative approach, which is why we use the framework methodologically which is a causality association, not necessarily a statistical regressive cause/effect association. The association of effects assessment is well documented in terms of its approach and use and attempt to define those issues.

As Dr. Reynolds points out in his review, they were looking for more support of that kind of approach, and we certainly, within the final stages of the report from the very early draft to this stage, worked very hard to make sure that we had at least a qualitative approach that was defensible in terms of expressing those opinions on this issue.

Is it perfect? Absolutely not. Do we wish to have those quantitative measures to say, you know, numbers of houses with impervious surfaces associated with habitats on one axis and the other, and see some sort of correlative or regressive relationship? Absolutely. That's where we'd love to go.

Q Right. But we can't get there, so we use the qualitative approach and it really comes down to the qualitative approach as defined by your subjective opinion; isn't that right?
A Professional opinion.
Q Yes.
A And that of 20 others in my team.
MR. LEADEM: All right. Those are --
A And the experience in this area.
MR. LEADEM: -- my questions.

CROSS-EXAMINATION BY MR. ROSENBLOOM:

Q Dr. Johannes, my name is Don Rosenbloom. I appear on behalf of Area D Gillnet and Area B Seiner.
Sir, I'm in the unenviable position, unlike the counsel that have preceded me, that I don't have a group of scientists behind me to advise me and so please be patient as I deliver questions to you that you may find somewhat simplistic and naïve, but I do wish answers to it.
Firstly, you'll recall at the time that you were being introduced to this inquiry and your expertise was being solicited from you for purposes of finding that you're an expert in this area, you'll recall an exchange that I had with you in cross-examination on your expertise related to the involvement of yourself and those within your staff that participated in this study regarding the 70 or so major projects that are the subject of focus within your Report 12. Have you had an opportunity overnight to provide me with some information?
A Yes.
Q And I wonder if you would be kind enough to do so, firstly, in respect to your own involvement in any of those projects, and secondarily, in respect to those other co-authors and staff that have participated in Report 12 preparation.
A The first characteristic that I, again, want to emphasize to you was that there are, within -- not just authorship, but the characteristics of the report and the staff that were involved from my team, some 22 people that were involved in this process, various specialists and professionals in different areas.
From the authorship of Lee Nikl, myself,

Roxanne Scott and Rob Hoogendoorn, what we participated in terms of those major projects, which were just one of the indicators we used within this study, initially we started with a set of 341 projects, which were developed as the methodological statements in the report say, from a series of inventories that exist in the registries of projects and project developments.

Major projects are defined in terms of their characteristics of how they're developed and what suite triggers a regulatory review and so on. So I won't get into the characterization and classification of what major projects are and are not.

So our database started off with 341 projects from 1862 to present. Of those 341 projects, the authors have been involved in 19 of those projects, so that's 5.6 percent. Of the projects beyond 1990, there were 74 projects in fact, and we were involved in five of those projects. Of those 74 projects, 43 were outlined in maps 16 as being associated with our overlap spatially/temporally with sockeye habitat use. Of 74 projects beyond 1990, the five projects that I outlined, I personally have been involved with - I'll do that count right now - one, two -- two.

Q Thank you. And in respect to your company generally and staff within your company, is the extent of your participation in those projects the same as what you have just provided to us, or would it be a more extensive participation?

A Oh, I won't be able to represent that at all. Golder is a company of -- a privately-owned company of 7,000 people or more. We have 3,000 in Canada, so it's a large company.

Q I meant in the B.C. office.

A In the B.C. office we have 400 people. I can't represent exactly what they're doing or what they're not doing. But what I will point out is we're professionals. We certainly have very defined standards and ethics in what we do.

My own background is one where I've been in and out of working with First Nations and communities, in salmon groups, in research and federal government and industry. So, you know, what we tried to use was the experience and the professionalism associated with that approach.

Back to Golder now, Golder is a ground engineering specialty group. We are not a large group like other companies with a full suite of services. We work on geotechnical issues, we work on archaeology issues, we work on groundwater issues, and we work on environmental issues.

The two projects that I mentioned for myself, those two projects were from an environmental review process and what that means is I can help a client or proponent put together the details for the environmental review, but I in no means participate in the review of the project and the information and it's in fact certification if it goes to that very point. In many cases, the two projects I outlined, one of them I was a discipline lead for a very specific topic within it, and if you were to articulate what my involvement in the larger project would be, it was probably less than .1 percent. So that's how it breaks out, if that's helpful.

Q Thank you for your efforts overnight in responding to that question. I want to turn briefly to the terms of reference and Mr. Leadem made reference to it. As I understand it, the decision to use as a window of review for this study, 1990 to 2010, is not embodied or embedded within the terms of reference, but I assume a dialogue you had with Dr. Levy and the staff of the Commission in limiting your study accordingly; is that correct?

A Let me just review --

Q Thank you.

A -- just a section here in my report.

Q By all means.

MR. LUNN: Mr. Rosenbloom, do you have a page number for that in the report?

MR. ROSENBLOOM: Pardon me?

MR. LUNN: A page number for what you were --

MR. ROSENBLOOM: A page number for the terms of reference?

MR. LUNN: Are you talking about the --

MR. ROSENBLOOM: I'm talking about the terms of reference and asking the witness --

MR. McGOWAN: Ninety-four, Mr. Lunn.

MR. LUNN: Thank you.

A The only reason I am referencing any of the words that I've written here in reference to the "Scope

of Work" was the definition of the interim Cohen Commission reporting and the definition of the real purpose of - and focus - of the report -- reports. Within that context, the very, very first statement in the "Scope of Work" indicates the decline in sockeye, and so that was the reference that we used.

MR. ROSENBLOOM:

Q So was it at your discretion that you chose this window of 20 years?

A I'm not exactly sure how that developed or evolved, but certainly all the information to the decline, and I represent that in the introduction of the report, about how that was phrased in this time period.

Q Yes. I'm more interested in fact in another aspect of your window, and that relates to your focus on major projects. I wondered if you would explain to me how you evolved in your study to limit your focus to the major projects, and I'll get into the definition of major projects in a few minutes. Is that embodied within the terms of reference?

A As examples, yes. Within the scope of how we were to approach the term or the scope of work, not explicitly, no.

Q Could I ask you how you then came about exercising your discretion and limiting your focus to major projects?

A I didn't limit my focus to major projects. It certainly was one of the aspects. Again, it has to do with what data is available to do some sort of review of -- and the association to. If we get too medium-sized or small or urban-based municipal projects, there is no comprehensive set of information that allows us to review those types of projects in the same process.

Q Right.

A From a major projects point of view, as I was indicating methodologically, there are a couple of good sophisticated data systems, databases around that. We could easily articulate the issues. As the "Scope of Work" suggests, they pointed to a couple of specific features or specific projects that are considered to be major projects and within that data system. So it wasn't for ease, it was for focus and --

Q I'm intrigued by your response - in the early part of your response to me just now - that you did not limit yourself to a focus of major projects. Did I misinterpret your remarks a moment ago?
A No. There are ten other indicators.
Q Okay. How am I to take, or how are we to take in your report, at page 52 - Mr. Lunn will put it up - under the heading "Development Activity and Impacts on Sockeye Habitat", page 52, second paragraph, second line.

> However, the goal of this component of our review is more narrowly focused on identifying whether or not major project development has led to decreased sockeye salmon production through changes in habitats over the period of 1990 to 2010.

How am I or how are we to interpret that if it isn't that you have - and I'm not faulting you in the slightest for any of this - but that you have, as I read this, chosen by discretion to limit your analysis to major projects.
A Oh, I don't think that's a fair statement. As Commission counsel interviewed me yesterday and we went through the details of the report methodologically and its structure, as we recognized this habitat protection strategy starting on page 50 is the fifth section.
What we honestly tried to do - and we can be faulted in this approach, there's no doubt about it - but what we tried to honestly do was when we were to address coastal zone protection strategies, areas of issues, we embedded that into a larger section. It wasn't appropriate to review the federal regulatory structure or the provincial regulatory structure within those strategies, so we thought we'd examine another approach. So this is a bit of a case study as best as we could reflect on what was available to us in the literature and the information.
So this section 5 more directly relates to those projects, perception right or wrong, which might have major impacts on the environment and are considered major projects.
The other part about this that's also very intriguing is -- and we make comment on this a

number of times -- it's easy to focus in on those individual issues and, fair enough, you're right, major projects was a focus, it's a point source issue. It's an individual little focused piece. Being able to look at the non-point sources, the diffuse issues, that's not really easily possible, and that's why we actually in fact reference all those recommendations at the end because that's the association that's also important.

But this was used as a vignette, as a case study that allowed us to explore some of the issues. So those results described here are in fact four major projects, yes.

Q Yes. And, in fact, I may be awfully naïve in suggesting this to you, but couldn't, for example, ten more minor or less major projects cumulatively have a greater impact than one major project in terms of habitat issues?

A We tried to address that, and that's a fair question. That's why you see some of these inserts here, some of the project definitions that we developed and in fact you see in Table 3. Table 3 is not a representation of major projects. It's in fact a representation of restoration projects.

The others are representation of examples of compensation and restorative actions, and so if we turn to the example of the Pitt River Intertidal Wetland in Port Coquitlam --

Q And let's get this on the screen, or maybe we already do.

A Page 52.

Q Yes, thank you.

A In that example - it's a little vignette - that shows a very interesting kind of approach in a tidal flats area where it wets -- it wets itself, pardon me - with tide, it has a higher elevation of water and when the tide is out, it has a lower elevation of water with floodwater events and freshet from the Fraser or the Pitt. It comes up in water, and so it provides this environment. It does actually actively, in terms of a restorative, compensative -- no, I'll call it in terms of a habitat, it does a couple of things.

One, it opened up the dike in the area. Two, it allowed off-channel habitat that hadn't existed before. Three, it probably is accessible to a

number of salmonids. I wouldn't necessarily suggest that it had the greatest of use of importance to sockeye, but it is being used by them.

Then it relates back to a series of projects honestly where it acted as compensation. That's from my understanding of the area and the region. I don't know if it's defined anywhere, but it acted as compensation for, I believe, a road expansion somewhere in Port Coquitlam, the Coast Meridian overpass and some other areas that it acted as.

Q Sorry, are you suggesting that this particular project, the Pitt River Intertidal Wetland Project was not a major project?

A Oh, no. This is not a major project.

Q I see. All right. Now, I want to --

A A major project is a major development project.

Q All right. I want to drill down now to some really basic stuff. Firstly, when you were analyzing or focusing on major projects, these are presumably projects where the proponent has come forward to DFO, has applied for review by DFO, has applied for HAD under s. 35/36 of the ***Act***. Presumably all of these major projects that are under review and part of the foundation of your report have had that history, correct?

A They may have had that history, yes.

Q What do --

A In some cases, no. And so your inference is actually three levels down within the review process and it usually comes at the very end. What the database and the information that are associated with major projects, as they are regulatorily defined - if I use that term correctly, I'm not sure - there are characteristics with under -- and we make that explicit reference to the ***Canadian Environmental Assessment Act***, the ***B.C. Environmental Assessment Act*** and their regulatory triggers within it.

And so DFO is potentially one of those responsible authorities within that characteristic that allow that, and it doesn't necessarily need to result in a s. 35(1) request and a 35(2) authorization --

Q But in all cases, the proponent has come forward and notified the DFO of an initiative being taken

and where there might be habitat consequences. That, presumably, is common to all of the major projects that you focused on in this report, correct?

A No. No, that's not the major projects list. And so there's very -- not a simple way to actually define that, believe it or not. These are projects that are listed within the CEAA or the BCEAA registry. These are also projects that have a significant feature on the landscape.

In the case of the 1862 project that I spoke about, it's the Crofton sawmill. It was developed back then. We put it in the database because it was a large articulated industry project-related feature that was on the environment. Similarly, Elk Falls Pulp & Paper, it was developed well before the 1990 period, has had a history on and off, and so we also put that into the database.

So our comprehensive review, as we do describe it, was -- and exhaustive review, not comprehensive -- was intended to find those projects that are large initiatives, those large development issues that have association. They didn't necessarily, in some cases, need to trigger a DFO response. Certainly the 1862 project, it was unconsequential so -- inconsequential.

Q Let me tell you where I'm going with this, Dr. Johannes. I don't know if you've had an opportunity to review the transcripts of testimony given by Mr. Nelson before this inquiry relating to enforcement issues and s. 35/36 prosecutions and so on. Do you have a recollection of reading that portion of transcript recently --

A I have not read --

Q -- about two weeks ago? Well, what is gleaned from that in the way of testimony is the following: Please correct me if, in any way, you have a different understanding of it.

Currently, the regime here in Canada in respect to habitat compliance is a regime wherein a party comes forward voluntarily to notify DFO of a project or an initiative that might affect habitat; that it's voluntary, you agree with that?

A I don't think I'm actually an authority to talk about that.

Q All right.

A I only have my own project experiences.

Q Okay. And but you would agree that you are well aware there are numerous initiatives, individual actions, projects, that take place where DFO is not notified and where there's -- and/or there's no application for a HAD.
A I'm not sure if I do know that.
Q All right.
A From the characteristics of large projects, it's absolutely, given the regulatory approaches now, it's impossible to develop a transit centre without making sure it goes through the entire regulatory review.
Q Absolutely. But the purpose of my cross-examination with you is to bring out from you what is under the radar, and what is under the radar has not been analyzed by you in drawing the conclusions that are a part of your report here. So I just want to first document what is under the radar. Would you -- you've already agree minor -- sorry, less than major projects, as you defined it, were not a part of your review, correct?
A You'll have to rephrase that, sorry.
Q That you limited your review to major projects, and that there obviously are other projects that are within human endeavour, day in and day out over the last 20 years, that were not part of your review.
A In section 5, we looked at major projects.
Q Yes.
A Throughout the report, as we indicated, the indicators develop ten different measures for metrics that allow us to talk about different components of the environment.

Within the characteristics that you're speaking about, I have no reference point or ability to -- I can speculate, but I certainly haven't got a firm understanding of the continuum, which it is. Regulatory approaches wane and become more effective over time. I'm not sure which projects were identified and which projects aren't, over time.

I certainly know within the reference that I worked in, which is both internationally and locally, the awareness, the understanding, the development of issues associated with damage to environment is changing. My hope, my honest passionate caring hope is that it will continue to

evolve to be effective.

Now, whether there is, as some of the other testimonies have provided, a continued loss of fish habitats across the country, again, I would only speculate on that. But it's -- you know, my hope is that we're going to do better.

Q Yeah, I appreciate that, but would you agree with me that to the extent that the Commission concludes, at the end of the day, that there is a great deal of habitat degradation going on that is not known to DFO and is under the radar, that that would undermine the conclusions that you arrive at in terms of your Report 12?

A The recommendation that -- again, I don't know if I agree with much of that. But what I do suggest is an alternative to that is that when you look at the Harper/Quigley audit, which is the last one that was published, known kind of information, and you look at the characteristics of their reported projects within there, you can certainly, if I knew the identity of all those projects, could tell you that information.

Because what's obviously represented in that information is some small projects and some big projects. So what files did they audit? Which ones didn't they? What does that information look like? What evaluation standards and program did they use to evaluate that? So I don't know. But it would be worthwhile to ask and look at that question.

So under the radar, stuff happens. People do stuff all the time. My hope is that there's something happening to respond to it. The reality of it, yeah, some of it escapes and that's --

Q To the extent that there is a weak enforcement of the s. 35 and 36 of the ***Fisheries Act***, obviously the public interest is exposed in terms of habitat degradation.

A I'm not sure if that's a question, but --

Q It is a question I ask.

A I can speculate on that, and I'll go back to a colleague of mine's report. Dr. Riddell wrote a report on the central coast salmon stocks and stock status and it was interesting, it's the statistic I've seen in terms of the number of records of inventory on streams over time. I believe he goes back to the salmon escapement data

system and progressively looks at the numbers of inventory observations conducted by fisheries officers and biologists over time.

What it means is how much attention is an agency spending on a specific stream or place? What Dr. Riddell shows in his stock status report - and this is published out of the Pacific Fisheries Resource Conservation Council - is, over time there has been a diminishing number of visits to individual streams and areas.

So speculation suggests that if that's happening in areas, I suspect that that's happening in lots of places. I don't know how many staff there are supporting ongoing for agencies like MOE and DFO and others that support, on the ground, reviews of habitat scenarios. So I don't know how frequently they've been there.

But certainly the indications by Dr. Riddell's kind of work suggests that there's been diminishing attention.

Q Would you be surprised if I told you that there's evidence before this inquiry that I believe last year - or it might have been 2009 - there was only one conviction in Pacific region under s. 35 and 36 of the ***Act***?.

A Would I be surprised?

Q Yes.

A I'm neither surprised or not surprised. I'm slightly ashamed to know that we're not supporting necessarily a good habitat review and quality that way.

Q I want to focus on the choice of the 70 projects or 74 projects. I haven't grasped how you delineated those 74. Do I gather that they were retrieved or were obtained through the Harper & Quigley study?

A No. As I pointed out earlier, methodologically we went to a series of databases and it had nothing to do with Harper & Quigley at all. The 74 is a data-sorting associated with time, and it comes from a project base of 341 projects, in fact.

Q And you filtered down to 74, correct?

A Yes.

Q And you --

A And it subsequently filtered down to 43.

Q Yeah, and you -- how did you exercise your discretion in applying this filter? What were the

characteristics of the 74 that weren't in the larger numbers?
A Oh, as I said, it was a straight filter, and the filter was time.
Q Straight what?
A Filter. 1990.
Q I see. And so you took all of the projects from that database for that period of the 20 years.
A Map H shows all 341 projects, and map -- map 16B shows 43 projects. There's a delineation and an association through that progression. So it shows a retrieval and a synthesis of information and, as I expressed to the Commissioner yesterday, the process of a filter in terms of likely interactions and approaches is a mechanism of filter with the application as we talked about in terms of professional opinion and expression of those issues.

So in terms of section 5 in the report, I mean, we speak about major project issues, and again, I'll refer you to some of the comments that we spoke with counsel this morning and yesterday about which was our understanding of the review process, taking it through a review process and seeing in your hands something like - something like - an environmental assessment certificate for a major project, and I have that in my hand. Within that environmental assessment certificate, granted either by the province or the federal government, is a series of commitments. Within those commitments, which are legal commitments to a proponent to build and operate a project, within those commitments will be explicit items that define habitat loss and gain.

Now, that said, that's the vision, that's the objective. Whether that is achieved is the whole issue that you're in fact, in part, addressing with me, and I don't know the answer to that. I don't know the audit compliance components of that, that issue. I'd like to see that information, but I don't have it.
Q As you look at those 40-some projects, can I assume all these projects, the data you're looking at is data prepared by the proponent through their scientific consultants and not compliance reports from DFO?
A Yes.

Q And do you not consider that significant in terms of the weight that should be given to your analysis of those projects?
A No.
Q Why?
A The final outcome of the review of a major project is in fact a regulatory review, and the regulatory review is not directed just by the science of a proponent. The review is directed by - I'm sorry if I sound like I'm lecturing - but I'll just explain this very briefly, my apologies.

To get the project into a place where it is reviewable, it needs something called Application Information Requirements. Those requirements are defined by a working group of federal/provincial/municipal agency staff that are involved in the process. They define the scope of the study and they review the scope of the study in the end and the results of that study - and the results of that study - and provide their recommendations to both federal and provincial agencies, in fact to say whether this is something that is suitable to go forward.

Q I totally, totally appreciate that, Doctor. Forgive me, I appreciate what you're saying. But to cut you short for a moment, my question is *ex post facto* the certification of the project. What Harper & Quidley (sic) speak about in their studies, are they not -- is partly the issue of monitoring and compliance of the projects as they are certified or approved or authorized for the proponent. Do you agree with what I have read in Harper & Quidley (sic) that there is a huge shortcoming in a lack of data in terms of monitoring and compliance what has been approved?
A On a general scale and scope, absolutely. In terms of the characteristics of my own experiences in projects, I would say given the professionalism with which I hopefully conduct myself and all my staff, you know, we have our own compliance and audits that are standards in approach. My hope is that most of my colleagues in the biological world, environmental world, would adhere to some sort of level of professionalism and, in some cases, that happens. That comes with some of that evolution of experience that I spoke about.
MR. ROSENBLOOM: In the Harper & Quidley (sic) study,

and it is the first one, 2005, and it's Exhibit 667, Mr. Lunn, if you could have it before us.

Q Because time is so short, I'll just go to the abstract. In that abstract in the second column, two-thirds of the way down, the authors say [as read]:

> Determinations of [No Net Loss] NNL could only be made for 17 authorizations as a result of poor proponent compliance with monitoring requirements and the qualitative assessment procedures used by the monitoring programs.

And it goes on from there.

This, of course, is a national study, but surely the comments of these authors would apply generally to the Pacific region and to the projects that we're dealing with out here. Are we any different than the rest of Canada?

A I think we are, and that's why we focused in on the marsh marine estuary, salt marshes and some of those areas, because that's, in part, where much of the experience has been gained over time. This is part of your lag-like comment. We in fact have just better experience in developing those restorative compensative habitat techniques. The science is just a little better.

Q Well, are you saying --

A Now, the devil is still in the details, because applying across lake areas and stream areas and everywhere else, it's apples and oranges, frankly. Again, this comes about (sic) what is the implications to sockeye habitat use?

Q So a limitation to an analysis of net - NNL - is surely to the extent of the quality of information that you have in respect to after certification or authorization of the project and the extent of the monitoring compliance.

A Yes.

Q Yes. And you have no reason to believe Pacific region of DFO has been any more -- has any greater capacity to do this work than anywhere else in Canada?

A That's a very fun question, I have to say. It's fun because of a lot of things. As someone that's lived in this area for 21 years, coming from

Ontario, and someone that's lived in Europe and see the sort of consequence of those environments where we develop and urbanize, in my little vignette, experience shows a little place in the Alps where, in a little Austrian village, there's a tiny stream area where there's probably 150 rainbow trout living in there. They're an exotic species there. But that, after, you know, 1000 years or more of history and development, that is a revered tiny little stream that they're working so hard to develop -- or -- compensation habitat restored in areas.

You know where that experience comes from? It comes from the Pacific coast, the northwest coast. So the stewardship issues, the local ecological knowledge, the traditional ecological knowledge combined together into something that's -- you don't find anywhere else in the world, frankly, is salmon stewardship.

I belong to salmon stewardship groups independent of my own science activities, because that's a fundamental part of my personal being. But these groups and the evolution of the ideas and the importance of salmon as an icon and a habitat, has allowed this part of the world to think much more about habitats and salmon and issues, and all the restoration river guidelines for colder water species, much of them are developed from California through B.C. to Alaska. Frankly, we do do a better job at that sort of stuff out here. The science is here.

There is only one course, Creswell (sic) -- there's now two courses in Canada, but historically there's only been one course on aquatic restoration. There's one at BCIT now, but that is taught in the University of Victoria and now BCIT. It's not happening anywhere else.

Q But all I'm suggesting to you, sir, is the capacity of DFO in terms of compliance, monitoring compliance of habitat out here in the Pacific region is no greater than the capacity of DFO in the rest of Canada. Do you not agree with that?

A I don't know the numbers of staff that are involved in this, but I do know that they may have or should have an easier ability to understand what's being done right and wrong, given the state of the science in some of this are.

Q All right. I'm running out of time. Up-river pollutants, pulp mills up in the Prince George area, this was completely off your radar in terms of your study?
A Yes. Mr. McDonald (phonetic) will cover that, I hope.
Q Then counsel, Commission counsel, in their examination in chief drew out of you that your study, in terms of No Net Loss, was really an analysis of square metre, square hectares of what we call aerial analysis as opposed to the quality and reproductivity of a replaced habitat. Do you agree with that?
A I agree that most of the metric that's been used is the square metres-like unit rather than quality.
Q And you would agree with me that in a perfect world, had you more time, had you had better data to work with, that the more important or more critical database for you would be to analyze the quality and productivity of the replaced habitat as opposed to whether one square metre got replaced with another square metre or two square metres.
A There's a breadth of study done by a Dr. Minns in Ontario who looked at productive capacity, and he was a DFO scientist. I suspect some of these are referenced in Harper & Quigley. But Dr. Minns spent a long time thinking about productive capacity and the characteristics of that.
Dr. Jamieson here on the west coast, also with DFO, has talked about sensitive habitats and critical habitat capacities. So those are coming onto the radar. They're not evolved as well as I would certainly like to see, and they are critical aspects to understanding habitats, for sure.
Q And that's a shortcoming that we're all left with at this inquiry because you, as an expert, aren't able to bring that to the knowledge of this Commission for all these reasons.
A I did it in a qualitative fashion. That's why there's yellow, greens and reds in maps -- in maps 3, 4 and 15, various colourations that are indicative of not necessarily our assessment of the habitat itself, but of the habitat use by animals. So the habitat uses are indicators of quality. It may not be the characteristic of

optimal habitat that they're looking for, but behaviourally, as we spoke about a little bit earlier, these are smart animals. They seek out the best habitats that they can, given the opportunities.

Q Very briefly, I just want to speak to two quotes in your paper, page 63 of Report 12, second paragraph. If you would explain this to me, second sentence of that second paragraph.

> More broadly, a hypothesis that the declines in Fraser River sockeye production are the result of major (or even moderate and minor) project development is not supported by the likely net gains in habitat that have occurred over the period of review.

The net gains of habitat you're speaking about is in the context of major projects, correct?

A The net gains I'm speaking about in this context is that same assumption that you and I spoke about earlier which is - you're absolutely right with your discussion about audit and compliance - a leap of faith. When it gets to a point where there is a s. 335(2) authorization on a HAD, there is an understanding that there is a habitat balance identified and articulated on the project. That balance, whether it's a minor project or a major project, is adhered to. Now, whether that's compliant in the end and audited for compliance, I am not sure of the answer.

Q And again, completely off the radar are the non-reviewed projects, the projects that don't have HADs, the projects where DFO didn't receive notification, correct? Obviously.

A I don't know if there's any inventory of what that looks like, but I would imagine or at least speculate that that might be possible.

Q So as you say in this quote that I just cited:

> ...are the result of major (or even moderate [or] and minor)...

Your moderate and minor projects were not reviewed by your team in respect to this project, correct?

A Yes.

Q Yes, I'm correct?
A Yes, you are.
Q Thank you. I just have one other quote to deal with, page 58 of your report, where you, again at page 58 down at the bottom, you say, right at the last four lines:

> More broadly, a hypothesis that the decline in the Fraser River sockeye adult returns (Figure 8) are the result of the development of major projects is not supported by the likely net gains in habitat [and] that have occurred during the review of major projects following implementation of the "no net loss" policy.

Again, same theme as my previous questions to you, what we take from that is you are coming to this Commission and you're saying the hypothesis that there is some relationship between major project habitat initiatives and No Net Loss and the decline of the sockeye, there is no relationship there.

That is your hypothesis, but you have not come forward, for reasons we've understood, to say that there is not necessarily a correlation between the decline of sockeye and habitat degradation of all kinds of projects that may be other than major projects.

A When we started this discussion with Commission counsel yesterday, one of the methodological steps that we made was, very first, looking at the habitats used by sockeye. The second part of that was represented in section 3 where we took those major projects and made the association, both time and space, to those sockeye habitats. The third/fourth approach is what you're speaking about now.

During the third approach, methodologically, we said let's say we're developing the Port Mann Bridge. What association does that have with sockeye habitat use? We made that association and did our qualitative analysis on that association. So in those cases, what we say at the population level, more broadly, the expression of these types of projects are not reflective of a change that we see from a certain period of time in the numbers

of sockeye.
Q These type of projects meaning major projects.
A Meaning the major projects that we certainly looked at in this case. We have no knowledge of all the projects.
MR. ROSENBLOOM: I thank you very much for your answers. Thank you.
MR. McGOWAN: Mr. Commissioner, Mr. Harvey is next. Perhaps he could get started, or perhaps we could come back a few minutes before 2:00.
THE COMMISSIONER: Yes, why don't we adjourn now and we'll try to get underway about five to 2:00. Thank you.
MR. McGOWAN: Yes. Now, Mr. Commissioner, just before you go, Mr. Harvey has alerted me to the fact that there is a chart in one of the upcoming projects he wants to ask this witness about. He has not given notice of that. It seems to be a fairly straightforward question he wishes to ask. I would suggest that the witness be permitted to look at the document over the lunch break.
THE COMMISSIONER: Very well. Thank you.
THE REGISTRAR: The hearing is now adjourned until 1:55.

(PROCEEDINGS ADJOURNED FOR NOON RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: Order. The hearing is now resumed.
MR. HARVEY: Dr. Johannes, it's Chris Harvey, appearing for the Area G Trollers and the United Fishermen and Allied Workers' Union.

CROSS-EXAMINATION BY MR. HARVEY:

Q I'd like to start with something you said in your evidence yesterday, which, if my note is right, is this, that there is in your opinion no loss of productive capacity in the Lower Fraser, in your opinion; is that correct?
A I'm afraid I don't remember the context necessarily for that statement. Within the characteristics of what we might talk about as sockeye habitat and habitat use, that might be applicable there.
Q Yes. But did you mean to include the Cultus Lake system in that conclusion?

A I was speaking at a very population level area and as we spoke about this morning, not necessarily getting into some of the details associated with individual races or sub-stocks of the populations of sockeye.
Q Yes, all right. Because I think we'll hear later in this week in the Peterman report that it's very likely that the Cultus had its productivity affected by human activities. You're not meaning to contradict that in any way?
A No, I'm not. In fact, there are reports that we cite, Schubert, Neil Schubert's work on Cultus, and some of the recovery strategy for Cultus Lake sockeye itself that speak about some of the spawning habitats and some of the other areas as being influenced.
Q Yes. All right. But in the Strait of Georgia, you have determined that the zooplankton levels have been declining; is that correct?
A I have not determined that. I have just used results from others to suggest that that's a trend that seems to be happening.
Q I see. So does it flow from that that it's important that the sockeye smolts entering the Strait of Georgia are well-nourished before they get there?
A That is a characteristic that's fairly important in some cases. Historically there has been a regression relationship that's been supported that says the size of the smolt leaving the environment is associated with its survival, and that's well-referenced, Ricker work and some others. It's not as supported by that issue as we might think, and over the last two decades or so there's been a variety of evidence that in part supports that and in part suggests that there is other factors that are considerably more important.
Q But it seems obvious to me, and correct me if I'm wrong, that as the challenges rise in the Strait of Georgia for sockeye, it becomes more important that they are full size and healthy with good energy levels before they reach the Strait of Georgia.
A I would think that that would be one contributing factor, but it may not in some years be the most important characteristic.
Q All right. But you have noted a downward change

in the quality and abundance of the preferred food in the Strait of Georgia; is that right?

A I wasn't able to well-articulate the characteristics of all the food, preferred food items. And as I was indicating yesterday and this morning, the information that I was able to receive from requests was the information provided in Map 12C, which showed copepods of various sizes and euphausiids, and it showed some indication of downward trending approach.

Q Yes.

A Although there is considerable variation there.

Q Now, there was a convenient chart in Project 8 that you were shown just before the lunch break that I'd like to look at. It's in the Project 8 report, which we haven't reached yet, at page 73. Mr. Lunn, could we have that.

MR. LUNN: I'm just pulling it up at the moment.

MR. HARVEY:

Q This is a figure which shows the number of effective spawners in a graph. It reads:

> Number of effective spawners of Fraser River sockeye salmon. The number of spawners has increased in recent decades. Has this led to more, but smaller smolts in poor feeding condition that will be more susceptible to predation?

And on the next page, page 74, the authors make the point that is a consequence. This is the paragraph beginning:

> Related to this is that the Fraser River sockeye may have become the unwitting victims of their own success. As shown in Figure 36, the numbers of effective spawners of Fraser River sockeye salmon have increased in recent decades, which in turn may have increased intraspecific competition and exposed smolts to higher rates of mortality. Previous studies have shown that increased sockeye fry abundance leads to lower average weight of smolts, and that the total biomass of a smolt year class may decrease with increasing number of spawners... The implication of this is that increased escapement may lead to

higher predation mortality in the ocean where there is a strong positive correlation between size and survival...

Did you wish to comment on that in any way? Does that qualify anything you've said?

A I have lots to say about this, and lots of other topics, apparently. This is an interesting discussion. This is one of the fundamental impetuses for the development of the Salmon Enhancement Program set originally, and lake fertilization and issues associated with that. As some of the work by Hyatt and McQueen and others in the Nimpkish system have recently shown, that climate, warming trends, associations between freshwater discharge also have implications in terms of how much productive capacity there are within rearing lakes, to support the growth and development of sockeye as young rearing individuals.

So again this is the devil is in this detail here. Lorenzen is not necessarily the best reference for this, and I know Jeremy Hume, and out of Hume in '96, and the context is a little bit skewed in terms of this discussion. So although the general concept is appropriate, again, the detail is associated with individual rearing lake systems.

For example, Chilko is a partially glacial turbid lake. Because of our conversation this morning about euphotic zones, it has a different capacity, carrying capacity, if you will, to support juvenile sockeye, and that's probably in the range, if I were to give it a number, around five kilograms of fish per hectare. And a place like Harrison, on the other hand, or even going to Quesnel, those lakes and those systems have a capacity to support somewhere in the order of eight to ten kilograms, if not more, of sockeye biomass within the lake system. So, you know, lakes and freshwater systems produce different size and characteristics of smolts.

If you go to the very West Coast of sockeye distribution into some of the coastal lake systems, what you'll find is sub-one gram smolts leaving, less than six centimetres, you know, fish about this size leaving to the ocean and doing

just fine in terms of returns. But again the example is wholly dependent on the conditions in the ocean that they're receiving into. If it's one of these considered a warmer poor years, then you get opportunities for enhanced predation. So it's a combination of those influences, for sure.

Q But it seems for sure you wouldn't want smolts that are more susceptible to a shortage of food, and more susceptible to prey in the -- I'm talking about the Strait of Georgia area. You wouldn't want that scenario to be happening if you were managing a fishery and had some control over it.

A You'd like animals that are in good shape leaving for the ocean, yes.

Q Yes. All right. Your Ph.D. work, I think, was in freshwater systems; is that correct?

A Yes.

Q Did that work include the carrying capacity of the systems that you looked at?

A Yes.

Q You mentioned, I think, when you were being examined on your qualifications, the top-down effect. That means overgrazing, does it not, driving down the food web?

A The conventional models on this ecosystem-like approach in trophic systems is top-down/bottom-up. Bottom-up being how much fertilizer or how much nutrients is there on a field for grass to grow. The top-down influence is if we've got caribou in the area feeding on the grass, how many wolves there might be that eat caribou.

Q Yes. Did you -- did you study the situation in Lake Ontario after the introduction of chinook in that system?

A No, I did not.

Q Are you aware of that being top-down overgrazing?

A Lake Ontario is actually, I would consider that to be a poor example for a number of reasons. At the same time as the issue and there was another Johansson (phonetic), Eva I believe her name was, out of the Centre for Inland Waters that was working in those areas looking at some of those dynamics in trophic level issues. At the same time, Lake Ontario is a specific example, is and was receiving lots of nutrients that were driving the system. So the changes in characteristics of species like alewife and perch and pickerel and

all those things became fairly important. So, I mean, I'm not sure if that's a practical example here at all.
Q All right. Well, it's getting far from the topic. And I take it that you were not asked to review changes in the food web, the sockeye food web in the freshwater system. That's beyond your study?
A In this study, yes, I was not asked to do that.
Q Yes. But you did look at an earlier experiment in the Rivers Inlet area, I think you mentioned; is that correct?
A No. What I was mentioning was some early work where I was asked to comment on the general characteristics and productive capacity of Owikeno, and that was relative to some early work in the Nass and some of the other coastal system lakes.
Q All right. I'd like, Mr. Lunn, if we could bring up the Walters, Goruk, and Radford paper that I sent around a week or so ago. This is a paper entitled "Rivers Inlet Sockeye Salmon: An Experiment in Adaptive Management". I think it was Tab 16 of --
MR. McGOWAN: I'm sorry, just before we move on, I'm going to suggest that we put the page numbers of Report 8 that were referred to on the record.
MR. HARVEY: Well, do we want to put the whole exhibit in? It's going to go in eventually.
MR. McGOWAN: Yes, Mr. Commissioner, I'd suggest we hold off on entering it as an exhibit until the witness comes. But for the sake of the record I'm going to suggest we put the page numbers on the record that were referred to.
THE REGISTRAR: Pages 73 and 74 will be marked as Exhibit 744.
MR. McGOWAN: No, I'm not suggesting, sorry, Mr. Giles, that anything be marked. I am just suggesting that those page numbers be put on the record. That somebody say them into the microphone. You have now said them, so they will be on the record.
MR. HARVEY: All right, thank you.
Q Mr. Lunn, could we have the next -- oh, I'm sorry, no, it's not that one, it's the one either before or after that. That's it, Rivers Inlet Sockeye Salmon, and there's mention of your work, I think, at page 256, the right-hand column, towards the bottom right quadrant. Yes. Towards the end of

that paragraph we see 1989 and 1991 in brackets, and then it says "K. Hyatt and M. Johannes", that's you, I think, and that's the work you did with Kim Hyatt, is that right, that's referred to here?

A It is. It was a contribution to my NSERC post-doctoral fellowship.

Q It says, "personal communication", and then it says:

> ...however, based on lake carrying capacity, presmolt densities, and typical egg-smolt survival rates for sockeye salmon, suggest that the number of smolts required to adequately seed the lake might be produced by as few as 250,000 spawning adults.

So that was your conclusion; is that correct?

A I don't have the information in front of me at this time, and I'd have to -- I can expand on what that might mean in terms of a calculation, but it seems a bit high.

Q It seems a bit high. But if we look in the upper left-hand corner, there's a graph, Ricker graph, "Figure 3 - Stock-recruitment pattern for Rivers Inlet", I think this is based, yes, on historic data from 1948 to 1973, and it would appear that somewhere between zero and 50,000 spawners is the -- would be optimum. Do you know if that coincides with your study, or did your study have the optimum level?

A The work we generated, and I'm not sure where -- where this information comes from here, particularly in terms of the recruits and spawners. I do know that represented in Dr. Walters' reference list are not a series of other publications that are supporting the Owikeno, Rivers, Smith Inlets areas that are obviously absent in terms of review of this information.

The confounding issues associated with spawners and recruits, for Rivers Inlet particularly, are for many years there was no way to separate them from the Skeena stock catch, and identify who was doing what. And in terms of enumeration of spawners back into the Rivers Inlet system, more than 60 percent of the major river systems in the Owikeno area itself are glacially

turbid. For many years they have gone in and tried to beach seine there and make estimates of numbers of spawners, and most people agree that's been pretty ineffective.

So backing up to what I might have said and why I might have said it, if I come back to the unit that I gave you a little bit earlier, which is kilograms per hectare.

Q Yes.

A The estimate for Owikeno, because it's a glacially turbid lake, it only supports so much productivity where little zooplankton can grow so big because there's only so much water column there. What you do when you start to look at a series of lakes and compare them as rearing habitats, you probably would get an expression that says somewhere around two kilos per hectare of - and that means surface area of the lake - two kilograms times the surface area of the lake gives you an estimate of the amount of sockeye that might be produced there. And if you back-calculate based on an average of one gram per sockeye, then you can kind of come out with a number, and then you back-calculate it to effective females, and so on. And it's all based on assumptions, of course. But really what it characterizes is that Owikeno is a type of lake has got a lower productivity than a Quesnel-like lake.

Q Yes. All right. You can't remember your conclusion, but if it wasn't 250,000, it was less than 250,000; is that the best you can say?

A I honestly cannot remember any of those details. I would happily work up some information for you, but at this time I'm not -- it escapes me, I'm afraid, I'm sorry.

Q And the point is that if you go over that number, whatever it is by, say, two or three times, you run the risk of producing an undersized smolt with low energy levels; is that correct?

A I don't think that's the case in Owikeno. Certainly reaching an upper carrying capacity of some lakes would, in fact, I mean, lots of the work by Kyle in Alaska shows that in some lake systems there is definitely a nutrient deficit there, that that causes them not to grow as much because what it's called is density dependence. And when you get density at high level, the

dependence on the food supply becomes very, very evident, and each of the rearing lakes in the Fraser will be unique in that issue.

Q What is the limiting factor in the Owikeno system that you looked at?

A The limiting factor in the Owikeno system will be light transparency, how much freshwater discharge influences the glacial flour deposition into the lake and how much of that euphotic zone we spoke about transparency-wise is available for zooplankton to grow in that area. That's the limiting factor.

Q Yes. So the availability of zooplankton is the limiting factor in that system.

A It certainly is one of the strong limiting factors in that system.

Q All right.

A Because these guys can't even see them.

Q Okay. But just to see what happened there, if we go back to page 254 towards the bottom of the page, the experiment, it's described in the paper, is to raise quite dramatically the escapement levels. And if we go a little lower there -- so, yes, sorry, that's the graph. And the graph shows the "Total" column, right at the bottom, total escapements, the average in the 1950s, 316, in the '60s, in the '70s it gets up to 373, 1980 it's 313, and then some dramatic increases take place in '81 and '82, '83 and I think they continued. Those amounts would be considerably in excess of what you determined to be the carrying capacity of that lake system; is that correct?

A If those numbers are real, then they presumably would be a lot of fish returning to the Owikeno system. And the reason I would suggest that they may or may not be an artefact of the data used to derive them, is for the reasons I spoke of before. You go into the Whonnock River, or the Washwash, or any of those, they're incredibly glacially turbid. When you look at the numbers associated with the final digits on any of those escapement estimates, they're zeroes because they are rounded large estimates. And there's a lot of information derived on Rivers Inlet which again I say is not published in Carl's paper, which talk about the inadequacy of the information used to derive these escapement estimates.

Q But whoever was counting, estimating the escapement, was doing the best he or she could, correct?
A Right. And there seems to be some sort of change between 1980 and '81.
Q Yes. Well, I mean, it was a deliberate experiment that's described in here to increase the spawning levels, the assumption being that there was greater capacity than you later determined in that lake system, correct?
A There certainly was an experiment, and I'm not sure about the numbers here, but the carrying capacity of Owikeno is and does only support a number of young salmon growing and developing In it.
Q Yes. For example if we look at page 257, I think there's a passage that describes what they were doing. 257, the left-hand column, the upper quadrant, if we start about eight lines down that paragraph it says:

> The DFO explicitly stated that the new long-term escapement target would be 1,000,000 spawners subject to review when recruits from the 1979-1984 spawnings had begun to add new (and hopefully informative) data points on the stock-recruitment relationship. Thus DFO was explicit about labelling the rebuilding plan and higher escapement target as an adaptive or experimental policy;...

That's what was going on at that time; is that correct?
A Apparently, by this text, yes.
Q And then if we go to the next page, 258, the top quadrant there, about halfway down that top paragraph it says "Estimated runs for 1985-1988", so now we get the results of those increased spawning runs:

> Estimated runs for 1985-1988 were only about half of the forecast values based on average historical recruits per spawner; the Ricker curve, estimated either with or without various bias corrections, resulted in lower forecasts (which were not made public) because it predicted lower recruits per

spawner following the experimental escapement increases that were apparently realized for 1981-1983.

And then dropping down under the heading "Why the Experimental Policy Failed", it says:

> From a scientific viewpoint, we might argue that the Rivers Inlet experiment has been a great success. It appears that the predictions of the Ricker recruitment model have been confirmed, and that the optimum escapement is indeed only about 400,000 fish.

And over at the right-hand column, the upper quadrant, is the -- oh, yes, the paragraph beginning "The experiment":

> The experiment has certainly not been a success from the commercial fishers' viewpoint. They have seen a drastic loss in catch, even allowing for the years (1979-1980, 1984, and 1990-1991) when they would probably not have been allowed much fishing in any case. They have seen a large reduction in the number of days fishing per season, followed by an exhaustingly long opening (11 d) in 1988. In return for these sacrifices, all they have heard is that maybe there has been a run of poor years for marine survival...

So it was put down to poor marine survival in the '80s, which was a time when the Fraser run, I think we will see, was increasing.

But I want to ask you about the reference that I read that "these results were not made public". And you said yesterday that your carrying capacity analysis, so far as you know, you described it as a grey publication, or used the word "grey", I think meaning it was never made public; is that correct?

A In this case it's a pers.com, so I don't know it's resulting kind of document. Kim Hyatt was the first author of that discussion, so...

Q Right. But you were in the DFO here for a time, and I'm talking about the '85 to '88 time period,

and I'm suggesting that's the time when the DFO should have learned something critically important from this Rivers Inlet experiment. But at the same time they were embarking on a similar experiment to increase the escapement levels in the Fraser. I want to ask, did you ever tell anyone in the DFO how critically important it is to do a good habitat assessment of spawning and rearing areas before increasing spawner abundance.

A I can't actually say whether I did or not. At that time I was still just going to be starting my Masters degree, I'm afraid, and was in Ontario still, so those things I'm not sure about.

Q Would you agree with the proposition that before embarking on an experiment, whether in Rivers Inlet or in the Fraser, which involves dramatic increases in spawner abundance, a precautionary approach would dictate doing a proper habitat assessment beforehand?

A I think it would be part of the contributing issue, and part of the discussion, for sure. But someone like Dr. Peterman could certainly address some of the characteristics of escapement and issues, and Dr. Walters has worked on and published extensively on over-escapement in systems. And there's lots going on in that issue for sure, and so I think your questions are better suited for Mr. English, last week, and Dr. Peterman potentially tomorrow. I'm not sure that's an area I can speak confidently in.

MR. HARVEY: All right. Thank you, Dr. Johannes. Those are my questions.

A Thank you.

MS. BROWN: Thank you, Mr. Commissioner. For the record, Anja Brown, and with me is Crystal Reeves, and we're appearing for the First Nations Coalition. And for Dr. Johannes's benefit, I'll advise you that the First Nations Coalition is made up of First Nations from up and down the Fraser River, as well as the Douglas Treaty Nations, the Council of Haida Nation, and is also comprised of fishing organizations along the Fraser River, aboriginal fishing organizations, that is.

MR. HARVEY: I'm sorry to interrupt. I forgot to ask that the exhibit we referred to be marked. I wonder if that could be done.

THE REGISTRAR: That will be marked as Exhibit number 744.

EXHIBIT 744: Walters et al, Rivers Inlet Sockeye Salmon: An Experiment in Adaptive Management, 1993

CROSS-EXAMINATION BY MS. BROWN:

Q Dr. Johannes, in reviewing your report, and I won't ask you to go to pages 15 and 16, but as you know, those set out the various sources that you went to, to compile the report. And I'm wondering if any of the data that you relied on was produced by any of the Lower Fraser First Nations.

A If those sets of information -- I do not know the full answer to that, but all our information is well cited and articulated in Maps 3 and 4, and 20-plus pages of references at the end of the report articulate individual observations that were accounted through something called the Fisheries Information Summary System, FISS, and in lots of cases I know of personal examples where First Nations have contributed to that data system.

Q Can you provide us with some specific examples?

A In this case I'm afraid it's a little overwhelming to try to articulate exactly what those examples might be at this time.

Q All right. I noted from your *c.v.* that there was a period of time that you worked for the Nuu-chah-nulth, and you managed and coordinated fishers and habitat projects. And I'm wondering if that's the sort of information that might have been utilized, specific to the Fraser, of course, as part of the data that went into your report. Are you able to advise us of that?

A I can advise you clearly that I made a statement on pages 13 and 14 about information and use of information, and my own beliefs about local ecological knowledge and traditional ecological knowledge in the concepts of developing understanding of habitats. Towards that end, it's not on my *c.v.*, but I am well published in an area where that understanding and knowledge is in many cases integral into how you develop some of this information.

For example, one of the pieces of information that I was very privileged to be part of was work with Tla-o-qui-aht out of the Tofino/Esowitsa area on the West Coast Clayoquot area. And in one opportunity I had we flew a number of river systems in helicopter, created a digital imagery that was almost 100 feet long if you rolled it out. In fact, we did. We rolled it out to council and subsequent to that -- chief and council, and subsequent to that asked them to populate it with, you know, good information that was of usable and something that they were able and willing to distribute and particulate with. That actually created an atlas, and you can find it online, on the Clayoquot Valley in a number of areas, that articulates pretty clearly the use of local knowledge and traditional knowledge in developing and understanding of the characteristics of environments and habitats at local and specific scales. It's wonderful, wonderful, wonderfully useful information to understand how things change and how things are changing. It certainly is a record of use.

Q Right. I couldn't agree with you more on that. it sounds like it's something that may have been used in your report, but you're not able to tell us for certain at this time. It's something your team may have relied on.

A Given the information sources that we used, yes.

Q All right. Mr. Lunn, could you turn up, please, our document 9. Now this is the 2009-2010 Annual Report for the Burrard Inlet Environmental Action Program and Fraser River Estuary Management Program, and the Fraser River Estuary Management Program is often known as FREMP. And I believe, if I heard you correctly earlier this morning, you made reference to FREMP.

A Yes, indeed.

Q Right. And I'm going to ask you some questions in relation to this annual report, but my questions will only be directed to FREMP and not to Burrard Inlet. Now, for the benefit of the record I'll just point to page 6, which tells us very briefly what FREMP is and what they do. And FREMP is described as an:

...inter-governmental partnership established

to coordinate the environmental management of the two most significant aquatic ecosystems...

So one is Burrard Inlet and the FREMP is specific to the Fraser River Estuary. It goes on to say that FREMP was established in 1985.

Page 7 illustrates some of the partners that are part of FREMP, including representatives of the B.C. Minister of Environment, Environment Canada and Fisheries and Oceans.

I'm wondering, Dr. Johannes, if you can tell us what you know about FREMP and if it's something that you've been involved in, in your professional capacity.

A Yes, I know about FREMP and I have been involved in the process of working with FREMP professionally in my tenure with Golder in terms of review of projects.

Q Page 13 of the report summarizes some of FREMP's highlights for that particular year, and the heading there refers to FREMP's Management Plan, and it indicates there that in 2003 the Estuary Management Plan was updated to reflect current realities and new actions. And I'm wondering, is the FREMP Management Plan something that you or members of your team would have looked at and considered in the development of your report?

A At a very broad level, yes. In terms of articulating and referencing it within the characteristics of the report, only as needed, as it associated with particular human development or human activity-related indicators that we were using. In terms of our articulated section 5 within the report on Habitat Strategies, we do make reference to FREMP and the association in terms of its regulatory functions and review.

Within the context of my own professional life, working with many of our proponents and clients, they use that as a -- not as an environmental policy so much as a guiding vision for approaches that they use and develop in the area, and working there. So those are all laudable kind of objectives.

Q Right. Now, pages 18 and 19 and 20 go into some detail on the environmental review process, and on page 18 to start with it indicates there that

FREMP uses what they call a two-track process for reviewing projects, so Track 1 projects are ones that are generally predictable, and it seems to be that they are smaller scale activities, they describe them as having little public interest, low risk of environmental impact. And a little lower in that top paragraph they talk about Track 2 projects, which they indicate are proposals of a more complex nature, generally have a greater potential for environmental impacts.

The next paragraph down at the bottom they say that:

> Review of Track 2 projects is the main function of the Environmental Review Committees.

So did in the preparation of your project, did anyone on your team specifically look at this environmental review process and some of the Track 1 or Track 2 projects that FREMP considered?

A We did not explicitly look at the Track 2 process, although that's embedded in the larger FREMP review process, and we do make comment about the Environmental Review Committee, both of FREMP and in part the municipalities that also use and adhere to that kind of process. Track 2 projects are also in many cases larger projects, as you articulated, and they are the ones that were captured for sure in the larger major projects kind of inventory that we did. We have and have provided to the cumulative effects chapter, you know, the complete list of those projects, and when I review those projects sort of in my mind, or even on a map with others of our team, we can articulate those projects that were part of our review. So, yes, it was involved in this.

Q so some of the projects that FREMP identifies as Track 2 projects may actually have been identified in your report as the major projects. Did I get that right?

A Yes.

Q All right. Page 20 of the report gives some examples of projects and they include "Construction (land-based structures)", which could really mean almost anything, "Dock and float works", "Dike works", "Marina", "Rip-rap",

"Dredging", that sort of thing. When you look at this list, are these generally projects that you would identify as small projects or as major projects?

A Within the 341 projects that I listed or indicated that we used this morning, I can see representation of across the Lower Fraser from most of these with the exception of things like rip-rap and vegetation management, potentially outfalls. Certainly demolition, breakwater, dike works, filling, pipe works, dock and float works, constructions, are all features of projects that we have developed in a database. But you're correct, some of them are larger and smaller projects.

If I go back to one of your earlier statements about the Track 1 type of projects and their review, it's quite characteristic of the notification process that Fisheries and Oceans Canada now uses when it talks about operational statements or guidelines, an approach where, for example, you're replacing a culvert. There is an operational statement that exists that says this is what thou shalt do --

Q Right.

A -- when doing that sort of thing. And I tend to view Track 1 types of projects not like that, but sort of consistent with that sort of approach, if that's fair.

Q Right. But your report only considered major projects, correct?

A I'm getting lost in what "major projects" really means.

Q As you identified them in your report.

A Yes, is the short answer. But each of the projects was individually articulated, whether it's a large and small project, when it was reviewed, when it was constructed, when it was operating, those sorts of parts of the database did exist. So we had staff that spent a good long time looking for projects to involve in it. That said, we did not do, which I was asked this morning about, basically looking for the audit compliance kind of issues associated with those habitat features on those projects.

The first or the third section of this report, independent of the fifth section of this

report, dealt with what was the spatial and temporal kind of overlap between these kind of projects and their potential effects and sockeye habitat use.

Q Do you happen to know whether there are any First Nations representatives as part of the Environmental Review Process under FREMP?

A My first initial response is I don't think that's the case, but I'm trying to think of examples where I have been in front of FREMP with a review and have had people participate from a bunch of different agencies, including First Nations. And I'm not sure of the answer to that, but as articulated in here, it's certainly not clear how First Nations participate.

MS. BROWN: If I could enter that as the next exhibit, please.

THE REGISTRAR: Exhibit number 745.

EXHIBIT 745: Annual Report - Burrard Inlet Environmental Action Program, Fraser River Estuary Management Program (FREMP), 2009-2010

MS. BROWN:

Q Dr. Johannes, I'd like to ask you next a series of questions that have to do with wastewater. And I noted that in the scope of your work one of the things, of course, as we've heard that you looked at were water quality conditions on the Lower Fraser and in the Strait of Georgia. And you've been asked and answered various questions in relation to the conclusions that were drawn in respect of liquid waste. And I'll just go to page 43 of your report, which summarizes that part of the report. And what the report says there is that you note that there will be likely interaction with Lower Fraser River and Fraser River Estuary sockeye habitats, and you also note the presence of wastewater treatment plants on the Lower Fraser. And we've heard about that yesterday and today in terms of primary and secondary and tertiary plants. Are there any tertiary plants that are currently operating on the Lower Fraser?

A Not that I know of, no.

Q And are you able to tell us what tertiary plants can do that secondary plants can't?

A I am not an expert in this area. My conceptual knowledge of them is that they remove the last parts of the biosolids out of the wastewater.
Q Now, still on page 43, then, you identified the Central and North Strait of Georgia areas and the Juan de Fuca Strait as a nil interaction, and that the interaction with sockeye habitats was not expected to be significant in those areas. And I won't take you to it, but as you know, Map 9B shows the location of the various water treatment plants on the Lower Fraser.
Now, isn't it the case that the Capital Regional District and in particular the City of Victoria, doesn't treat its sewage at all. Is that accurate?
A I did not report on any of that in this report, and I assume that they're changing things, but I don't know the full answer to that.
Q Okay. So there's no evidence in your report about what happens in and around Victoria, and you say that you don't know whether they have sewage treatment plants there or not. Was that something that you or anyone on your team looked at?
A No.
Q Why wasn't that looked at?
A In part it was outside the scale and scope of this project because it was fairly well defined that it was within the Strait of Georgia that we were looking, and the Juan de Fuca Strait was something that we added because it was being used as sockeye habitats. The other issue is just generally on Maps 12A, B and C, the characteristics of the Juan de Fuca area suggests that it's quite a very mixed rich cold area that is influenced by limited change. And when you go to references like Mason and Cummings, they fairly clearly say that it's a very active mixing current area and there seem s to be little influences. And from that I inferred the association one to limited, more limited use - I won't say limited use - more limited use by sockeye as habitat relative to the rest of the Strait of Georgia in a northward passage for young salmon made it a little bit less a larger indicator issue for us to use.
As I think I have said, you know, the discharge points, areas of discharge, the amount of discharges, it is an indicator that we just

could not explore, the data was way too scattered to actually accumulate and assemble in some semblance of a manner that provided an efficient indicator. But within the indicator framework that someone like Stahlberg suggests for the Wild Salmon Policy, discharge permitting points and things like that, is a useful indicator, and I think at a finer scale it probably would be of use. So we just didn't have opportunity to use it in this case.

Q Well, we heard from you yesterday that some populations of juvenile salmon spend up to a month in the Strait of Georgia.

A Probably longer in some cases.

Q Right. And I believe Map 4 of your report, and again I won't take you there, or ask you to go to it, but it indicates that there's a southern migration route of salmon that appears to pass directly by the City of Victoria. So if it's in fact the case that there is untreated sewage being discharged into an area through which salmon flow, how are you able to justify a conclusion that there is nil impact on those salmon.

A It's a relative contribution and that's again the way we were apprising this situation is relative: has there been a change, a dramatic change that suggests an influence. If in fact there was suddenly a tertiary treatment system in Victoria that came on line, the suggestion would have been that would have been a large change in the system. Can we view how that might positively or negatively influence sockeye use.

At the same time, as we spoke about yesterday, the Johannessen references in terms of PBDEs and their accumulation at outfalls, particularly reference to Iona Island, is another area of where proximally sockeye use those habitats. And what that reference and that set of information indicated was very proximal to the outfall of Iona Island itself was the accumulation of that material, and that the sockeye were sitting not at 120 metres but at 10 to 15 metres in the water surface, using an actively mixed area and migrating fairly quickly.

The evidence associated with Harrison river-type sockeye that might have the preferred use of the Gulf Islands and then the southern route out,

suggests that they grow and rear in and around the southern Gulf Islands and across the Strait of Georgia, and when they get into the Juan de Fuca area, as Mark Trudel's work and some of Dick Beamish's work has indicated, they actually chug pretty quickly out of that area, out to the Pacific Ocean itself.

So the summary of those sorts of issues and combined suggest to me in terms of at least a speculation as I'm progressing here, that that influence may have some merit, but it's not going to be one of those particular indicators that suggest this was a consequences or a causal feature associated with declines in sockeye salmon at the population level.

Q But isn't that really an example of a conclusion that's drawn in the absence of any evidence?

A Yes.

Q Do you know if there have been any specific studies done about the water quality in and around the City of Victoria?

A There is, I would assume, and I believe I've even seen it maybe ten years ago, a CRD, Capital Regional District, is probably collecting monitoring information in some ways. But I am not privy to what that information looks like --

Q All right.

A -- or how it has changed, or what it reflects.

Q And am I correct, then, that to take it a step further, you're also not aware whether there have been any such studies done that relate directly to what impact, if any, untreated sewage has on sockeye salmon habitat?

A I am unaware of such a study.

Q Could you turn up, please, our Tab 4. Now, this is the Summit on Fraser Sockeye Salmon: Understanding Stock Declines and Prospects for the Future. And what it says at the Preface is that this is a scientists' think tank that met back in December of 2009 to consider causes for the low returns on the Fraser River. Is this think tank or summit something that you participated in or were aware of, Dr. Johannes?

A I was aware of.

Q Now, what I'd like to do is to take you to page 23 of that report, please. In the right-hand column at the top, the heading is "Lacking information

about the north arm of the Fraser". And one of the participants there who's a fisherman directs a series of questions at Mike Lapointe, who I understand to be or at least at that time to have been a member of the Pacific Salmon Commission. And the questions there are directed at concerns, really, about the outfall of sewage out of the Annacis Island treatment plant and the presence of chemicals that are coming down the North Arm of the Fraser. And this particular participant and the response from Mr. Lapointe seems to indicate that there's nothing, or perhaps very little known about what's happening on the North Arm of the Fraser, and that there's been no research done. Is that something that you agree with?

A Water quality data in the Lower Fraser is limited.

Q And is that true for both the North and the South Arms?

A Yes, to some extent. Yes.

Q And in the preparation of your report, did you make any distinction between the North Arm and the South Arm and what was happening in either of those, or did you look at it more on a global perspective?

A We articulated what evidence there was in terms of the observations of sockeye habitat use in those areas. We did attempt, strongly attempt to accumulate the water quality information for much of those regions as one of our indicator-like approaches to this. We were unsuccessful in doing that, but in terms of using the existing studies to assess the use of those habitats by sockeye, we certainly did that exhaustive search, which I was speaking about this morning. So we considered both areas as best reflected in the information that was available.

Q Now, going over the page to page 24, the discussion there considers some of the compounds that we discussed yesterday, and it says at the top of the page, compounds such as pharmaceuticals, including endocrine disrupting compounds, a trend in fire retardant chemicals, and indicating there that that was correlated in terms of the time pattern with the early upstream migration of the Fraser sockeye. In your report, did you consider any correlation between the migration of Fraser River sockeye and the presence

of these particular chemicals?
A As a broad indicator we spoke about contaminants in a number of the map sheets and within the report. AS you know, Dr. Hinch spoke about adults and timing and considerations of the characteristics of their environment in another technical report, and Mr. MacDonald will talk about contaminants in detail and give it a much better coverage than anything I could ever do.
Q And then if we could go briefly to page 118, please. This is a further discussion about contaminants in sewage and emerging concerns, and there's discussion there about Triclosan, which is described immediately above the table there as an insidious antibacterial agent. And I know you've told us that you're an expert on wastewater treatment plants and what they're able to filter out, and what they can't, but I'm wondering, do you know if the primary and secondary wastewater treatment plants along the Lower Fraser have the capability to deal with Triclosan?
A I do not know that.
Q And the report goes on from pages 121 to 124, and I won't take you to them in the interests of time, but there's further consideration there about other compounds of concern, including ammonia and cadmium, and I'm wondering in the preparation of your report did you look at the Greater Vancouver Sewage and Drainage District Annual Reports?
A Certainly as best as we could. But again I'm relying on Mr. MacDonald to actually review most of the contaminant issues and those associated with discharge rather than it was not just part of our scope that was important.
Q And in your report you concluded that the impacts on Fraser River sockeye salmon habitat as a result of the discharges that are emitted from wastewater treatment plants was nil or low, and I think you indicated that it was in part because of the short period of time that the fish are exposed to these chemicals and other compounds; is that right?
A That's one approach to say that, yes. The other issue associated with that is there is limited trophic interaction between them, meaning that sockeye don't and are not benthivorous animals, so they're not feeding on those areas, whereas we explored yesterday with the paper that I suggested

and we have cited de Bruin's work on movement of materials from sediments into mussels, and then Dr. Johannessen's work on contaminants and the characteristics and comparisons between PCBs and PBDEs. So both those areas, both the exposure and the use of the environment, sockeye are not well exposed to those things is the first line of issue.

The second is every document that you've referenced and cited to me suggests that Metro Vancouver to some extent, even maybe the Capital Regional District, are attempting to improve their standards of water quality and discharge from all these plants and areas.

Q Well, we don't know what Victoria is doing, correct?

A It's not referenced in this report, yes.

Q Yes. All right. And if I heard you correctly this morning, you indicated that the sorts of contaminants that might not be captured by wastewater treatment might affect salmon in ways other than by actually ingesting them as food, that it could potentially affect the capacity of their gills and that sort of thing; is that right?

A I think Dr. Hinch's commentary probably does a much better job of articulating those issues than I would.

Q All right. And in terms of the limited period of time that fish may be exposed to these sorts of chemicals, what I'm wondering is if the fish is taking advantage of the currents in the Fraser River, then aren't the contaminants flowing alongside the fish?

A I'd assume that we'd have to explore how those contaminants are transmitted, but if we go with what is suggested in Metro Vancouver's Annual Liquid Waste Management Monitoring Reports and other characteristics, much of that is deposited in the sludge or in the sediment areas. Annacis is a secondary treatment system, so I'm not sure how much of its material is disposed of as actual sludge, although we give tonnes per year as a characteristic in here. And as I was indicating, Johannessen's work that is one of the exhibits suggests that it accumulates in first sediments, rather than re-suspends into the water column. But again, that information, that study would be

of use.
Q All right. And the material that's deposited as sludge is the material that's captured by the treatment plant, correct?
A It's captured by the treatment plant and discharged.
Q Right. So my concern, or my question, really, is in relation to those compounds that may not be captured or aren't captured by primary or secondary treatment plants and their potential effect on fish, since conceivably these compounds will be travelling in the water, the same water that the fish are travelling in as they leave the Fraser River and enter the Strait of Georgia. So they not be exposed to the compounds for a particularly limited period of time. Do you agree with that?
A No, I still don't agree with that, but I do suggest that Don MacDonald will do a much better service on this whole topic. And the reason I don't agree with it is because discharge, particularly for migrating juvenile salmon, it's an incredible amount of water that's flowing out of the Fraser River and these guys are moving incredibly fast with the flow, and they can get out into clean water fairly quickly. If you consider days of exposure as hours of exposure or months or weeks of exposure, I mean, that's the characteristic of understanding how fast they move through those areas, but you know, that duration of exposure, the dilution factors, all those things still suggest to me that relative to our analysis of sockeye population level characteristics and these indicators that, if anything, those situations have improved in the treatment process, at least that's what the written monitoring and other reports suggest. And the other comparison to that is that sockeye move through these habitats very quickly.
So the comparison just says, is that one of the reasons that sockeye have declined? It's not a smoking gun evidence piece. Is it a contributor? It may very well be. But I can't answer the details on some of that.
Q All right. Now, if I could take you to page 40 of your report for a moment, please. And I just have a question there. So this is Table 2. Mid-page

where you speak to "Significance of potential interactions", and here of course you're looking at population and changes in population size. And the second bullet there you indicate that:

> Although the duration of interaction is high, it has been ranked as low because it is expected that habitat conservation strategies will avoid and limit negative interactions with sockeye habitat.

And I'm wondering if you can advise us of what conservation strategies specifically you're referring to there.

A I make reference to a couple of pieces of information there. One is edge effects and the other is conservation strategies. One of the conservation strategies, for example, if you work in and around the City of Burnaby, they have another, not standard, but a review approach, which is independent of DFO's approach, which allows you access to and in those areas. Their standards for riparian habitat management and edges is a very conservation-oriented strategy. And so they go through an independent environmental review committee process through the City of Burnaby to articulate those issues.

The second issue is this edge effect. Edge effect is, you know, where are development projects, including urban development or outfalls, or any of those types of issues in terms of development, allowed to occur now, and they're not allowed to occur in many of those areas. There's large buffer areas. The ***Riparian Area Regulations*** or for the City of Burnaby or the City of Coquitlam, for example, it's a 15-metre or a 30-metre buffer area around riparian areas and river systems. So those edge effects are implied. Now, as I always have maintained, I mean, that's a leap of faith, that's an assumption that those regulatory issues are adhered to, complied and have effective audit on them.

From our view and articulation of this issue in this report, what we've said is we believe these ERC processes and the management issues and the regulatory structure and the approaches that have been implied here, are better than they were,

and we don't know the exact dimensions of loss and gains on some of these habitats, but we know that the characteristics are improving. And because things are potentially improving and we're getting more experience in developing habitats that are gained as opposed to lost, that it would give us a reference point that say this is again not one of these strong issues that supports a causal link to declines in sockeye salmon. But within that, the Lower Fraser, we certainly say that there's a moderate geographic overlap there, between population level or development issues, or those sorts of things. So, you know, we go through our reasoning here and articulate it as best as we can.

Q Right. Now, in response to a series of questions that were asked earlier of you today by Mr. Leadem, and this was when he was asking you questions about restoration of marsh habitat, I believe I heard you to say that one of the ways to mitigate and to deal with the washing away of new habitat was through habitat banking.

A One is a strategy and one is a technological technique-oriented process.

Q All right.

A No, they don't link.

Q And when you were giving your evidence earlier today, which one of those two terms were you referring to when you were talking about habitat banking?

A Oh, habitat banking --

Q Yes.

A -- is a strategy approach.

Q And what is it?

A Basically, I'll give you an example, for the Port of Montreal in the St. Lawrence River. Port of Montreal has an annual dredging program, where near their berths where the St. Lawrence River flows out, there's lots of sand that's deposited in areas and it actually makes the depths of where the berths are change, and in fact increases or reduces the amount of water there. So every year they've been given an opportunity through Fisheries and Oceans Canada and other groups to actually dredge that material out.

Well, they take that material and if you look at the historic characteristics of the St.

Lawrence in that area, you find all these little sand gravel bars and dunes and everything else that are around. What the Port of Montreal has been doing is creating these, independent of any other work, they've been creating these as opportunity allows them, and creating larger complex, more diverse types of habitat that have opportunities to grow and develop, independent of any review process, independent of any kind of characteristic for habitat policy that might be assigned to their activities or projects.

So what they do is, it's called a banked habitat. They collect a number of square and cubic metres of areas and they say we would like that expressed on the ledger. And I'm not saying whether this is good or bad. I'm just saying this is how it's done. They express that on a ledger saying we'd like the regulatory agencies to understand that we're creating this habitat with hope that if we get into a bind we can use some of it to balance our habitat loss and gains on the balance sheet.

Q All right. So you didn't mean literally creating a bank or a rip-rap or something like that.

A Oh, I see.

Q It's a strategy.

A I'm sorry, I rattled on there for a little while about that. No, it's not a bank. No.

Q And just to close off that line of questioning, I'm wondering has habitat banking as a strategy been used on the Lower Fraser?

A My understanding is that FREMP and the Port, Metro Vancouver, are engaged in some of those activities.

Q Mr. Lunn, could I have Tab 6 now, please, and this is the last document that I'll be referring to. This is a document that's called "Saving the Heart of the Fraser" and it was written in 2000 and I see it was prepared by Dr. Marvin Rosenau, who we heard about earlier this morning, he was one of the reviewers of your report, of course, and his co-author, Mark Angelo. It was prepared for the Pacific Fisheries Resource Conservation Council.

So first of all, I'll ask you, Dr. Johannes, is this a document that you're familiar with?

A Not strongly familiar with, but I certainly know some of its contents.

Q All right. I'd like to take you through it. And I'll start at the bottom of page 1. This is in the Executive Summary" so to summarize there, the paragraph discusses the many impacts that European settlement have created to the waters and the floodplain areas of the heart of the Fraser. And the writers describe it as extensive and significant change, that it's compromised expansive habitats, and they say there that impacts continue to occur as a result of land clearing, diking, watercourse draining, forestry, mining, agriculture. They say:

> Thus, the remaining environmental and ecological integrity of the instream and riparian areas of the...Fraser is at imminent risk.

Do you agree with that statement?

A Yes, as it defines a lot of species' habitats.

Q If I could take you next to page 79, please. Sorry, before we go there, can we go to page 4, please. And what's set out on pages 3 to 5 are 17 concerns and recommendations that are made by the author. And at number 10, they articulate a concern about rip-rapping, and they describe it there as armouring the banks of the gravel reach, and that it often destroys fish habitat. They say the extensive placement of this material has largely disrupted natural fluvial processes and the proper functioning of the condition of many banks of the river between Hope and Mission. It goes on to say that:

> A solution could involve purchases and decommissioning of existing, but not critical, locations of rip-rap bank protection within the reach in order to provide compensation under the ***Canada Fisheries Act***, the [***CEAA***] and the No-Net-Loss Policy, for areas where the placement of new rip-rap is unavoidable.

Are you able to make any comments about rip-rap and if it's something that you looked at specifically in the preparation of your report?

A I can make comment about rip-rap. Within the

context of this report, not explicit characteristics of stream banks that had extent of rip-rap kilometre-type habitats, no. Part of the commentary about rip-rap relates to people that we've spoke about numerous times, Quigley and Harper. They actually wrote a "Streambank Protection with Rip-rap: An Evaluation of the Effects on Fish and Fish Habitat", as editors in 2004. So that document exists and goes into a lot more of an audited kind of approach about the effectiveness and use of rip-rap and characteristics. That said, engineers appreciate the use of this sort of thing. People live along the banks of the Fraser River where floods and other things occur. So all sorts of compromises are intended with the commentary that Dr. Rosenau and Mr. Angelo have commented through their recommendations here.

THE COMMISSIONER: Take the break, Ms. Brown, thank you.

MS. BROWN: Thank you.

(PROCEEDINGS ADJOURNED FOR AFTERNOON RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: The hearing is now resumed.

CROSS-EXAMINATION BY MS. BROWN, continuing:

Q Dr. Johannes, turning back to the Heart of the Fraser report, if I could turn your attention, please, to the bottom of page 85. This is the part of the report that deals with bank armouring and it explains there for those us that don't know that an extremely destructive activity affecting the proper functioning condition of the Fraser River gravel reach has been the extensive armouring of its stream banks and it says bank hardening, or armouring, is intended to stop erosion along a stream perimeter. And if we go over to the next page, 86, at the top, what the authors there say is that:

> Bank armouring of the gravel reach could be considered equivalent to arteriosclerosis of the Heart of the Fraser. Indeed, the effect of rip-rap is so insidious and destructive

that it is the view of some experienced habitat biologists that it should be classed as a deleterious substance under the Canada Fisheries Act.

Do you agree with those statements in terms of bank armouring and rip-rap?

A Along the extent of the time period they're speaking about, yes.

Q Staying on page 86, if we go down to the fifth paragraph, it notes there that most of the extensive bank hardening has already been in place by 1990 but it notes there that the activities continue to occur in locations that are of interest to protect infrastructure. And it goes on there to provide specific examples of bank hardening along the Fraser River. Do you agree that, given that this sort of activity, as well as rip-rap is continuing, that those sorts of activities have a role to play on the impact of Fraser River sockeye salmon habitats given the comments made here by these writers?

A I think the characteristics of both diking and development of rip-rap for flood protection and for erosion issues associated with fish habitats is a very important issue, absolutely fundamental. As I pointed out, the rip-rap report that Quigley and Harper edited in 2004 suggest, they went through and other authors examined fish distribution in and around those areas and found there was something lacking in terms of the habitat characteristics of those environments and the types of fish that use them on a continuous basis.

In terms of the use at a population level by sockeye salmon, it's a bit of another story. What we have seen through a series of evidence, which we speak about in this project, and this is the major portion of the Fraser populations of sockeye for young salmon migrating they often stick to the middle/centre part of the Fraser River and its discharge. And that area is called the thalweg. And so what the information suggests is that they're two to five metres in depth and they're just chuggin' out, they're flowing with the flow. And so the implications of this issue, I don't discredit as being absolutely fundamentally

important to fish species as a whole, probably assignments to coho and chinook and other species like that, it's fundamental. If it's an issue associated with sockeye, the two points that I'll make are, one, it's not such an extensively-used habitat environment by population level Fraser sockeye.

Secondly, what we are seeing is clear examples where people are certainly in this evolution of understanding experience in dealing with rip-rapping or habitat restoration issues, are starting to explore other options to use there, including that Pitt River inset example I have in the report on inset number 1, which suggests that they've broken that trend and tried something else. So there's an evolution there so change is happening. Whether it's going to be progressive and thoughtful, those are the parts of the recommendations I certainly go on to make a lot of discussion about. In terms of its use for habitat, well, there's lots of discussion about its ineffectiveness.

MS. BROWN: Right. If I could enter that as the next exhibit, please. And then finally just quickly, if I can turn up Tab 3 from our list of documents?

THE COURT: Ms. Brown, before you do that, Tab 4, was that marked as an exhibit?

THE REGISTRAR: That was Exhibit 12 already.

THE COURT: That's Exhibit 12, thank you.

THE REGISTRAR: Yes. Item 6 will be marked as Exhibit 746.

EXHIBIT 746: Saving the Heart of the Fraser - Addressing Human Impacts to the Aquatic Ecosystem of the Fraser River, Hope to Mission, Nov 2007

MS. BROWN:

Q And finally then, I would just like to ask you one or two final questions about this document. It's a Review of Groundwater - Salmon Interactions in British Columbia and it's prepared in '06 by Tanis Douglas. Have you seen this paper before?

A In passing, yes.

Q All right. I'm just going to ask you a couple of general questions about groundwater. And in this paper, the author talks about two of the benefits

of groundwater to habitat, that it sustains stream base flow in rivers and, secondly, that groundwater discharges stabilize temperatures in the river and provide thermal refuge for fish. And I'm wondering if you considered the effect that increasing population and agriculture and industry along the Fraser River, the impact that that had on groundwater and, in turn, the impact that that would have on Fraser River sockeye fish habitats.

A In this report, no.

Q And why not?

A One, there's not a good set of evidence that describes the water extraction, the actual physical extraction of water in those areas. Two, the linkages to the characteristics of river temperature is a study into itself. And so it was just beyond the scope of this set of work. It was just not possible.

Q All right. Thank you.

A Is it something that should be done? Oh, sure, that'd be a great idea.

MS. BROWN: Could that document be entered as the next exhibit, please? And those are my questions. Thank you.

THE REGISTRAR: That will be Exhibit 747.

MS. BROWN: Thank you.

EXHIBIT 747: Douglas, Review of Groundwater - Salmon Interactions in British Columbia, Nov 2006 [Watershed Watch]

MR. DICKSON: Mr. Commissioner, it's Tim Dickson for the Sto:lo Tribal Council and Cheam Indian Band.

CROSS-EXAMINATION BY MR. DICKSON:

Q Dr. Johannes, I want to explore a little bit with you the conceptual approach you took in your report. And a number of times I've heard you say, and I've read in your report, that in respect of a particular human activity, one of the ten that you looked at, there was no change in that activity that might explain the decline of Fraser sockeye. Do you know what I mean by that?

A At a concept level, yes.

Q And so I'll just take you to a few examples in

your report, if I could.
MR. DICKSON: Page 42, Mr. Lunn?
Q This is on large industrial projects. And if you look at the bottom, the last bullet, you say:

> A low ranking was assigned for areas adjacent to sockeye habitat in the Lower Fraser area because the evidence available indicates that habitats have not been in a state of decline over the 1990 to 2010 period.

And so you're looking at the change over that period; is that correct?
A Yes.
Q And then if we go over the page to 43, the third bullet on "Significance of Potential Interactions", and this is relating to waste, you say:

> The magnitude of effects from wastewater treatment discharge has been decreasing over the period of time under study, as treatment plants have been expanded and upgraded to become more effective.

And again, it's the change you're looking at over that time period; isn't that right?
A Yes.
Q And so is what you're saying essentially this? Look, this human activity doesn't explain the decline in Fraser sockeye because that decline has been going on since the early '90s and from 1990 this human activity hasn't increased? And so there's no causal effect there; is that correct?
A I was very careful in this concept and, as you can see, there isn't a struggle with the approach here. You know, we defined an approach and went for it. We looked at the series of indicators. The struggle was articulating that approach well knowing that, yes, there's change in rip-rap. There's characteristics that are happening, all those things. So to summarize that, on page 63 and 64, I was very careful. And as a team, we were very careful to write this passage that talked about:

> Given the extensive special scale of the

observed biophysical changes within the habitats used by Fraser sockeye, the confluence of when changes occur relative to the Fraser sockeye decline and the mechanistic basis for the adverse effect.

That passage was the one that we tried to use to reflect the characteristics of the report. It's the very last passage of the report. So I mean, that one, it talks about the mechanism and the confluence of those issues over time. And so that is certainly reflective of what we tried best to achieve.

Q Yes, but let me get at it again. When you're looking at these ten different factors, and for some of them you're finding, look, this factor doesn't go to explaining the decline because there has been no increase in the impact of this factor and there may be a decrease. Is that so?

A Yes, it is so.

Q And so I want to explore two aspects of this type of analysis with you, if I could, and the first is cumulative effects. And you said in response to Mr. McGowan yesterday that you didn't perform a cumulative effects analysis; is that right?

A In the true sense of a cumulative effects analysis comparing past and present and future projects and their special and temporal overlap with the association of these indicators, no.

Q And when I read your report, it seems to me that you're looking at the ten factors in isolation from one another; is that a fair enough comment?

A I think they accumulate as human activities in different spheres of influence. The scope that you've just described is a subsequent chapter in the technical reporting series for the Commission. So we did not achieve that portion of the scope for sure.

Q Right. It's not in your report. You're not conducting that analysis?

A No.

Q Very well. But for those factors where you're saying, look, there's been no increase in this human factor and so that doesn't explain the decline, would you still agree that those human factors nonetheless negatively impact sockeye? They might not explain the decline by themselves

but they may be restricting a sockeye population's ability to adapt to some other environmental change; is that fair?

A I think you're right. There's an accumulation of stresses that are very profound. If we extend your point to an analogy, the dikes of the Lower Fraser, and we go into a lot of detail about that and, as does Dr. Rosenau in various documents. In this case, we speak a lot about the diking of the Fraser and, you know, over time there's been probably an incredible loss of both salmon, fish and sockeye habitats within that. Has that changed over the last two decades that might be a causative or confluence link to the declines of the Fraser sockeye now? No. Is there a potential impact historically that that certainly has got a legacy almost? Absolutely. That's why we're seeing examples like inset 1 where we're suddenly opening up dike faces and doing things a little bit differently. So yeah, there's lots of issues out there. That's absolutely true. Is there a confluence to the declines of sockeye salmon at the population level? That's what we've been discussing.

Q And if the largest contributing cause of the decline is, say, the warming of waters within the Strait of Georgia, or, say, within the Fraser River itself, other factors that you've looked at may aggravate that problem; is that fair enough to say?

A As we were exploring with the issues about rearing lakes and having smaller-sized animals that are of poor condition, sure. All those things are stressors. And do they accumulate? Well, better minds than mine will be able to address those sorts of issues. As Dr. Hinch has described, the accumulation of temperature stresses into adults in some way are expressed in a bunch of different ways. That's absolutely for sure. So how these accumulate as stresses in young salmon or in adult salmon certainly is a piece of key issue and indicators.

Q And when we read your report and you say, look, there's a low magnitude of impact or a nil magnitude of impact, we shouldn't necessarily take it from that that this is not a problem for sockeye but rather that it's not the cause of the

decline; is that fair? I mean it may be an aggravating factor when combined with something else.

A I think to expand on that. In concept, I agree with what you just said. And how population size accumulates relative contaminants to stress out sockeye, both adults and juveniles, that's an issue. But by qualitatively ranking these things, and it infers back to some of the severity in disease and impacts in disease that you've seen. Those are qualitative analysis, just as this one is. If we put numbers across this, nil would be a zero and a low would be a one. In the same characteristics, when you see lows expressed, we're not saying there's nothing there. When we even say a nil, it's not saying that there's not this ongoing stress, if we're talking about a change in the population over this last period of time. So sure they accumulate. I do agree.

Q I want to ask you about a second aspect of your analysis and that's lag effects, what I'll call lag effects. You restricted your study to the period of 1990 to 2010 and I understand you had limited time to prepare your report. But would you agree that there may have been effects that took place, construction that took place prior to 1990, the effects of which, the impacts on sockeye of which were delayed in their effects past 1990?

A I attempted to express that a little bit earlier today. First off, I would like to say that most of the limitations are not necessarily time-related but information-related, what was available to use as part of this report rather than, you know, time constraints. The second part is when we spoke this morning when I was asked this morning the generation time issues associated with anadromous salmon is a very curious event in that there is no kind of stock memory or race memory for an individual salmon population other than survival and success. So if they're spawned in a particular area and they survive relative to their neighbours that spawned in another area, then the only proof in the legacy of the issue is their survival. So in terms of legacy of projects and issues on salmon, that's only represented by their ability to survive. And what we've been seeing is salmon not declining until a certain

period.

What I also can say is when we represented in our figure on page 58 the no net loss policy being implemented, the understanding was that before that period losses of habitats was not prohibited and that this articulated piece of policy approach within the ***Fisheries Act*** and its characteristic allowed projects to not do the same sorts of things. So the general intent there is I am not sure about the legacy of the effects of lots of projects. I can say, though, that the major pulp mills, most of them have been shutting down. The regulatory issues applied to pulp mills and their discharge were improving greatly. The effluent from discharges on wastewater treatment plans, similarly. The regulatory influence on development of projects has been enhanced. The compensation and restoration habitat techniques and technology have been improving.

So those, as a sum, suggest, you know, that's not necessarily consistent with thinking about a legacy influence on projects.

Q Let me take you to Mr. Rosenau's general comments.

MR. DICKSON: This, Mr. Lunn, is what was provided to us earlier in the day by Dr. Levy. And I'd like to go first to the third page of it, if I could. So Dr. Johannes, these are the additional comments by Mr. Rosenau that we didn't have access to yesterday and this morning but now we do. And you'll see that there are three block quotations. And I wanted to take you to his comment under the second block quotation. So down toward the bottom of what's on the screen now, "Study should have". So this is addressing your statements regarding your review of the impact of large industrial sites. Mr. Rosenau says:

> Study should have encompassed impacts that have precipitated the decline prior to the last 20 years as opposed to just over the last 20 years. Impacts may have occurred before 1990 that triggered things that only started to manifest themselves after 1990. SOW does not restrict the analysis from 1990 to 2010.

And so I think it's fair to say that Mr. Rosenau

was of the view that there could have been impacts pre-1990 that had carryover effects, effects that lagged and started to manifest after 1990. You agree that's his concern?

A I agree that's his suggestion on that very early draft, yes.

MR. DICKSON: And if we go to page 25, Mr. Lunn? Thank you.

Q So this is his comments on your Map 8, which is relating again to the industrial projects, the major industrial projects. And on this page, that second paragraph, he says:

> What is important, from a sockeye view, is that things that happened a decade or two before 1990 may have only started to be felt, from a fish perspective, some decades later.

And again, so he's saying there are lag effects or there can be lag effects and these must be taken into account. You agree that's what he's getting at there?

A I agree that's what his view is at that point, yes.

Q And then if we turn over the page, he starts going through some of the key issues that need to be addressed. And at the top of that page, he's saying that:

> Key to the productivity of salmon utilizing the Fraser estuary is the large, shallow tidal flats that are abundant here—fish production is reduced when the young salmon are partially or completely restricted from these rich feeding grounds.

And then he gives examples in the next slides of restrictions of access to those feeding grounds. And the first is the B.C. Ferry causeway and you can see with the yellow lines, I think he's indicating that the fish used to go right across that causeway and now they have to go around it.

MR. DICKSON: And if we go down, Mr. Lunn, to the next one.

Q It's the same thing for the superport.

MR. DICKSON: And then over the next page, Mr. Lunn, thank you.

Q There are two jetties there, the North Arm Jetty and just below it, the Main Fraser Channel Jetty, and both of those, he's saying, are blocking access to productive feeding grounds. And so he's saying, I think, when I put the two pieces together that, you know, these were put into place before 1990 but they continued to have effects and the effects may have been lagged/delayed past 1990. Did you take into account the B.C. Ferry and Roberts Bank Superport causeways and the two jetties? I didn't see specific consideration of those in your report.

A Map 8 has those two particular features articulated in a map, of course, and so, as you will note from Dr. Rosenau's discussion here, he uses the words "juvenile fish", "juvenile salmon", in multiple, multiple areas. One of the very, very first issues that we tried to address was, so what habitats are sockeye? Sockeye is a species using and not using. So you go through the extensive literature material that we provided and all of Maps 3 and 4 and they come out fairly definitively as saying the population level for the Fraser sockeye do not use these habitats.

Now, as I've said yesterday, if I were looking at chinook, chum or even coho salmon in this same reference point and discussing these same projects, I would be saying something different. But the characteristics associated with sockeye salmon habitat use is the following. The North Arm very infrequently is used by sockeye salmon, as a migratory corridor as juvenile salmon out. The southern arm, extensively used. They, as we spoke probably an hour ago or so, they use the thalweg or the main river system, which means that middle/centre, big sausage of velocity and they get spit out into the Strait of Georgia. They are not particularly feeding. They're not doing anything other than travelling.

And that's why we made really good effort of trying to put together an understanding of what they used and what they didn't use because that certainly confounds the whole expression, as it associates with sockeye about what's important and what's not. So I was very careful about that issue. And those projects were important to consider. Absolutely. But sockeye, in all the

work that's been on Berth 2 for Terminal 1, you go through the environmental baseline assessments for those areas and they're not capturing sockeye; they're capturing chum and chinook.

Q I want to just turn, just in the last few minutes, to one last issue. And that is, again, consideration of the quality, the productivity of the sockeye habitat, when it's replaced in these compensation programs. And I heard in your exchange with Mr. Rosenbloom, he was asking you about the quality of the sockeye habitat in the compensation programs. And you said, I believe, that you did address habitat quality, as opposed to aerial extent, habitat productivity, in Maps 3, 4 and 15 by assigning colours that correspond to the use of that habitat by sockeye. And you were saying that sockeye use indicated habitat quality. Do you remember that exchange?

A Yes.

Q And I guess my simple point is, I believe that he was asking you those questions again in the context of habitat compensation. So just the lands that have been compensated for laws, not more broadly the habitat that is used by sockeye because when I look at those maps they're on quite a broad level and I don't see that they're focusing on habitat compensation. Would you agree with that?

A Yes.

MR. DICKSON: Okay. Those are my questions. Thank you.

MR. McGOWAN: Mr. Commissioner, just in terms of marking the -- I'm going to suggest that we mark both of the comment sheets that were distributed to counsel, the comments of Dr. Reynolds and the comments of Dr. Rosenau, that were inadvertently not included in the report. I'm going to suggest that they be marked as 735B and C so they're kept with the report.

MR. LUNN: There are actually three documents. Rosenau also provided general comments, which is what Mr. Dickson has been referring to.

MR. McGOWAN: I believe the first part is already included in the report at pages 94 -- or in the high 90s.

MR. LUNN: Okay, great, thank you.

THE COURT: So it's B and C, is that...

MR. McGOWAN: I'm going to suggest B and C. A, you will recall, was the errata sheet.
THE COURT: Right. Okay. Thank you.
THE REGISTRAR: So for Reynolds, will be B, 735-B, and Rosenau will be 735-C.
THE COURT: Right.

EXHIBIT 735-B: Reynolds, Review of Cohen Commission Technical Report 12, Jan 13, 2011

EXHIBIT 735-C: Rosenau, Review of Cohen Commission Technical Report 12, Dec 22, 2010, and General Comments, Dec 2010 - Jan 2011

THE COURT: Thank you.
MR. McGOWAN: That concludes the examination of Dr. Johannes.
THE COURT: Thank you very much, Dr. Johannes.
A Thank you.
THE COURT: We're adjourned until tomorrow morning at 10:00, Mr. McGowan?
MR. McGOWAN: Yes, tomorrow at 10:00.
THE REGISTRAR: The hearing is now adjourned until ten o'clock tomorrow morning.

(PROCEEDINGS ADJOURNED TO APRIL 20, 2011 AT 10:00 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.

Karen Hefferland

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

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.

Karen Acaster