

MINUTES OF THE COLLIERY DAMS MEETING  
HELD IN THE CITY HALL BOARD ROOM, 455 WALLACE STREET, NANAIMO, BC  
ON THURSDAY, 2012-DEC-06 COMMENCING AT 200 P.M.

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PRESENT: Judy Forbister, Concerned Citizen  
Lorne Gale, Concerned Citizen  
Louise Gilfoy, Concerned Citizen  
Steve Hill, Concerned Citizen  
Don Graham, Concerned Citizen  
Tom Grey, Concerned Citizen  
Bill Heathcote, Concerned Citizen  
Roblyn Hunter, Concerned Citizen  
Brad Maguire, Concerned Citizen  
Paul Neilson, Concerned Citizen  
Adrian Parker, Concerned Citizen  
Lawrence Rieper, Concerned Citizen  
Jeff Solomon, Concerned Citizen

Chris Grapel, Project Manager, Klohn Crippen Berger  
Will Jolley, Senior Dam Safety Officer, Dam Safety Program, Victoria  
Michael MacLatchy, Water Resources Engineer, Associated Engineering  
Scott Morgan, Head, Dam Safety Program, Victoria

Staff: Al Kenning, City Manager  
Tom Hickey, General Manager Community Services  
Susan Clift, Director of Engineering and Public Works  
Bill Sims, Manager, Water Resources  
Philip Cooper, Communications Manager  
Jan Kemp, City Manager's Office

1. Introductions, Review of Council Motion and Meeting Format:

Tom Hickey welcomed everyone and introductions were made.

Tom Hickey read the Council motion which was made at the Committee of the Whole meeting held Monday, 2012-NOV-26:

“It was moved and seconded that Council direct staff to invite the leaders of the Save the Dams initiative to attend a meeting with our staff to review and discuss engineering and technical information about the dams as well as the inundation area, to discuss priorities for future remediation and improvements to Colliery Dams Park and to report back to Council at the earliest possible opportunity.”

Tom Hickey advised that he plans to have a report ready for the Council meeting to be held Monday, 2012-DEC-17.

Jeff Solomon read wording from an email he had received from Councillor Pattje dated 2012-NOV-30:

“The main purpose of my motion is to get a dialogue going and to, hopefully, get answers as to why it is that there is such a discrepancy between the numbers being quoted, such as the possibility of failure percentages, the consequence numbers and the cost of remediation, replacement or removal. That, to me, has to be a first attempt at finding common ground.”

Jeff Solomon stated that his group’s objective is to understand that reasonable consideration has been given to saving the dams and to show that the recent studies are open to interpretation and that remediation was a viable option and our overall objective is to save the dams which means saving the lakes as part of the park and to satisfy safety requirements of the community.

Jeff Solomon:

- I am going to bring up the point that there is a wee bit of concern about a conflict of interest.
- I understand that you work for Klohn Crippen Berger.
- I also understand that there is initiatives and a possible agreement with your company to do the actual work on whatever happens on the Colliery Dams and there’s a concern about that.
- I’m not questioning your integrity, however, I want that to be a record that there’s a concern about your position representing your company.

Chris Grapel:

- I can answer questions about that.

Will Jolley, Senior Dam Safety Officer, Dam Safety Program, provided a brief PowerPoint presentation which included information on dam safety, dam failure and removal of dams.

Each dam has a consequence classification. The lower and middle Colliery Dams have a consequence classification of “extreme”. The ratings are in terms of loss of life, economic and infrastructure impacts, environmental and cultural impacts.

“Extreme” consequence dams have a consequence of failure of greater than 100 fatalities.

“Very high” consequence dams have a consequence of failure of fewer than 100 fatalities, but greater than 10 fatalities.

“High” consequence dams have a consequence of failure of less than 10 fatalities.

“Significant” consequence dams have a low potential for multiple loss of life, based on a temporary population in the inundation zone.

“Low” consequence dams have no possibility of loss of life (other than unforeseeable misadventure).

Chris Grapel stated he would be happy to answer any questions regarding the seismic study.

Jeff Solomon:

- Lorne is going to be asking most of our questions.
- We know something has to be done with the dams which has been accepted from day one but did not feel all options have been considered to seeing value of keeping the lakes and some of the existing structures.
- What was your understanding of the direction that was given to you with respect to the possibility of constructing new dams or revitalizing the existing structure?

Chris Grapel:

- There was an RFP related to a seismic hazard study, and I can't recall if I was asked by the City or if it was in the RFP to consider options for what to do as a function of whatever comes out of the seismic study.
- I believe that through the proposal being prepared and questions and answers coming back and forth there were some general options that came through with respect to what to do, are they okay, nothing needs to be done, or can they be repaired, or do they need to be removed.

Jeff Solomon:

- In your study you did make mention that the direction from the City was that it wasn't wise use of taxpayer dollars to re-do the dams even extensive upgrades would not be considered.

Chris Grapel:

- Yes, I said it would be an expensive proposition. The City said didn't want to go down that road and that they would focus more on removal than rehabilitation and that was in 2009.

Jeff Solomon:

- When you say expensive, were you asked what expensive might mean?

Chris Grapel:

- It's hard to come up with cost estimate unless you have a design, and to come up with a design you need drilling investigation, and then typically engineers like to involve a contractor to come up with costs to help give the owner a better idea.
- Sometimes owners like to collect tender bid item costs, and you can use that to start assembling costs.

- The City doesn't have that data base so it was not originally part of the scope but we said we'd take a look at it.
- We went through it and determined there was a lot of risk downstream including the school, etc. in the Harewood region.
- Typically with a dam study you present a variety of options to the owner and after you are familiar with the ground conditions then you can determine if it would be an earth dam or a concrete dam.
- You can try a number of varieties, but that wasn't part of the seismic study.
- I said for argument's sake, let's assume that it's going to be a concrete dam, which are very reliable structures, and we went with that.
- We roughly costed it out at approximately \$10M or more, and it is not based on anything more than judgment and crude figures.
- That's how we came up with approximate cost for a new dam.

Jeff Solomon:

- I do remember that and I know you weren't asked specifically about that replacement, you seem to have added that to the study that it was potential loss of life and more and I guess you know by now that number now differs dramatically than the numbers that have been presented which is a number of our concerns.
- You also brought up numbers for remediation and removal.
- Just walking through process you basically did say in each instance that these are very rough order of magnitude, then design really defines what the cost is.

Chris Grapel:

- Yes, typically you get some numbers, then design the work then whittle it down and whittle it down and sometimes after the study you realize the numbers could actually go up and then the owners aren't usually happy.

Jeff Solomon:

- You did a lot of research, and did you find the structures differed dramatically between 2008 and 2010?

Chris Grapel:

- No, they hadn't changed that much if at all.

Jeff Solomon:

- So there was no further deterioration of any significance?

Chris Grapel:

- No, certainly the obvious things were the upper wall face of the middle dam looked as bad as it did in 2008.
- It's hard to tell how concrete changes with time unless you take accurate photos from every angle, and measured.

- We used instruments to test density and quality in concrete and they were generally weaker than we would have liked to have seen in a structure like that, particularly the durability of the concrete seems to be different between the middle dam and the lower dam.
- You just have to look at the walls and in the middle you can see aggregate hanging out.
- The lower dam seems to be a lot better, and I believe the concrete strengths were weaker in the middle dam.

Don Graham:

- Did you calculate the probability of a seismic event located of such magnitude that it could damage or destroy the dam?

Chris Grapel:

- EBA hired a seismologist as they knew we needed to get some seismologist input, so they hired CAN Engineering, and what he did was told us that the design earthquake that would affect us the most would be from the Howe Sound area not off the West Coast and he said this is typically the kind of ground motions we are seeing this quake produce and this is what it would look like at your site.
- We took that event and did the analysis for the events of the dams are supposed to withstand, the one and 3,000 year event.
- The City came back to me partway through the study, this wasn't in the original scope of work, but we were happy to help, and said, we understand the walls of the middle dam would topple, and what kind of event could cause that.
- We ran them all and what we did was we took the seismic event and we scaled it down and I had a seismic modeling expert and they managed to scale down the quake and reduce the severity of the shaking. I can't tell you exactly how it was done, but I am confident it was done well and then we came up with how much deflection we think the walls will take before it starts to topple. It was an estimate.
- So, we didn't deal with a magnitude-type event, what we dealt with was peak ground acceleration, and that's what we used instead of saying magnitude earthquake.

Mr. Graham vacated the Board Room at 2:36 p.m.

Jeff Solomon:

- What was your conclusion due to potential loss of life if dams fail?

Chris Grapel:

- At the time I was basing it on what my colleague had done in 2008 and I looked at it and walked around for myself and I questioned whether or not one to 10 was appropriate but there was a healthy debate on the matter then ultimately we decided to do a study, so I made the recommendation to do an inundation study to better understand the consequence of failure.
- Apparently I was wrong on the estimation of one to 10.

- When you look at the size of the lakes and then you look at what's down there, and you have a hard time seeing initially how more than 10 people could lose their lives in such an event but it's also a concern for the children and the daycare and I wanted to make sure, so that's why I made the recommendation for the inundation study.

Jeff Solomon:

- Time and again in your study you mention about social impact and community input.
- You refer to the loss of the lakes as being fairly significant impact to the community.
- Is that correct?

Chris Grapel:

- Yes, I think it's a fairly significant impact for the whole City of Nanaimo and even myself as every time I come to Nanaimo I go there as I think it is a beautiful park.

Jeff Solomon:

- Did you see a big difference in the structure in 2012 compared to 2010?

Michael MacLatchy:

- No, I didn't see a significant difference but you have to remember that primarily we were looking at the consequences of collapse and other conditions of the structure

Jeff Solomon:

- Was it ever brought up in terms of actual removal of the structures for the potential of asbestos in the structures since we are talking about hazardous material that was used a lot, going back 100 years?
- Were you asked about that?
- Has that been brought into issue in terms of cost?

Susan Clift:

- What happens now is that we are required to go through a number of steps in terms of removal of any material whether it be the coal slag that's in there now, the sediment, or the concrete core so that will be part of our standard operations from here on in.
- We will study that material to determine how we would dispose of each type of material.
- It has not been done now but it is going to be done.

Jeff Solomon:

- Has it ever been factored into the potential cost?
- It is very expensive and difficult to remove asbestos.

Susan Clift:

- We knew there was a chance of contaminated material in any parts of the dams, so absolutely there is a safety factor in our cost estimate.
- It is a large safety factor.
- There were a lot of worst case scenarios in that estimate.

Jeff Solomon:

- We have these studies in hand and we wonder about discounting of the results from 2010 as being significant enough to have some action.
- There are concerns about that process and what did or did not occur after the study was produced.
- Is there some type of explanation about that?
- We know you requested the inundation study, but what else?

Tom Hickey:

- We were in contact with the Dam Safety Branch, and talked with Chris and his recommendation was to go to an inundation study.

Bill Sims:

- We didn't know which 10 people would die, and we did a Council seminar session of risks.

Jeff Solomon:

- When did you advise Council?

Tom Hickey:

- October 2010.

Jeff Solomon:

- So about the time the article was produced in paper.

Tom Hickey:

- Yes, around that time.

Jeff Solomon:

- You said something had to be done, but not sure what?

Bill Sims:

- Yes, that is why we asked for the inundation study.

Jeff Solomon:

- You're quoted as saying Westwood Lake is a "no brainer".
- So, there wasn't the same consideration for Colliery Dams as Westwood Lake?

Bill Sims:

- I don't remember saying "no brainer".
- Westwood Lake is a different situation; the downstream consequence is "high", since there is less potential for loss of life.
- We knew the existing structure of the dam and its condition was relatively good as the structure was documented.
- The area that was buttressed was relatively small but even still we tripled the size of the dam.
- Westwood also doesn't have the issue with needing to pass a large flood because the spillway is at the far end of the lake and is sufficiently sized that any large flood coming into Westwood Lake would raise up to its lowest point and would eject out the spillway without going over top of the dam, so it was a relatively simple fix.
- The condition of the dam was good.

Lawrence Rieper:

- Was it was the highest risk dam at the time?

Bill Sims:

- In 2003, yes.

Jeff Solomon:

- Was it in worse shape than Colliery Dam?

Bill Sims:

- I think it was the highest priority.

Lorne Gale:

- I believe they are saying they felt Westwood Lake was in a worse condition.

Chris Grapel:

- I recall the Golder 2003 dam safety review report identified that the dam safety review report listed priorities and I think Westwood was viewed to be the highest priority.



Jeff Solomon:

- I also want to say before I ask you the last question that I have since been told that the proper protocol is not to use names in a public forum and I won't be doing that again.
- My last question is, your direction in 2011 was really not to worry about the issue of the Colliery Dam that it is potentially insignificant in comparison to other issues that happen, like a seismic event and I do need to ask you about that because that's what you said.
- In correspondence with one of our committee members, you said that.
- I passed it out at Council meeting and they should have given you copy of it.
- You basically discounted that this was an issue that needed to be dealt with yet apparently it was on record that this certainly needed to be dealt with.

Bill Sims:

- I don't recall ever thinking, feeling or writing that the seismic issue at Colliery Dam was not an issue to be dealt with.

Jeff Solomon read a portion of a letter.

Bill Sims:

- The damage due to the failure of a seismic is in the \$40M range, we would be in the billions of dollars across the City of Nanaimo. That's the context.
- That wasn't discounting the seismic risk.

Adrian Parker vacated the Board Room at 2:51 p.m.

Lorne Gale:

- I am an engineer, I did my undergraduate studies in mechanical engineering and I have my PhD. in fluid dynamics and surface chemistry and I approached this group, they did not approach me.
- I am a local resident to the dams and enjoy them as a lake and as a park and I was shocked, surprised and stunned to hear of their demise.
- I will provide an objective perspective in this discussion, questioning, not challenging.
- Scope given for the RFP process – you were limited to certain activities, obviously couldn't spend enormous amount of money to do an exact study but you did what you could with what you had.

Chris Grapel:

- Yes, I spent quite a bit of time out of personal interest.

Lorne Gale:

- What was the value of the contract?

Susan Clift:

- Between \$60-65,000.

Lorne Gale:

- Did the City solicit such companies that had a background?

Chris Grapel:

- There were a couple of companies that weighed in.
- The City owns a surprising amount of dams for a city its size, so they're on the radar so to speak.

Lorne Gale:

- There are lots of assumptions throughout the studies and I understand you have to make some assumptions.
- The one in 3,000 year event is dictated by what?

Chris Grapel:

- 2003 Golder report in discussion with the Dam Safety Branch and according to the 1999 Canadian Dam Association Guidelines.

Lorne Gale:

- Is that the only option?

Chris Grapel:

- The Canadian Dam Association is a non-governmental organization that consists of the dam engineering community in Canada.
- I suppose I should state for the record that I used to be on the Board of Directors of the Canadian Dam Association.
- It consists of dam owners, typically, a lot of small dam owners like the City of Nanaimo think that it doesn't apply to them because that's BC Hydro, Alberta Environment and all the big dam owners all the way across the country but it actually represents all the dam owners in Canada.
- Among them are also consultants, contractors and regulators.
- It's the *de facto* guideline not only in Canada, but for a lot of other places.
- They sell a lot of guidelines to countries like Africa and Asia as well.

Lorne Gale:

- Is there no flex in the one in 3,000 number?
- Who determined it?

Chris Grapel:

- It was determined by Golder & Associates in 2003 as a function of the consequence classification that they determined was appropriate for these dams.
- The consequence classification determines the magnitude of flood or seismic events that you have to meet.
- In 1999 they used to give a range, and I think it was one in 1,000, one in 10,000 and Golder figured that one in 3,000 was appropriate.
- That was a subjective judgement call and I did not disagree with that.
- I thought it was appropriate.
- Obviously these dams don't rank up there with the high end which would justify a one in 10,000 earthquake like some of the larger dams in Vancouver and similarly the consequences were high enough that they didn't deserve to be classified with the upper end, at the time it was called the low range, or whatever it was at the time.

Lorne Gale:

- Later in your report you indicate that an event that's much less than that could be problematic too, and we got down to a one in 475 year event?

Chris Grapel:

- A 10% chance of occurring in 50 years, and there are a lot of numbers in the report, and in the report I think I said it would be about a 15% chance of one in 50 years, but that would probably be like one in 400 year event. There is a formula, but I don't have it with me.

Lorne Gale:

- So, even if the report had been written with a one in 1,000 year starting assumption, essentially the results would have been the same and you would have still found that a 400 year event could mean a failing mode.

Chris Grapel:

- Yes, it's hard to say and I didn't do that particular analysis.

Lorne Gale:

- So, how many engineers?
- This is all based upon dozens of assumptions that make up this report, then your report goes over to next company and they base it all on what was found there.

Chris Grapel:

- I don't know if they based it on what was found there or what Mike did.
- He just took a look at the physics of the water being released from the dams in the order that I presented them, and none of those statistics were being used for certain,

but when he got into his flood inundation study for the large flood event that I applied to these dams as a function of their classification, but he can talk about that.

Lorne Gale:

- Did you read Michael's report?

Chris Grapel:

- I did read through it.

Lorne Gale:

- Okay, because he does reference back to the study a lot and I think that's where the concern came from for staff and obviously the Councillors, those numbers used there which may have been quite shocking, and whether that's been represented correctly.
- If I can jump to that then, Michael obviously in your summary you make it clear that there's a 40% chance of an event in the next 50 years that could cause failure.

Michael MacLatchy:

- I think, as I said, there is the potential for an event as frequent as 40% in 50 years.

Lorne Gale:

- Where did that 40% come from?

Michael MacLatchy:

- It comes from the report.

Lorne Gale:

- It doesn't come from the report, that's the trouble.

Chris Grapel:

- I picked a range from 10 to 40% that was the available data.
- I analyzed the model.
- You are on the right path; I'm not saying it is incorrect.
- There are a lot of numbers in those reports.

Lorne Gale:

- 40% in your report, it isn't there in the sense, I mean, yes, you gave a range.

Chris Grapel:

- I gave a range but then I said it was more like 15%.

Lorne Gale:

- So that's what I'm saying. How from your comment, you took the high end of the range

Michael MacLatchy:

- I talk about the range being 10 to 40%.

Lorne Gale:

- In your summary you make a standalone comment that says a seismic event could lead to further damage as high as a 40% probability.
- So, I'm just saying for people who don't understand these things, they just read that and go, "Wow".

Chris Grapel:

- It's alarming.

Lorne Gale:

- It's alarming and I'm saying it could be misrepresentation and it could be as low as 10% or less and my next question is what is acceptable risk.

Chris Grapel:

- That's where you've read the report about ALARP used is through the Canadian Dam Association Guidelines.
- They talk about the probability of loss of life but also the number of loss of life, so as more people die during the failure of an engineered structure, the more society thinks that should really approach the probability that frankly starts to get infinitesimal and it's what's happening, the latest guidelines that Golder worked under were superseded in 2007, so I was working under a new set of guidelines which aren't terribly different but for the fact that the conservatism relating to loss of life due to floods or earthquakes became more stringent, so there were words and language in my report on where I tried my darnedest to explain in to a layperson as I knew eventually would read the report, but basically that ALARP concept which means "As Low As Reasonably Practicable", came out of the 2007 guidelines.
- What I was looking at was, let's just say for argument sake because there was some debate, let's just make it 10% and there's figures and discussions on that.

Jeff Solomon:

- Was the 40% discussed with Council on October 22?

Bill Sims:

- The range of 15-40% was discussed, I believe.

Jeff Solomon:

- Is that exactly what was said?

Tom Hickey:

- We can check the report. *[The Council report was checked and shows the ALARP model, and staff noted in the report that the dams pose an unacceptable risk.]*

Susan Clift:

- I don't think the numbers were in the report at all. It just said "significant".

Bill Sims:

- I just want to point out one thing: Chris was dealing with the seismic event and whether he's pegging it at 15% or 10- 40% but the other risk of failure was relatively frequent flood which was also what Mike was looking at.

Chris Grapel:

- What's happened with the seismic event too since the completion of Mike's report which is based on the release of water, not probability, is due to the number of lives that are at risk now, that justifies these dams being extreme and for an extreme consequence dam, now the earthquake gets lifted up and there is actually a clause in the CDA guidelines that if you can't prove that an earthquake won't cause loss of life you should be using, I can't remember if it's the one in 10,000 event or the maximum critical earthquake, which the maximum critical earthquake doesn't exist – no one's experienced it, but it is a statistical construct that seismologists prepare to reflect all the bad things that they know, so you were saying there are assumptions, there's a whole bunch more and when you get into the one in 3,000 year events this is what we have for recorded information.
- It's like going to the shooting range with a Derringer, and you're trying to pop something 1,000M away.

Brad Maguire:

- Can you characterize a one in 3,000 event in terms that lay people can understand in terms of what it would be on the Richter scale?

Chris Grapel:

- Imagine the force that's pulling you into the ground when you stand up.

- Imagine somewhere between two-thirds and three-quarters of that force all of a sudden being applied to your body horizontally or vertically.

Brad Maguire:

- But that could characterize many large earthquakes, is there a number that compares it to the Richter scale?

Chris Grapel:

- No, I've been pulled apart on that.
- I don't use the Richter scale as a way.

Lorne Gale:

- I think what we are getting at here is that there are a lot of assumptions.
- Going back to this CAN company, and predictions of what it's going to be like here, at the end of the day, like you said in your report, it comes down to engineering judgment, and you walked around and said it's hard to say what sort of effect will be here and what casualties there will be.

Chris Grapel:

- I have very little doubt that an earthquake that size will not knock over that wall.
- I have very little doubt that the time that it falls over is very important as to whether or not the middle dam retains its compounded safety.

Bill Heathcote:

- What magnitude would make it fail?

Chris Grapel:

- I did the Westwood Lake work in 2004-2005 and we were using a different method of analysis and I think we were using a mag 7 or a mag 8.

Bill Heathcote:

- There was a big quake here in 1946.

Chris Grapel:

- The information I have available for the study and certainly our team considered that quake, there have been people that have looked at it since and figured that maybe there was 3, 5 or 7% gravity horizontally being applied to the structures.

Lorne Gale:

- The dam stood up to that.

- Assumptions, yes, when it comes down to engineering judgments, such an event would obviously cause widespread devastation, I agree.
- We design schools to a 2,475 year event, so basically schools would be down at that point.

Chris Grapel:

- Yes, I mentioned that in the report but I don't know if that school has been upgraded or not.

Lorne Gale:

- It's not just that school, it's widespread.
- So, taking all things into consideration and what is reasonable, that's something I feel that the school would want.

Chris Grapel:

- That is something I put in the report saying it's up to the City to decide what chart they want to use.
- That chart has been set by a non-governmental organization but any time I offer that it's always to the owner to make sure that they understand that if they wish to increase it i.e. make it more stringent, then that's their choice.
- It's never occurred to me that anyone would want to reduce it.

Lorne Gale:

- I'm not suggesting that, all I'm saying is that given there is quite a range of probability of failure event that may impact the outcome of the event.

Chris Grapel:

- I read through the report once last night and I'm complimented that you studied my report so much. Did I present one in 3,000 or did I present one in 2,475 on the ALARP.

Lorne Gale:

- So I guess the question applies again, if this had been considered a one in 1,000 would that have dramatically changed the situation?

Chris Grapel:

- Well, a one in 1,000 means that it would be more likely to fail.
- A one in 3,000 is less.

Lorne Gale:

- So it's a less likely occurrence in a bigger event?



Chris Grapel:

- If it's a smaller event that causes it to fail, that makes it worse.

A graph entitled "societal tolerance of risk" was presented.

Chris Grapel:

- This is  $1 \times 10^{-3}$ , or another way of saying one in 1,000 so what I plotted in my report was over here, which was logarithmically one in 3,000 and is more or less halfway between one in 10,000 and  $10^{-3}$  and  $10^{-4}$  so this is what I plotted in my report.
- If it's one in 1,000 it's even worse.
- When I was looking at it I was looking at 10 souls, but what they're looking at now is a range further up, so more likely a smaller event.
- The next line up is  $10^{-2}$ , which is one in 100, so the further you get up this way this is a smaller event causing the failure.
- When the Canadian Dam Association developed this, they thought long and hard about it and they looked at a variety of risk management approaches and different things, the nuclear industry considered what's considered safe for public exposure to risk.
- It's a broad topic, there are a lot of opinions, but this one has one that they've pulled out a number of international dam standards and they've thoroughly reviewed and considered it.
- I wasn't part of the selection process for this.
- What this says is if it's in a one in  $10 \times 10^{-7}$  event and say 99 people could die, that's so remote that it's broadly acceptable by society but I have a hard time accepting 99 people dying.
- This is how the process works.
- If it was one  $\times 10^{-5}$  probability of it happening, a really thin chance of 99 people, you fall into this zone called ALARP and there's a grey zone for an owner to say is this good enough, is this truly ALARP.
- Depending on the situation, someone might say that's too close, these numbers are too wishy-washy, what do we have to do to be lower.
- What the Americans do and what Trans Alta Utilities is doing is doing probable failure modes analysis you start coming up with your best guess of the probability, so that's how you might affect the repairs but this also speaks to how much money do you want to spend to get to this.
- If you end up one  $\times 10^{-4}$  probability failure of 99 people dying, that's generally unacceptable, which you have to watch the minute someone draws a line in the sand like this is realize that this is not a sharp line and you have to start asking questions like does that work for me or does it work for my organization, does that work for the kids at the Little Fern Daycare.

Susan Clift:

- One of the things that we did when we showed this to Council is we tested it against some common occurrences, things that we do every day like drive and get on a plane with 300 other people.

- In a 747 there's the potential for 300 people to die as you're in that plane, so we looked at what the probability is of dying in a crash in a 747 and this is the probability that we came up with.
- I don't remember the complete number but we plotted it on a graph and it's in the band of acceptable risk and when you make a decision to drive every day you know you have the potential for loss of life either of yourself driving or a pedestrian, so as a society we take that risk and we accept it when we get into the car, so what we wanted to do when we showed the graph to Council is to show how these risks that we're all familiar with every day, how does it relate to the risk of having the dams in the community.

Jeff Solomon:

- May I interrupt, I appreciate some of this but I really want to focus again that we have consistently accepted there is risk and there are issues with the dams.
- We can go on and on about that subject and what needs to be done, but we knew that from just reading the first few paragraphs in the study four years ago, but the concern is what we do with that at this stage of the game and having a rash decision that it has to be done right now, we have to get of them, they have to be gone, that was the part that is very unsettling.

Susan Clift:

- The thing that I'm hearing and not just in this room is that not everyone is on the same page, so that's why we're talking about this.

Robyn Hunter:

- Our group has done a lot of studies and talked with engineers, so we're up to speed with that.

Lorne Gale:

- Would changing the assumptions change this outcome?

Chris Grapel:

- I don't think it will change the outcome of a seismic hazard.

Will Jolley:

- From my perspective, seismic studies have been done to determine whether dams are safe, in the last 30 years especially since it was recognized that seismic shaking can cause liquefaction of certain kinds of earth fills and that this was really discovered in the 1960's and became something of a grave concern to dam owners and especially BC Hydro because of the number of dams that are constructed in the way that dam fill is fairly loose, so studies were done in the 1970's and upgrades were done in the early 1980's.

- The Coquitlam Dam, Aloette Dam and Bear Creek Dam were reinforced with buttresses and about 10 years later they were re-assessed and Hydro and other owners, and we are learning so much more now about movements of trussle plates and how that affects earthquakes and in the 1990's there were another rash of upgrades and there was more upgrading of dams.
- Some large concrete dams were post-tension anchored into the foundations to make sure that they were seismically upgraded.
- The Coquitlam Dam was upgraded again with much larger berms on upstream and downstream side and the same with Aloette Dam and then in the last 10 years there has been a lot more work done and BC Hydro is just doing another Province-wide seismic assessment which may be going to change the way we look at seismic shaking again.
- Using the Coquitlam Dam in the last round of assessments they determined it could not be saved and they built a new one downstream so we don't know everything about earthquakes and we don't know exactly what the one in 10,000 years will do, but our knowledge has really increased a lot over the last few years.
- Which way the earthquake shaking goes is always going up in almost every case.
- There's been the odd case where certain parts of the Province the shaking determined from the new studies is not as high as 10 years ago, but in almost every case the force generated by a earthquake in a particular location goes up.

Chris Grapel:

- I took a five-day seismic boot camp to supplement my graduate studies from the University of California at the Berkley Campus.
- These are the guys that are paid by the United States Geological Service to load up a Hercules with a drill rig, a cone rig, a lab, a team of engineers and when they have a major earthquake in Ceylon, Sri Lanka, Turkey any big quake, they leave Oakland with all that gear on and they study the quakes.
- I had a long talk with the head of it and I told them about earthquakes in Canada, and that theirs seem so much stronger and I asked them why ours are not as strong and what did this mean for the long-term.
- He said Canada is an interesting position because Canada is tectonically very similar to the US except not as active.
- It seems that Canada has the capacity to produce large earthquakes but we haven't seen them yet, but it could be that Canada is tectonically different enough that Canada gets the massive quakes but not a lot in between.
- He said what he would expect as an engineer working in BC is that the quakes are going to keep going up and they could go up a lot.
- The expected results of future studies or experience for determining what the severity of shaking for any given earthquake say 60 years ago people used to design dams for 10% of gravity acting horizontally now it's depending on what's downstream it could be as much as three-quarters of the force of gravity and in the States its one or more.
- There is a slowly ratcheting up of what we can expect in a seismic event as a function of what we learned about the tectonics in geology.

Lorne Gale:

- Did you say Westwood Lake was a Richter 7?

Chris Grapel:

- It was about two-thirds to three quarters of the force of gravity.
- It was done after they had released the new seismic data.
- The Geological Survey of Canada released a new data base on ground motions for engineering designs in 2004 and that was considered when EDA did that design.

Lorne Gale:

- In terms of the PGA [*Peak Ground Acceleration*] is it less than what we're looking at here?

Chris Grapel:

- It's about the same.
- The reason we had to take a different approach this time is that Westwood Lake is an earthen dam and is more or less homogeneous or at least we can assume it is, here the core wall we had to treat differently to get that structural soil fill interaction.

Lorne Gale:

- The point I'm trying to get at is that this is one of the assumptions and could the outcome be different if different assumptions, that's what we're trying to identify.
- For example, on your model you said it has a  $\pm 15\%$  accuracy.

Chris Grapel:

- Sure, those are the deformations.

Lorne Gale:

- Yes, so if it was not that way would the mode of failure of the toppling of the wall, would that may have been a different outcome?

Chris Grapel:

- When I looked at that at the beginning of the study, it's always important before you start doing a great long read and calculations to take a look at it and say well what do you think is going to happen because the computer is going to compile calculations.
- When we looked at that our gut sense was that we felt that wall was going to fall over, in fact we identified that in the proposal while we were pre-determining the outcome of the proposal is when we said we think this is what's going to happen.
- Our initial gut feeling is that the middle walls were going to fall and we thought we were just going to roll it out there and say this is what I think is going to happen.
- When we turned on the software and we did the detailed deformation of modeling with the earthquake event shaking the hell out of the dam, I even had a great video that I would show the City when I gave the presentation to both the City and the Dam Safety Branch, that showed the dam flopping back and forth and showed the wall tipping over

and the middle dam or the lower dam, then the question was the reinforcing of the walls and we are pretty sure there is no reinforcing in the walls.

Lorne Gale:

- And how much would that change if there was reinforcing?

Chris Grapel:

- That's hard to say and there are going to be more assumptions with that because concreting was in its infancy at that time in Nanaimo and I can tell you even to this day despite the best intentions, sometimes concrete doesn't go quite the way you want.
- A good example of a concrete structure of the day is the Morden Mine head frame that is in south Wellington and for something that was designed by experts in Europe, it has all the classic problems of concrete that I've seen as late as this summer – honeycombing, bad mixing, I mean no one sets out to do a bad job, but sometimes things happen, particularly if you're in a frontier setting which Nanaimo more or less was during the turn of the century, so we don't think there is reinforcing in there.

Bill Heathcote

- What is the cost estimate to remediate dams?

Chris Grapel:

- In our report we showed putting big berms in on either side and we came up with a strategy for the middle dam, and prices can be surprisingly high for jobs like this.

Lorne Gale:

- So the point is the modelling  $\pm 15\%$  could change the outcome if the wall wasn't going to topple, if reinforcement was there, some of these other assumptions.

Chris Grapel:

- If some of the reinforcing was in good shape, if it wasn't corroded, etc.
- You would know all this if you took the dam apart, but that's not preferred.

Lorne Gale:

- Even the way you did, though, you made a comment that the toppling has a very remote chance of occurring that was point one.
- Then you said it could possibly topple, point two.
- So is it too late to have a number put to that?

Chris Grapel:

- That was when the City called me and asked me to add this to my report and then we did more thinking, and there's more assumptions, so certainly for the big event there is

a lot of energy going into the dam and we are pretty confident that that wall will topple and the fill behind it will vibrate out.

- For smaller excitations it is harder to say.

Lorne Gale:

- So remote and possible.
- I'm just thinking that goes over to Michael's study then and he considered that's what's going to happen and fair enough that's a worst case scenario and we have to view designs that way.
- Once again, is it possible to happen?
- Does it represent as accurately as it could be?

Chris Grapel:

- I think what you have to focus on is the most confidence that you can get out of this report is for the one in 3,000 year event and whether it's the 10 or 15 or 40%, the reality is these dams have to safely impound the reservoir for the design earthquake which now is a one in 10,000 year, and I believe that the wall would fail sooner in the middle and the dam failure would be initiated sooner depending on the severity if the shaking going on.

Lorne Gale:

- If we did a little more extensive modelling, be it physical models or 3-D computer modelling it could more accurately define the actual event?

Chris Grapel:

- We discussed that and I don't know how you'd physically model something that I believe was hand-built using concrete; you'd have to make assumptions to come up with a physical model.
- We talked about the 3-D model and there is a three dimension effect as that thing is wedged in there, but we're not talking about high quality concreting of construction, so the reality is, like Jeff said, something has to be done about those structures so that's what the seismic structure ultimately concluded it talked about three routes to take.

Jeff Solomon:

- I did read the study a number of times and the quality of the concrete was referred to many times and we do understand that but we also understand that it's held up significantly well considering the fact that they had no machinery and possibly no metal in it so in 100 years there hasn't been any issue, so we're assuming that there is the possibility of building something with new construction materials, new concrete that something could be built that would actually retain the water?

Chris Grape:

- Absolutely. You could build two new concrete dams if you had the money, and have spillways going over top so you don't have to play around with widening, deepening, blasting, etc.
- You could do that, it's not impossible, the question is, is the money there?

Lorne Gale:

- Your report shows that the cost of removing would be greater than remediating.

Chris Grapel:

- Well, it does but there's a bracketed section that excludes a whole bunch of things which are costly or more so than the actual removal. I've removed a couple dams and you start digging and you might have to segregate materials such as slag or concrete, so just keep that in mind that there are some pretty large costs that were left out.

Lorne Gale:

- Yes, but relatively speaking looking at what you have there, you felt that relatively speaking it's a probable cost.
- The only thing you excluded on the remediation was the de-watering and environmental permitting that has to occur either way.

Chris Grapel:

- It does, it's different whether you're building or maintaining the exact same reservoir footprint then some of it might fall out of it but in order to build you're going to have to move the dams or build them downstream and as an engineer, without doing a study on exactly what's required, one tends to be a little vague on these things because department costs could be considerable.

Lorne Gale:

- Based upon the report that said it was a comparable cost, why was the emphasis made on the removal and not remediation?
- Why can't they consider further remediation?

Bill Sims:

- The seismic study and costs address what we need to do to upgrade the dams to that 3,000 year seismic event.
- With the results taking us up into extreme, that makes things look a lot different.

Susan Clift:

- Plus the spillway.

- We came up with our best estimate based on information from various sources including having to build a spillway around both dams.

Lorne Gale:

- That's a possibility, but I don't think it's a requirement.
- I guess what I'm getting at is my first shock was seeing in the newspaper that there's a \$7M option to demolish and \$20-30M to remediate.
- That's what sparked my interest in the project.

Chris Grapel:

- First, we have to understand what the remediation cost was for.
- Because the City was familiar with the Westwood Lake-type repair, that repair is not a repair that the earthquake could happen and nothing is going to change.
- The reality is that there could be deformations of the upper stream shell.
- That berm is in place to buy time.
- Westwood Lake is a big lake and the Chase Dams are little.
- It's one of the physics constants of the universe that I'm aware of that the pressure acting on the upstream face side of the dam is the same whether the reservoir is 200M or 2,000.
- The potential energy is a bigger battery and takes more energy, that's an important difference.
- In the case of Westwood Lake, it buys time.
- It's not to fix the dams forever.
- That's the kind of repair that we proposed for middle and lower – berms.
- The concrete and everything is left in place and if it vibrates around and we think there's no reinforcing in it and it cracks and it starts leaking, then the City has to go back up there and look and ask what we do next.
- That's what this cost estimate is.
- There are other things that can be done but my scope wasn't to provide an exhaustive list of all the different things.

Jeff Solomon:

- You would have considered the berms as satisfactory in terms of mitigating the risk?

Chris Grapel:

- They would buy you time to send somebody up there with a large pump to start draining the reservoirs down if they started leaking so severely that it was going to be a dam safety risk.
- The comment I made to the City was that if you get a quake this big, there's a lot of you-know-what that hits the fan and the City crews are dedicated fellows, but I know where I'd want to be after a big emergency like that.
- I'd want to be home making sure everybody is okay.
- So, City resources could be taxed quite severely and the point I made was are you sure you want a bunch of these all over the place, that you're buying time?
- That ALARP is guidance on how to deal with these things.



Bill Heathcote:

- Can you not take those dams and buttress them in there?
- BC Hydro does.

Chris Grapel:

- That's what we costed out here was buttresses, but they're not a permanent solution to fix.
- Hydro, I don't believe, fix their dams to survive a seismic event, I believe they fix to survive and then be addressed afterwards.
- I believe they fix their dams permanently.

Lorne Gale:

- It's a fine suggestion and it comes back to the City and whether or not they have more resources available to check on them.

Chris Grapel:

- Every time Hydro fixes their dam they have to come back and fix them again because the quakes keep getting bigger.
- It seems to be a growth industry for people doing work for BC Hydro.

Bill Heathcote:

- I worked for Hydro and it seemed like the dams were worked on definitely were leaking.

Chris Grapel:

- It's one thing for them to leak quite a bit through the foundation and to be looked at and to be judged well this is a steady state of that and it's another thing for a dam that doesn't really leak all that much to get hit with a big earthquake and then a lot of water starts coming out of it.
- That gets an engineer's attention when you start looking at a dam and start asking what's changed.
- I've looked at dams that haven't experienced earthquakes that all of a sudden start seeming quite bad and experiencing a lot of problems and we've had to fix them very quickly.
- No one likes a leaky dam because they built the dam to hold the water and they don't like it to drain through the foundation and leak out.

Bill Heathcote:

- You're saying that to buttress both of them sufficiently wouldn't do the trick?

Chris Grapel:

- You've got material that's been hand placed in each one of them.
- It's going to have a softer response than the dense rock fill you put on either side.
- You're not going to be able to densify all that material existing by putting a roller on it and packing it.

Bill Heathcote:

- So can you not buttress them and take the centre out and put a new core in?

Chris Grapel:

- If you're going to do that, I'd say build new dams, but that's a lot of work.
- Then if you're going to fix something that just barely survives a seismic event that we're concerned with now, given this trend, old problems are going to arise from old solutions.
- Given the fleet of labourers that the coal mines would have had and they had a lot of people working on surface that weren't allowed to go down below, and I think they built the dams by hand.
- They dumped over and they spread it.
- If they just dumped it over and dumped it over again, it's even worse.
- That would be my worst case scenario.

Bill Heathcote:

- They probably used it as a tailings end to get rid of it and make a dam out of it.

Chris Grapel:

- As best I can tell, at that time they were enlarging Harewood mine and I worked on a lot of mine sites and it's a lot easier to take the rock and dirt downhill than to take it uphill.
- So if it's needed, that's where you take it and I could see how they would have dumped it.

Bill Heathcote:

- What I'm getting at is there is no compaction of that dam whatsoever.

Chris Grapel:

- Right, if you put dense berms on either side, the inside is still going to move around so that concrete wall is not supporting.

Bill Heathcote:

- There's nothing to say you can't take that core out of there, though.
- We did it at Kelsey Lake at one part of it, and the other part we buttressed.

- The costs weren't terribly high, and you're talking \$20-30M.

Chris Grapel:

- It just seems like a whole lot of extra work.
- I'm not talking \$20-30M.

Lorne Gale:

- That's the point, so can we address that.
- That's what we've been doing as the public.
- The \$7M and the \$20-30M, the report indicates differently and we feel differently, we need to know that reasonable consideration has been given to these other options of maintaining the lakes because it is a general consensus of Nanaimo that the lakes remain, so can we do it with reasonable consideration?

Chris Grapel:

- One of the last things I did with my former employer was I received a call from the City of Nanaimo saying that since I know these dams pretty well, and I'm building dams, could I come to Nanaimo and talk to us about the seismic study and when I met Bill Sims at the airport, he gave me a copy of the Associated report.
- I looked through it and we went up to the dams and Bill asked what it would cost for new dams.
- I said I had put a few of these up and I think the best course of action for the City, if they want to have something that they don't have to come back on all the time every time the geologists change the data base, you will want concrete dams.
- Typically you go and drill holes, then we do a study and say a concrete dam, rock filled concrete face, it's a vertical membrane and I've proposed these dams, a concrete wall down the middle of a dam, for another site but it had a lot of reinforcement steel.
- All things considered, I said I think this is going to definitely get you into the high single millions to something that is probably measured in terms of tens of millions.
- By tens of millions, I was thinking \$10-20M.
- I have done no studies, no costing, I keep up with an area of a triangle multiplied by the length of one dam and said if you use roller compacted concrete, I know this price, and that's how I came up with it.
- As you know, you get into a design and there are a whole lot more things you can work with and it's amazing how they can all go sideways too, but that's the beginning cost.

Lorne Gale:

- My theory is that the removal cost would be equivalent or more than remediation depending on the level of remediation.

Chris Grapel:

- In this report I looked at the volumes.

- That was one thing I was able to do, they gave me a CAD model, we calculated the volumes, then using some numbers from the City and using some other numbers that I had floating around in my head I came up with what's here.
- The reality is that for the dam removal exercise I would be surprised if the environmental and everything else costs weren't equal to the actual cost of digging dams out.
- Then the City has very ambitious and I think good plans to do a lot of re-vegetation, re-naturalization, plus two bridges and that's going to cost money as well.
- The \$7M is about right, maybe a bit high.
- Until we get into it, for instance test the concrete.

Adrian Parker:

- If the remediation is to go into effect, those dams would be available for public use, probably again within in a year or two.
- Turning it back into a natural river environment, it's going to be a decade before that park starts to look like a proper place where people want to go.
- To make it a place that people are going to enjoy it again and how long it's going to be.
- It can be remediated in a couple of years or we can remove it from enjoyment for a decade.
- I don't think that's been factored into the costs at all.

Tom Hickey:

- Some of that will depend again on our level of naturalization because if we're putting in more mature trees and are doing some things like re-planting, the trail system itself and the bridges will be available to the public soon.

Bill Heathcote:

- Why spend all this money to tear them out?
- Why not take that money and remediate these dams and have the natural thing that was there?
- If you took that \$7M and plunked it into fixing the dams you would be on the right track.

Adrian Parker:

- It seems to me that obviously if there is an equal cost between remediation and removal that the City is opting for removal because you want zero risk.

Chris Grapel:

- They don't want zero risk.
- There's a balance and that will be on the chart that we spent some time talking about.
- The City, like a lot of dam owners, want to get in that ALARP zone as quickly as possible if they've got an unacceptable condition.

Tom Hickey:

- To remediate the dams we also have to talk about adding the spillways.
- We do need to, because that is a very extreme consequence, and we're meeting another standard, and that's what changed between the initial study and now the standard we have to meet now.
- We have to meet a higher standard for either remediation or the removal.

Lorne Gale:

- Without going there, we don't know.
- Without doing some sort of conceptual design to actually prove that yes, a new spillway, a new dam that will seismically sound and is actually so much more to get rid of the dams.
- That's what we're asking, to just prove that point as it is, it's just speculation.

Chris Grapel:

- I wouldn't say it's speculation, it's a bit more than just speculation.
- Speculation would be a report saying it's a no brainer, rip them out.

Lorne Gale:

- As we would say, it's an educated guess.

Al Kenning:

- As a City administrative-type for a long time, I can tell you that if you go with the engineer's estimate in a few months you're going to be going to the public saying, I'm sorry, we don't have enough money.
- My experience over a long time is that engineer's estimates are always too low,
- That's why the \$7M has been increased substantially from the engineering estimate to a number than can actually do the work.
- If the engineer is saying \$10-20M to build this dam, I'd be saying to my engineers you'd better make sure we can do that because once we go out to the public and we don't have enough money, which we won't, we're going to have a big problem.

Lorne Gale:

- I accept your experience for sure, but can we prove it?
- Rather than just throw these numbers around.
- We didn't get a chance at all.

Al Kenning:

- Our engineers are telling you; in their judgement it's going to be substantially more.
- In my judgment the engineers are usually too low and we need to take that with a grain of salt.
- The \$7M has been adjusted by City staff to say what else are we going to have to do?

- The \$10-20M, I don't think has.

Concerned Citizen:

- You've got two lakes that were used for industrial purposes in the past.
- Right now, whatever is at the bottom of those lakes is covered by all that water.
- When you drain all that water out you're going to expose whatever stuff is left over from that industrial process at the bottom of those lakes and you could be getting yourself into a real jackpot in terms of costs.

Susan Clift:

- That's why we put \$7M in the budget.

Concerned Citizen:

- \$7M may be just a drop in the bucket.

Chris Grapel:

- These lakes were fairly far away from coal mines.
- Miners are very practical people, they prefer not to haul waste up hill and if they have something to dump unless they need it somewhere else, they dumped it pretty darn close to where it was dug out of the ground.
- When they needed fill to run across the dam to put the railway to haul the coal down to the wharf, they just took all of the stuff that was lying around and threw it on there.
- I'm doing some railway engineering now and what amazes me is what rail roaders are willing to accept for a sub grade.
- It doesn't have to be good, they accept that they're going to maintain it and the weight actually of the train underneath the ties works out to be a surprisingly low bearing pressure.
- Coal miners were flipping their tracks all over the place, for them it was no big deal.

Brad Maguire:

- It seems to me that a lot of this discussion is based on uncertainty on the type of fill.
- What I don't understand is that I know we've had some concrete tests done, but why hasn't ground penetrating radar not used?
- Why haven't they done, for example, a seismic study to gauge the inside structure of the dam so that we have a better understanding of exactly what is there?

Chris Grapel:

- I have used ground penetrating radar a lot.
- Ground penetrating radar is very good at picking up interfaces as long as there's no clay involved.
- There is no clay in these dams.
- Holes have been drilled.

- Geophysics is a great tool and I cross my fingers when I call it “geofantasy” because at times it can generate very interesting information that is just not reflected by reality and I’ve looked at information coming out of bore holes that does not match with the geophysics or what the geophysicists are telling me.
- I’m not saying that they’re wrong, but they’re looking at electricity, radiation or energy of some form through a material.
- They send it in, they know what signal it is then it comes out the other side and they make guesses as to what’s in between by how the signal has changed.
- In this case they’ve drilled holes in 1978 after Will and a few other people from the City went out and found the dams, or when the authorities became aware of them, and they have been able to define a lot of the information about the inside of the dams.
- There is good drilling information available.
- Rock fill is some of the hardest stuff in the world to assess.
- It’s hard to drill through with an auger, yet when you put a diamond rig in it it washes all the stuff that you’re interested in away.
- We used the information that they had in 1978 and it actually wasn’t all that bad.
- I don’t think penetrating radar would be required.
- As far as sensing the inside of the concrete, what we did was we took a local engineering firm, Herold Engineering, and they took their sensor and they ran it over the dam in several lines above water, and found no evidence of any kind of reinforcing.
- When I spoke to Douglas Anderson, a previous engineer who worked on the dams, he had taken apart most of the middle dam and he knew how thick the wall was and the sensor that we used to figure out if there was reinforcing was seeing through the wall, as it was capable of seeing through much more concrete than what was in the wall.
- It’s a good question, but one of them hasn’t been done and the other one has been done.

Bill Heathcote:

- I think that we’re assuming here that these dams don’t need to be fixed.
- We’re assuming, ourselves, that they do need to be fixed.
- So let’s have a design and a costing to compare with.
- So we’re going to throw \$7M and have absolutely nothing when we’re done.

Chris Grapel:

- Just keep in mind that I said if you want to do this, that’s what you have to do.
- Everything’s possible if you have enough money.
- You won’t have dams with the dam removal option, the rehabilitation option you’ll be chasing now that everyone is aware of the consequences, no one is refuting them, but there could be deaths.
- Enough deaths to justify what’s going to be the maximum probable earthquake and then for the flood, the probable maximum flood.
- These are two design events that do nothing but get bigger with time so the minute you tie a dam design to those two things you’re going to always be fixing, upgrading, every time a meteorologist gets nervous about the rainfall or a seismologist revisits the data base.
- That’s a reality that the City has to face with that.

- It's like contaminated site remediation, what was cleaned up 20 years ago, you could try to develop it now but someone is going to say you have to meet the new codes and you'll end up with old ghosts arising from supposedly covered over graves.
- That's why I suggest if you're going to do this you build a new concrete dam.
- A concrete dam is going to survive a large earthquake.

Jeff Solomon:

- You've insinuated that the middle dam is more vulnerable.
- Was there the possibility of that dam going and then possibly causing the first one to go, so were you ever asked about this concentrating on reinforcing or just doing the upper dam?

Chris Grapel:

- We did present an option for that.
- You get into the spillway and earthquake, particularly now, with everything going up so you really at that point have to pick your repair method very carefully to the point where it almost looks like you could be better off putting a new dam in.

Jeff Solomon:

- So let's say there was a decision made that this dam is more vulnerable, its potential is a major issue because it affects the first one, fix it.
- Let's do it or rebuild or build a new one.
- Would that meet the requirements to lessen the risk significantly?

Chris Grapel:

- I'm going to talk about now, not back when I did the report because things have changed.
- We thought that the lower dam would be damaged.
- We were confident that wall would have cracked during the earthquake and there would have been a lot more leakage and what we don't know is all the problems of honeycombing, bad concrete, etc., so assumptions.
- We said we thought it was going to start leaking and looking if you replace the middle dam so it doesn't hammer the lower dam, now you have a bigger quake, I think you're going to have more damage.
- Has that been analyzed with the bigger quake, no.
- I think if you take a look at how that dam was put together I think you will have to come back to it and do either extensive testing and evaluations or be forced to draw the reservoir down even if you buttressed it and you could find yourself into a removal and rebuild situation after rehabilitating it and replacing the middle dam.
- There are no calculations on cost or anything like that; I'm just tossing concepts out.

Steve Hill:

- So far what I've heard is that you've got \$7M cost to remove the dams.



Susan Clift:

- Remove the dams and rebuild bridges and re-forest.

Steve Hill:

- \$7M coming from the taxpayers, an estimate.
- And we also have replacing the dams up in the high single millions into the tens of millions.
- Let's pick a number, say \$12M, we don't know.
- We've got \$7M and we've got \$12M to replace the dams.
- We also haven't looked at the possibility that both those dams can be used to generate hydro power and they can generate money.

Chris Grapel:

- I don't think they could generate hydro power.
- Well, you could, but whether or not it would be economical.
- A lot of small hydro projects now they require significant subsidies from BC Hydro to exist because a lot of the creeks they're on run dry.
- I don't know if it's a given that you can generate hydro power on those creeks.
- You'd have to study it, but I understand the river goes dry or gets down to a very minor flow very quickly and as far as reservoirs go, the battery I referred to, that would go very quickly if you had a turbine attached to it.

Steve Hill:

- You don't need to generate power all the time because you make the most money generating power when Hydro wants it which is in the winter.
- You don't care if you can't generate power in the summer.
- You can still make money generating power just during the five months of winter and forget generating power in the summer.
- I did a study a few years ago I figure you could generate about \$200,000 gross a year in power revenues based on the latest BC Hydro power.
- So it seems to me that when you have two numbers like that between \$7M-\$12M, you have two assets that exist right now, two dams, if you wanted to put dams on those rivers you'd have a heck of a time convincing anybody to let you do it.
- You've got them now, you've got those beautiful lakes, and you've got swimming and fishing, those intangibles that are so important.
- It seems to me that when you have a situation like that that it's at least worth looking at the option of generating hydro power.
- Should look at replacing the dams and putting hydro in but it's worth doing that because from a taxpayer point of view, once you've paid off your budget costs, you've got a continual flow of cash coming in.

Paul Neilson:

- I just want to add to that because there are so many educational and possibly economic benefits from those lakes being there and environmental is unbelievable.

- It's an osprey habitat, kingfisher habitat and they're not going to hang around there when it becomes a muddy crack.
- There's just been a study released on all the bat endangerment, there's a kajillion bats out there in the evenings feeding off the surface of those lakes.
- There are school buses up there with kids fishing and stuff like that.
- It seems to me like this could be an educational, economic, energy, environment showcase.
- It's really a chance for Nanaimo to step forward and instead of being Nanaimo, home of the giant muddy crack, it could be Nanaimo, home of a beautiful place that's doing its best to preserve those environmental and educational aspects, those heritage aspects, make partnerships with ministries, wildlife, with environmental, educational, with the university, with schools, whatever.
- There's a BC lakes stewardship, there's a friends of osprey program, it's really a chance for us to do something, not just a chance to just go oh well we're just a bunch of scaredy guys and really want zero risk and let's just wash our hands and shuffle off.

Jeff Solomon:

- I guess what we want is to recognize the incredible value of the lakes being intact as well as a potential of the incredible value that would be lost.
- Money is very important as is fiscally being prudent and responsible.
- This is extremely important, however, this has been lost in the equation and that's absolutely terrible.

Chris Grapel:

- I've heard this before about dam removal, and I wrote about it in the report and I'm surprised no one's said it yet about sustainability triple bottom line, and that's great as long as you can afford it but any time I've ever dealt with dam removal everybody talks about that but in the end what can you afford?
- I agree there's value that can't be measured at all.

Roblyn Hunter:

- In terms of what we can afford, there's been a lot of projects that we couldn't afford.
- It's all the will, the priorities that we have and a lot of those projects do not serve the majority of our community whereas this absolutely does.
- So in terms of cost, that has not been factored.

Tom Hickey:

- That's always a community decision and Council has to make those decisions.

Roblyn Hunter:

- But you've been talking a lot about how the project is not worth doing because of the cost.
- You've been saying that and we're saying that maybe it is and we need to come together on that.

Tom Hickey:

- That is Council choice at the end of the day.

Roblyn Hunter:

- You've been talking about it.

Bill Heathcote:

- The Council has no idea what this is all about, they are taking your advice.
- The engineers in the City and your advice to make a decision.
- They have no knowledge; they've never even practicably worked on a project like that.

Roblyn Hunter:

- You haven't done a design; you're pulling numbers out of the air.
- Yes, they are educated, but still.

Tom Hickey:

- Let's go back to the \$12M, because I think if you're doing a hydro dam, I think if you'd have to tear the dams out and then rebuild so again you're into a lot more.

Steve Hill:

- Chris said he came up with a number that was in the high single millions, maybe into the tens of millions, so I picked a number of \$12M, plucked out of the air which is not a bad number, all I'm saying is if you have a choice between \$7M and \$12M, plus at the end of the \$12M you still have your assets in place, the intangibles as well as the tangibles, plus you have a facility that is generating income on a yearly basis out into the future and that income can only go up as energy costs go up then maybe we should at least do a study to see whether or not it is a feasible option.
- Right now all we're saying is we have to tear the dams out and it will cost \$7M.
- I'm saying I think based on those kinds of numbers it's worthy of taking another look at this and maybe there is another option we should consider.

Brad Maguire:

- Has the City considered a public private partnership?
- We might be able to get an industrial partner who wants to generate that power to help us with the cost of those dams.

Lawrence Reiper:

- At the first open house, they said that the \$7M did not include the naturalization.

Tom Hickey:

- The \$7M does include the naturalization.

Chris Grapel:

- One of the things that's coming out as a result of deaths around operated dam structures whether it's mechanical bits and pieces, appurtenances, gates, injuries, is public safety, public interaction.
- If you were to put a hydro plant at this you'd have to start fencing off any booming to keep people from getting into the water and from getting close to the intake.
- You introduce a public safety risk and then you have to put controls in.
- You can't create zero risk but in this case you'd create zero risk by removing the dams but if you were to turn this into a hydro development, you'd have to put restrictions on the usage of the reservoir and that's again changing what's there.
- If you want water flow and you're content to not let the turbine spin for a period of time, then you could but I wouldn't want you to drill a hole through the concrete and what's more by the time you got to the point where you could get the pipe down low enough I think you'd remove most of the dam and you wouldn't want to core into this concrete without being able to see it.

Steve Hill:

- I'm talking about rebuilding the dams and included in that is the hydro generation facility which wouldn't really be that expensive because they're not that big and you're building a dam anyway so that's why I'm saying let's do a study.

Lorne Gale:

- All we're asking is can it be considered because at this point the City hasn't commented on whether it can be considered.

Jeff Solomon:

- We know from 2009 that it was never considered.
- In 2009 they said that wasn't going to be a wise use of taxpayers' money – you wrote that in your study so we know that was never considered.

Tom Hickey:

- Let's go back to 2009 when we talked about new dams.
- The price was so high we said let's look at remediation.

Jeff Solomon:

- But you didn't know what the price was then either.
- There was no design so how can you have a price.
- In 2010 you said it would be about \$10M.

Lorne Gale:

- Can we explore options?

Tom Hickey:

- Right now Council direction is to remove the dams and explore or at least get on the same technical page with information as there's been a lot of misinformation and if we do further study we are still required by Provincial Dam Safety Branch to take immediate action.

Lorne Gale:

- This is my thought so whether the dams are remediated or rebuilt or removed, they all require water to be removed?

Chris Grapel:

- I would say so, if you're going to rebuild them or you could put something downstream, that happens too.
- To get to remediate them, you would want to get rid of water.

Lorne Gale:

- Does that not buy us time?
- Would that give us more time to investigate what is there?

Tom Hickey:

- In the winter, spillways are way undersized and how would you keep them drained out?

Chris Grapel:

- There would be a lot of money in dewatering as in the winter you get more flow, enough to justify a hydro plant so instead of spinning a turbine in a hydro case you'd be paying money to pump it out.
- Dewatering costs for these things are a lot of money.
- I know contractors will give unit and daily rates for big pumping.

Lorne Gale:

- It's meant to occur in the summer, this removal.
- Wouldn't that buy us time from now until then to look at the situation and then they can still be drained in the summer and you can inspect them further?
- The point of that first hour of discussion is to establish that these reports are on assumptions and the more we can learn about the walls, the better the risk could become.
- We're on the borderline right now with your study.
- We're at this number now, so if it goes to this number here ....

Susan Clift:

- This is from the early study, we're there now, and it's not an "if".

Lawrence Reiper:

- In my paper I suggested that beyond the lower dam there's a huge hole on the outlet of the Chase River and you could presumably put a pile of rock or earth or mostly rock up to the level of the dam.
- At the bottom of the Chase River is about six metres if I understand that point.
- It's just a matter of tipping a lot of earth or rock into that hole as a holding device if the dam should break and there could be a spillway built from either or both of the dams to the trench which is quite considerable of the Harewood Creek as an overflow as a temporary measure or as a permanent measure, and do whatever other remediation as well as that.
- Is that a reasonable thing?

Chris Grapel:

- What you're describing is a lot like what gets done for debris flow areas in this Province where a lot of water comes down, picks up a lot of logs and trees and shoots down as a very soupy but dangerous mass at very high speeds and I think the erosive power of a lot of water released cannot be underestimated and I think that if you were to do such a structure it would have to be of reinforced concrete and anchored and it would not be a matter of ending up being some big rocks.
- It would have to be a much more reliable structure than that and then from the perspective of whether or not that would be permitted as a mitigation of a potential dam failure, I have a feeling that would run into difficulties being approved by the Dam Safety authorities as a way of mitigating potential loss of life.

Will Jolley:

- I know of one instance where that was done to safeguard a dam for a very short period of time.
- It was done by blasting but it was only for a very short period of time.
- I'm sure there are other kinds of mitigation that could be done.

Roblyn Hunter:

- Are there other ways to do it short term so we could buy some time to look at other options?

Will Jolley:

- I hadn't really thought of any, but other than putting a large berm downstream.

Jeff Solomon:

- Is there an early warning system in place?

Bill Sims:

- We monitor for seepage 24/7.

Lorne Gale:

- So to address the ifs, it is possible to remediate the situation so we can get to a flood and seismic safe situation?

Bill Sims:

- No, I don't think anyone has said that anywhere in any of this discussion at all.

Lorne Gale:

- Okay, I'm asking it now because that's what we're trying to get at.
- We don't want to discredit or disrespect the safety of the community, obviously we live there, but we want to make sure that these numbers are realistic.
- If the wall didn't topple, how much would that change the model?

Michael MacLatchy:

- Then you revert to the consequences of the flood, not a seismic event, and the dams are inadequate for safety passing floods.
- The lower dam cannot pass 100 year flood safety.

Lorne Gale:

- The spillways need to be changed?

Michael MacLatchy:

- Yes, the spillways have to be upgraded at this point to probable maximum flood because the dams are classified as extreme.

Lorne Gale:

- If the dams were not there would this extreme rainfall event not cause widespread flooding somewhere further down, for example the railway?

Michael MacLatchy:

- Not so much, the flow rates for the probable maximum flood are much lower than what happens when the volumes of the dams are raised.

- The PMF [*probable maximum flood*] is the triggering for the dams collapsing, and it's 10% or less, I recall, much less than when the dam volumes are raised.

Lawrence Reiper:

- Can you bypass the dams, in other words, to drain off at the side through Harewood Creek?

Michael MacLatchy:

- That's what we are talking about.
- The spillways have to be improved, it's the same thing.
- I don't know if it's cheaper as they have to safely pass the PMF from a much larger watershed down Harewood Creek channel and it would be experiencing the same event.
- Our PMF is 200 cubic metres every second, 200 tons of water a second.
- The capacities vary, but for the middle dam I believe it's in the 50 cube range, and the lower is 25.

Chris Grapel:

- Basically the volume of this room every second full of water.

Lorne Gale:

- It comes back to most cost effective method to reduce the risk?

Bill Sims:

- I can speak from where I believe the City has taken its decision, while financing may have been a part of it; I think main focus has been in the risk reduction.
- You mention we're a bunch of nervous Nelly bureaucrats, but public safety is a different feeling to sit here and realize that you're the one that is responsible for the public safety.
- So, yes, this is a pretty strong recommendation.

Jeff Solomon:

- You were responsible years ago and you did nothing.
- And so now you're saying we're being responsible and we're acting in an appropriate way and we're destroying the park and that isn't okay.

Tom Hickey:

- Those are all value decisions.
- Public safety is a high priority.
- Council has stated that.
- Staff are recommending that and Dam Safety is telling us that this a high priority.



- Maintaining the lakes, you believe that's a high value, but a lot of people put high value in naturalization as well.

Paul Neilson:

- I don't think so.
- I don't think naturalization exists for that area anymore – it's gone.
- It's a century ago.
- The environment has moved on in that park.

Roblyn Hunter:

- I think you should have talked to us about what we wanted to do.

Bill Heathcote:

- Why was it done behind closed doors?

Paul Neilson:

- What you're saying is naturalization is what I call destruction of that eco-system that's in place.

Al Kenning:

- I want to make a comment about this anger about the fact that we knew about the risk for some time and didn't do something.
- I don't quite know how to respond to that except to say would you rather we still ignore it?
- Say we were wrong and we should have done something, would you advocate we do nothing now?

Jeff Solomon:

- We want you to do something now.
- We wanted you to do something years ago.

Al Kenning:

- That's what we're saying, we're now doing something.

Paul Neilson:

- But you've left it to a point where there's no alternative.

Jeff Solomon:

- Now you're saying that there's no alternative and you're not suggesting that there's another alternative.

Bill Heathcote:

- Why wasn't this done four years ago?

Tom Hickey:

- Again, you do need the inundation part of the study to match with the seismic study because that is how dam safety regulations are built, so we were following Provincial process and recommendation of the engineer.

Jeff Solomon:

- But the recommendations are very clear in the 2010 study that something needed to be done and nothing was done.

Roblyn Hunter:

- And even if you were waiting for the inundation study, it was stated that the public needed to be included in the decision and that was not done.

Will Jolley:

- The City of Nanaimo has a long history of fixing up their dams and I would say in the 1990's the priority was the large Jump Creek dam which is the main water supply dam and there were some significant issues and problems with that dam despite the fact that it was built in the 1970's.
- It was a long process; I'd say a good 10 year process that the City went through to go from recognizing a whole series of problems with the Jump Creek dam to a final really, really good solution that they came up with.
- It was a huge public spillway, which we were uncomfortable with, it was an emergency spillway that was a flat gate in the service spillway which we were uncomfortable with and there were a whole series of things that had to be worked out together, including seismic standards.
- There was a problem with the low level outlet that caused damage so severe that the dam almost failed.
- The City took about 10-12 years to come to final design and construction that everyone was happy with, so it didn't happen overnight.
- We knew there was a problem with that dam but we had faith that the City would get there, which they did.
- I don't know what the costs were, but they were substantial.
- That was the focus at the time, the water supply to the city, which is of course something that everyone in the city needs.
- After the Jump Creek dam was fixed, Nanaimo looked at their dams as a whole system and they have a good dam safety program.
- They have been moving along and working on all the different priorities for the past 25 years for fixing up dams, so for good reason we are finally seriously looking at Colliery Dams.

Jeff Solomon:

- Let's look at it in a positive light in terms of maintaining the dams or building the dams and keeping the park.
- That's what we said would be the objective of this meeting and would like to know that there are alternatives other than removal.
- We believe that there should be alternatives considered.
- That's where we'd like to keep this meeting.

Susan Clift:

- You asked why we didn't act in 2010.
- Basically we wouldn't have been able to come up with an action plan without completing the next step because if we had acted only on what we knew then, we would only have been able to address seismic issues, but what this process told us is that we have more to worry about than the earthquakes.
- We also have to worry about potential flooding, and with global warming it is a real possibility and we need to worry about that more and more.
- So the action we would have taken would not necessarily have been appropriate with just half of the information that we needed, so that's why we needed to do it.

Jeff Solomon:

- I think it would have changed this study that was produced if you had fixed one of the dams and built it properly, I don't think the statistics would be exactly the same.

Chris Grapel:

- When you look at the consequences of failure, to determine the consequence classification for the dam, what you do is take a look at the worst case risk and the way I've described this to people is that if God himself comes down and knocks your dam out and all the water rushes down.
- That's the way it gets done because you want to understand how bad it can be.
- Some people will say what's the failure mode and how does the failure mode work into this and subject to water release, so it wouldn't have changed what Mike did for the seismic event, I think you still would have looked at it as a sunny day failure is what we call it and all the water gets out of one dam and knocks the other one over and then you take a look at that.
- I have a client right now who owns a chain of dams upstream in a major Western Canadian city and they're doing that and at the same time they've got deep pockets and they're fixing these dams.
- The flood, again, you apply the big rain storm, the runoff event, whatever it is that creates the PMF and then you take a look at what that does to the dams and then you model that to get the inundation.
- So, it wouldn't have changed, is that what you're saying.

Jeff Solomon:

- I'm just saying that if you have a brand new dam at the upper dam, it seems pretty logical to me that you don't have the same kind of risk.

Chris Grapel:

- You have to look at it in terms of the potential energy.

Michael MacLatchy:

- You have to look at the consequences of it failing, even if the probability may be considerably less you still have to know what that is.

Jeff Solomon:

- I'd have to say to come back in 3,000 years and make sure it's fixed up.

Lawrence Reiper:

- But the damage has existed for 100 years and Harewood has also been beneath it.
- There was always a bowl by Seventh or Bruce or whatever, there was a possibility there for 100 years of some flooding when it was farm land, and the City knows it has grown in that area in the meantime.
- There has always been something there to flood, but only in the last two months has anybody cared.
- You didn't know that the dam was higher than Harewood?

Susan Clift:

- That's the burden of knowledge.
- We didn't know it was a high consequence risk.

Lorne Gale:

- Chris, you have lots of recommendations in your report, and they've been heeded, I believe.
- One of the things you recommended was the City would meet with the community and that it could be a contentious issue, public consultation should be one of the considerations and we don't feel that recommendation was followed.
- So what do we need to do?
- Can we do a study to prove one way or the other some feasibility to prove one way or another that it's not possible or it is possible to remediate the dams?
- No one has answered that yet, it's just "yes this", "no this" thrown out there, they're not exact.
- I accept all the points, but what do we need to do to prove it?

Tom Hickey:

- That decision was made on the best information we had.
- Council looked at that information and was really concerned about the public safety and also the costs.

Roblyn Hunter:

- You talked about the Council having to act right then and there and it was given that you were basically telling them that these dams should be removed because that's the only way to make them safe as was needed, and so you said it was possible to upgrade them?

Tom Hickey:

- Yes, we went through the options presented that were to remove or remediate or rebuild.

Bill Heathcote:

- But you have no design to tell you what the real costs are.

Steve Hill:

- Did you use the number of \$27M when you talked to Council?
- Did you tell them it would be \$20-30M to remediate, yet we've heard here today numbers to rebuild the dams that are way less than that.

Al Kenning:

- You haven't heard numbers from us; you've heard numbers from the engineer, which I'm saying is apples and oranges to the \$7M.

Chris Grapel:

- The engineer has not done all the things that you folks acknowledge as being needed.
- I'm trying to be helpful.

Bill Heathcote:

- Yes, but how can you come up with a number unless you have a design?

Jeff Solomon:

- Did you say \$20-30M at that meeting?
- Did you present that number to Council?

Tom Hickey:

- Yes.

Jeff Solomon:

- You have to realize that what other decision could they make?
- People are going to die and it's going to cost at least \$20-30M to do these dams properly and that information is not founded in fact.

Al Kenning:

- It is our best estimate.

Bill Heathcote:

- No, it isn't because you don't have a design, you're guessing.
- This is what we're saying.

Al Kenning:

- We're telling you that without a design it's our best estimate.

Jeff Solomon:

- Then do a design and get a cost.

Al Kenning:

- That's what we told Council.
- This was an estimate, our best estimate based on what we know and we still believe it.
- There are a lot of shots at the "In Camera" decision-making and I want to go through an explanation of how that came to be, and you'll probably shout me down and disregard me, but I want to tell you a little bit about our life.
- We got the information and we understand that there is a serious risk to life below the dam.
- We believe we have a responsibility to have an emergency plan in place.
- We also believe we have a responsibility to do some communication with people whose lives are at risk.
- If we take an open report to Council that says all these things with no communication ahead of time, what happens is we put that report on the agenda, the media picks it up on Thursday, Council doesn't meet until Monday, so we have a great hue and cry in the community about these people downstream who could die and yet we don't have a decision from Council so we don't even know what to tell them.
- We can't have a communication plan in place and we can't have a plan in place to talk to these people ahead of time.
- We thought it was important with a school and a daycare downstream, where mothers take their children, to have the decency to go to them before this hits the paper to say that this is a risk that you're going to have to be able to answer questions about.

- I still believe we made the right decision.
- I understand that it is difficult for people in the area.
- Nobody wants to take these dams down.
- Do you think when the engineers came to me and said we're going to take these dams down I was happy about it?
- I like this park too, but we did have to deal with the reality of the way the communication flows when our agenda goes public and we felt we had a responsibility to the School District and to the daycare downstream to have a plan in place to deal with it.

Jeff Solomon:

- In 2008 and 2010 people were going to die if the dams broke and I don't see that you had the same type of response by going and telling people about the issue.
- There was absolutely nothing.
- Now, suddenly you have this report that more people are going to die and the City is more liable, and now we have to act like this.

Al Kenning:

- That is correct, we had new information about the inundation study and we had the new information about the high consequence and with the new information about the high probability.
- All those things came together and we felt we had to do something.
- Nobody wants to do anything.

Lawrence Reiper:

- Is there any reason why your presentation to Council and in fact anything that the Council was told couldn't now be released?

Al Kenning:

- I think it's all virtually on the website.
- I'm not sure there's anything not on the website, except maybe the liability issues where we did advise Council that they have some responsibilities in law around knowing about this risk and appropriate actions to take.

Lorne Gale:

- Can we prove that remediation options are feasible?
- What is required to do that?

Al Kenning:

- What would have to happen is that Council would have to authorize us to do some significant engineering consultation to find out what the realistic implications are and it would certainly be my recommendation that that would be concurrent with the work that is going on to figure out how we're going to actually take the dams down, because

I don't think that anybody in their right mind would want to recommend that we slow down the process of making the downstream people safe so it would have to be something done concurrently, at extra cost.

Lorne Gale:

- So we could explore options.
- This is what Council wants us to do, to come here and understand why there are a few discrepancies. We feel there is a discrepancy in the value of the two options, so can you provide a substance for both the \$7M and the \$20M options?

Al Kenning:

- I think we can provide substance for the \$7M, and what you've heard about the \$10-\$20M is that it is an estimate based on engineering knowledge.
- We have said that it's \$10-\$20M and I still believe that because this is a massive job to build dams.

Jeff Solomon:

- Wait, you said \$20-30M.

Tom Hickey:

- Our report said \$20-30M.

Susan Clift:

- It did, and it was based on knowing that we'd have to do that spillway which has not increased in estimate, so the spillway is an addition.
- Also to reforest it and rebuild the park because if we were to remediate basically the whole park would be a construction zone for a couple of years.

Roblyn Hunter:

- Are you talking about the channel that runs the whole length of the park?
- From what I read, they're saying that a channel is needed to run from the upper lake to the bottom, the full length of the park.
- I don't understand, is there no other way to do it other than to have that channel?

Susan Clift:

- Yes, the other way is to build a new concrete dam so that acts as a spillway instead of a bypass.

Steve Hill:

- Based on the numbers that I've heard here today I think it is fiscally irresponsible of the City not to investigate the possibility of rebuilding the dams and including hydro



generation in them and looking at the income from that and taking it all into account, it doesn't have to be a huge expensive study, but right now you have nothing.

Susan Clift:

- To get a firm estimate for new dams was between half a million and a million.

Chris Grapel:

- To drill, design, generate drawings, generate cost estimates, for the engineering services, and pay someone like Mr. Heathcote or someone in his position, it will be half a million and a million.
- That's for a full package, stamped, issued for tender, ready to build.

Lorne Gale:

- Normally it's 5-10% of the total project value that's just for consulting and for doing a design.
- That is normally what consultants charge.

Chris Grapel:

- Dams are a little different, each one has their own character, it's hard to say and again here I am, you ask questions on costs and I'm answering as honestly as I can in the range and hoping to God nobody cuts me a PO and says do it.

Lorne Gale:

- In order to do a study that doesn't require the full design, drawing, package, but a study that would allow us to relatively price these two options better, what are we looking at for that, does the City need to know this information, will this help the decision?

Chris Grapel:

- In order to decide this you have to have designs and costs, so yes, I'd say that's what you'd have to do.

Bill Heathcote:

- Is it fair to say you have to have that level of information for the option of building new dams, but you don't have to have that level of detail to decide to remove the dams?

Chris Grapel:

- With all respect, there's been descriptions of the costs that have been honestly provided to the best of my ability without a lot of preparation, throwing numbers around, that's inviting more of the same, with all respect.

Jeff Solomon:

- If it was designed and once it is costed out, would both have to be done at exactly the same time and could this be done?
- The upper dam is more vulnerable, there's no question, it's not as wide, but if it was costed out and if it seemed like it was applicable, could one be done one year and a year or two down the line the lower one be done?
- Would that be acceptable to the Dam Safety Branch?

Scott Morgan:

- Our job is to ensure public safety.
- Our clients aren't the dam owners; they are the public and environment.
- What we do is risk manage, really, so we would have to look at the numbers and see.
- I wouldn't know until I see a report.
- I cannot say.

Chris Grapel:

- All dams have their own character.
- These guys have seen pretty much everything that comes in on a dam in this Province unless it's a mining dam and that goes to a different department.
- I can tell you I've proposed some innovative things and the predecessors to these gentlemen have questioned severely.
- It's not a rubber stamping process, they are very thorough.

Lorne Gale:

- I feel there is a study that could be done somewhere between a full design and basically an estimation design.

Chris Grapel:

- Yes, you could do a pre-feasibility study, but don't take those numbers and hold on to them as tightly as what comes out of a design report.

Lorne Gale:

- No, but they would have a degree of accuracy greater than what has been done so far.

Chris Grapel:

- Yes, and I've done those studies.

Jeff Solomon:

- If the City requested a study like that, how long would it take?

Chris Grapel:

- It's going to take a few months, four to six months.

Jeff Solomon:

- So we know that nothing is going to be done in terms of these dams and water for a number of months because we're waiting for the water level to go lower, right?
- So, is there the possibility of bringing this matter to Council to ask them if they would consider a design study that would include replacement of the dams?
- There is this timeframe as nothing is going to be done for six months.
- Nothing has actually been done anyway, there's just the entertaining of the contract, isn't that correct?

Tom Hickey:

- We're doing the environmental right now and we're working on the contract to do the design, and we wanted to get going on that as soon as possible to meet a timeline for the summer.

Al Kenning:

- I think that is a reasonable question.
- I think you should know, though, that staff would be recommending that any study be concurrent with the current work because I wouldn't support putting the current work on hold while we look at other alternatives that I think might be a bit of a long shot.
- So, I think if we made a request that Council fund an additional study concurrent with the other work, I think that's a reasonable request and Council would consider it.

Robyln Hunter:

- And as long as it doesn't negate the option if they do find that replacement remediation is an option that the work that you do with working towards that doesn't stop that option.
- If you're hiring people to remove the dams ...

Al Kenning:

- No, no, we're doing design work.
- It would depend on how long it takes because at some point we'll have to proceed with hiring a contractor and that's a fairly lengthy process.
- Whether it can all fit within the time line, I don't know.

Lorne Gale:

- Are there other options that can proceed for the safety factor?
- Are there other options that can make it safe in the meantime?

Jeff Solomon:

- Lowering the water level perhaps?

Chris Grapel:

- In order to do that, as Mr. Heathcote suggested putting a siphon in, yes, you can, but whether or not a siphon can keep up or is big enough, then I expect would make a dent.
- I recall that BC Land had a siphon truck with a pump on a trailer that went to various places that could be provided.

Will Jolley:

- There's only one of them left and it's not big enough for that kind of area.
- You'd have to have a huge pipe.

Chris Grapel:

- That will have a cost, it has to be emptied but if you start emptying it now to do studies or to do whatever, I'm assuming you're asking to take it out now, the plan that I understand with the removal is to wait until the river flows are attenuated to be next to nothing and then, so you don't have to pay money to manage more water than you have to, but that's getting us into late summer.

Jeff Solomon:

- I'm also glad you're bringing up the fact that there is very little water that flows there during the course of the summer.
- It's only a trickle, and when you talk about recreational use of the park and the lakes, the water disappears if the dam is empty.

Chris Grapel:

- Is it the wrong time to talk about an apparent conflict of interest that you perceive?
- I've tendered a number of jobs to the City and I've been the best bidder or the lowest price, Westwood Lake, upper Chase Dam, some inspections and the seismic study.
- Ever since I issued that seismic study the City has been calling me and talking to me about it.
- I haven't been sending them a bill or anything, because I get along well with the City and I like the dams and I like the park.
- They've been calling me on and off, this has been on their radar, it's not like they shelved the report or anything.
- I got a phone call in early June of this year asking if I could come to Nanaimo and I met Susan and Bill and that's the last I heard from them.
- I quit my job, took the summer off, showed up at the new place of business and within a month I got a phone call asking if I'd be interested in this work if it came up, and that's the first I heard of it afterwards.

- I don't think anyone would think I'm in a conflict of interest if you were building new dams.
- So, it's the choice that the City made, not my presence.

Jeff Solomon:

- We'd love for you to build new dams

Lorne Gale:

- Can we look at this siphon option to reduce the current risk and then propose a study that can prove the financial numbers, or other options?

Will Jolley:

- If we're looking at the risk of flooding, I think the siphon option is fairly small.
- I don't think you would have a great deal of impact but certainly the amount of water flowing through a siphon would be a very small amount as compared to the flood flow.
- If you're talking about siphoning to lower the reservoir so you can pick up and store some of the water that might have some impact but probably not.
- It is certainly possible to do that assessment.

Lorne Gale:

- The risk that is being carried right now by the City you did in the summer, but this is an option to reduce the risk right now.

Jeff Solomon:

- Or do you feel it's okay to just leave it?

Susan Clift:

- What I'm hearing is that you're not significantly reducing the risk by siphoning during the winter.

Will Jolley:

- Likely not.

Susan Clift:

- And so is it a worthwhile thing to do?
- You can't get one big enough.

Lawrence Reiper:

- How about a ditch to go along the creek?

Chris Grapel:

- I think you'd do a massive amount of disruption.
- What's being talked about is a massive amount of disruption and I don't even know if that will work.

Lorne Gale:

- What would it take, a simple calculation to figure out the flow rates of a siphon and the size of a siphon?

Chris Grapel:

- You're talking in a room like this, every second.

Lorne Gale:

- My point is it won't take long.
- You and I could probably work it out.

Chris Grapel:

- I can tell you right now it would be like trying to turn on a fire hose and take a McDonald's straw and try to reduce how it's beating against the wall behind you.
- I don't mean to be facetious, but I don't see the siphon making that much of a difference if you get a big flood in the winter time.

Lorne Gale:

- I'm not saying the siphon would combat a flood.
- Right now we can say that with siphons you can actually drain the dams, if big enough.

Susan Clift:

- Only in the summer.

Will Jolley:

- There is a tremendous amount of energy at the flow at the end of the pipe at the downstream end.

Lorne Gale:

- We're just trying to propose some options.

Chris Grapel:

- There may be some things that maybe we could think about a bit more than right now.

Robyln Hunter:

- I guess what we'd like to hear from the Dam Safety Branch that we can extend the time so that we can look at other options because they haven't been explored properly in our minds and so the City is saying we have to do this because the Dam Safety Branch said that November 30 is the date that the decision has to be made and what we're asking is that there hasn't been enough time for public consultation, proper looking at options ....

Jeff Solomon:

- I don't hear that.
- Yes, there is a deadline, and correct me if I'm wrong but what I also heard from Mr. Kenning is that if you went to Council and requested a design study be done concurrently with the possibility of redoing the dams it would fall into the same time frame, is that correct?

Al Kenning:

- Well, I'm not sure.
- It may.
- I don't know exactly what the time frame is and I need to think about it.

Jeff Solomon:

- But would that be acceptable to the Dam Safety Branch if that request was made to Council and Council agreed that they would proceed with, what we are really asking for is for a design on the possibility of replacement of the dam.
- Would the Dam Safety Branch be accepting of that as a move forward in terms of remediating risk?
- Is that okay?

Will Jolley:

- We didn't require that the dam be removed.
- We required that the risk be reduced.
- We wanted a plan and we wanted it very soon.
- The risk has been known for some time and it now has been quantified properly and under the regulations we are requiring that something be done very soon.
- If some other proposals could be brought forward at the same time it would take to do a study and design for removal, we would accept that.
- I'm speaking for the controller of water rights, the regulator, and this is just what I think.
- So there would be a need for interim risk mitigation measures of some sort in the meantime.

Michael MacLatchy:

- A feasibility study for building new dams would just be feasibility; it would still have to go through engineering designs.

Lorne Gale:

- That could take a long period of time, no doubt.

Roblyn Hunter:

- So what do you suggest?

Will Jolley:

- Well, if the City wants to talk to us about options, we could have a broad brush discussion, but any kind of mitigation would have to be approved and designed by an engineering consultant.

Roblyn Hunter:

- Has the early warning system been considered?

Will Jolley:

- There is an early warning system in place right now with the automated seepage measuring and automated reservoir level.

Roblyn Hunter:

- I believe that just goes back to the City, doesn't it?
- I'm talking about an early warning system that you have a horn that people can hear it right away and react right away.

Susan Clift:

- We're moving over into the emergency response, which is something that starts with Dam Safety and their information, but it ends with our emergency personnel and we have put together an emergency response plan.
- We now have action plans together for both flood inundation and seismic inundation but in terms of seismic inundation, we essentially say that if you feel the shaker, then you need to remove yourself from your house.
- You do not wait for the sirens or wait for any notification, but for floods we definitely will have time to evacuate people and that action plan has been put into place and in terms of sirens we believe we have enough.
- It is probably the most efficient to bring first responders on site to do that as opposed to have sirens that everyone can hear.

Roblyn Hunter:

- That doesn't make sense because sirens are immediate and the early responders take time.



Tom Hickey:

- In an earthquake you don't have enough time anyway.
- In a flood situation we'd have be able to alert everyone.

Susan Clift:

- We think we need four hours to evacuate so it's in that time frame so having a siren that goes off in the hills or is part of a moving vehicle, you don't buy that much time.

Roblyn Hunter:

- What I had understood is your concern is if there is a catastrophic fail that people wouldn't have a chance to get out.
- That was my understanding at the open house.
- If you have a horn and you hear that, then you can get out a lot quicker.

Susan Clift:

- I wouldn't rely on a horn; I'd get out period, with or without the horn.

Chris Grapel:

- For a flood event, the PMF event isn't going to happen overnight.
- The PMF comes after 40 days and 40 nights of rain.

Roblyn Hunter:

- At the open house, the issue was that there would be 10 minutes to get out and if you're saying there is going to be a shaker, is that definite that's what would cause it to fail or could there be another reason that we wouldn't feel that shaker?

Susan Clift:

- Yes, that would be the flood inundation and that's where we would be able to give a warning.

Roblyn Hunter:

- Okay, so really then you've looked after that.

Susan Clift:

- Yes, that was one of the things that we prepared even before we went public with this.

Roblyn Hunter:

- So is that enough for the Dam Safety Branch in order to give us time to work on this?

Will Jolley:

- Yes, it is.
- What we'd like to see is a copy of the interim emergency response plan and we haven't seen that yet.
- We'd like to see that and put that in our emergency response plan.
- We have two copies of the City's two different kinds of emergency plans here.
- They are very well organized, actually.
- One of the few communities that has had table top exercises.
- We'd like to see that plan.
- It's very similar to the tsunami response plan like places Tofino or even where I live, a siren is not really needed because it's the strong shaking that you feel.

Roblyn Hunter:

- Okay, I understand that now.
- I didn't understand that at the open house.

Will Jolley:

- I don't blame you because there are two very separate kinds of failures.
- One is the earthquake shaking which can cause disintegration of the dam or some serious leakage which would result in a quick failure, and then there's the flood failure.
- They are very different.
- One is instant and the other one takes maybe a day or two.

Bill Heathcote:

- I've seen back 50 years ago the water right to the top of the old bridge that used to be in there on Howard Avenue and down into where Barsby School is.
- I've seen them barricade off Howard Avenue from Sixth to Seventh and we couldn't go through there.

Will Jolley:

- The dams have been there for over 100 years and they have experienced some big floods.

Bill Heathcote:

- And what I'm looking at is that I don't see the flood anymore.
- I mean, look at the rain we get.
- There's nothing much coming down there.
- I don't know what that flood event; something's changed there because it used to be when you had a flood event like that, like literally I've seen it at the top of the bridge.

Tom Hickey:

- There have been heavy flows because we've been monitoring the spillway.

Bill Heathcote:

- But we don't seem to get those big flows; you must be restricting them somewhere up top.

Susan Clift:

- No, there's no way to restrict them

Chris Grapel:

- That's one of the things that comes with it.
- I've noticed climate change looking at long-term data and what happens is you get less severe rainfall events, like less things like everyone remembers, and a lot more big events or a lot more dry events.

Lorne Gale:

- We've moving towards consideration of a feasible study to present that to Council and that will hopefully either disprove or prove a discrepancy in what we feel is the cost of these options.
- Can I put you on the spot again and say that a feasible study that would provide enough information for potentially a contractor to look at and give some more accurate numbers and still have a feasibility study and still be respectful that you represent our tax dollars and we don't want to over-spend it.

Chris Grapel:

- It's a number in the tens of thousands of dollars, but really if I start saying these numbers and then I get it wrong and propose it then ...

Al Kenning:

- When he says tens of thousands that could be \$90,000 just like he said tens of millions.

Chris Grapel:

- I'd have to go and figure that out.

Lorne Gale:

- This is your opinion and we can go and ask a number of other engineers in town the same question and we can get some numbers but what we're saying is that that doesn't seem to be an unrealistic number to spend and Council to agree to, to actually prove that maybe there's an option and that's one way of considering it.

Jeff Solomon:

- And that's where we're putting you guys on the spot with whether or not City staff will come from this meeting and present to City Council on December 17 giving them an option that was not considered before and that's what we want to know.

Al Kenning:

- What I want to make clear is that I'm saying that I think it's a reasonable request so long as it doesn't result in slowing down the work on the deconstruction of the dam not that we're ready to award any contracts but I think engineering needs to go simultaneously because staff won't support anything that slows down that process.
- But if we can get additional information during that process that provides information about the cost of rebuilding and Council is willing to spend that then that's up to them and I'm not going to stand in the way of that if Council agrees to it.
- Just so long as you know that Council is going to receive the budget on Monday that's not going to be pretty, so anything more to add to it, I'm not saying they won't do it, they probably will, but it's not a slam dunk.

Lorne Gale:

- So to rephrase that, so that it's not to stop the deconstruction, but it's to continue to minimize the risk.
- I think that's important enough that the goal of going ahead here is to reduce risk.

Al Kenning:

- That can be through deconstructing or building new dams.
- But what I'm saying is I'm not going to support anything that slows down the process.
- Susan tells me that we're very much in danger of not being able to meet our targets anyway, so we certainly don't want to slow anything down, but whether we can do two things at once is potentially possible.

Lorne Gale:

- Doing two things at once is obviously going to be a throw away of money on one of them.
- Can we comment on cost of the design work occurring of the deconstruction?

Chris Grapel:

- There is no design work occurring.

Al Kenning:

- We are in the process of trying to negotiate some work to be done.

Roblyn Hunter:

- Are these put out to tender?
- Is it competitive or are you just telling people to go ahead and do it?

Al Kenning:

- In this instance because of the urgency, this Council has authorized us to negotiate a direct award for this work.

Roblyn Hunter:

- How much time will it take if you did it competitively?

Al Kenning:

- It would take months.

Lorne Gale:

- But you don't know what the price of what you're being approached for.

Chris Grapel:

- I gave them an outline based on my experience in doing this kind of work and the City has said we have a meeting coming up with the citizens; we don't want to contemplate doing anything after getting the initial biophysical work done.
- I think their intent was so they wouldn't be disingenuous in meeting with you guys yet commissioning a bunch of engineers which I think is admirable.
- I don't know.
- I gave them a long bulleted item of what I think they need to do, I consulted with some biologists, I consulted with a socio-economic person that is within our organization, like how do we get out there and communicate with people and talk about how things are going to happen, so we're proposing a consultation in process.
- We are proposing it and right now we've got approval for me to attend this meeting and to help the City with a variety of little things up front.
- We have approval to do some biophysical and I think that's it.

Lorne Gale:

- So if it's going to happen with anything concurrent, the design work that will go into actually deconstructing or removing the dams will be a sizeable amount of money considering that's potentially a \$7M contract.

Chris Grapel:

- Well, the thing is you've got to look at what liability a consultant company takes on when they do a design.
- The fees would be less than to build one.

- Because there's now a big reservoir of water, and I've done this before, by my stamp do say I certify, or say that this is acceptable and this is good and you can rely on it and people will be safe for intended use.
- With a demolition, the liability is gone.
- Doing engineering design for a removal is not all that involved.
- It's all the things that happen afterwards.
- I think it's measured in hundreds of thousands.

Lorne Gale:

- So my point is that this is how Council will make their decision.
- There is no doubt that you'll be providing them with option (a) is going to cost potentially the loss of hundreds of thousands, and option (b) is going to be loss of tens of thousands.

Chris Grapel:

- One gets you a final product, the other one gets you partway down the road to designing a final product and a building, so it's a little different.

Lorne Gale:

- Sure, but the Council is going to make the decision next week whether we get to do this feasibility study.
- Basically they could be throwing away hundreds of thousands of taxpayers' dollars based upon your recommendation to keep going.

Chris Grapel:

- Well, some of the things we are doing right now are, I can only speak to what I've been told can go ahead and it's stuff that you'd have to do either way.

Susan Clift:

- Which is why we authorized it.

Jeff Solomon:

- But they also authorized it on false information and that's not going to be lost in this.
- There was information provided to Council about numbers that have absolutely no ...

Al Kenning:

- That's your opinion.

Jeff Solomon:

- You do not have \$20-30M.

Al Kenning:

- I don't think you shouldn't be making those allegations because these are professional engineers ...

Jeff Solomon:

- But you said \$20-30M.

Al Kenning:

- Yes, and we believe that.

Jeff Solomon:

- But there's no founding, there's no basis to that.

Al Kenning:

- That's your opinion.

Lorne Gale:

- Can we have substance of those numbers?
- That's what I asked for earlier.
- Substance for \$7M, substance for \$20-30M.

Chris Grapel:

- If that's the study you're talking about regarding get Council to approve the engineering studies.

Lorne Gale:

- We've got to give them a reason to believe, that's why we came together today, to believe that those numbers aren't accurate and I fall into that group too, that's what caught my attention, I do this for a living.

Al Kenning:

- We're prepared to say that these are best estimates and that if we spend some money we'll be able to refine those estimates and I think that's a reasonable ...

Chris Grapel:

- There's nothing hidden about how those numbers came up.
- The level of reliability that goes with them is clearly spelled out.

Lorne Gale:

- The \$20-30M or your numbers?

Chris Grapel:

- My number.

Lorne Gale:

- And we're happy with yours.

Jeff Solomon:

- We have no problem with yours.

Lorne Gale:

- Subtract three from there, though, which based on your experience, I don't want to discredit it but I'd like to see some basic estimate up to that point.

Susan Clift:

- Based on what's not in the engineer listing?

Chris Grapel:

- And we recognize that as engineers, we do all that we can to account for all the bits and pieces but it's often the inter-linkages and the effort by others as it stands it seems that when I prepare cost estimates I get them close for what the contractor estimates but the owners' costs and the environmental costs, they're wild cards.

Al Kenning:

- To give you an example, the conference centre cost \$72M.
- The contractor got \$30M, so the rest of the money goes to other things, engineers, architects, acquisition of property, landscaping, hard and soft costs around the building, furniture, all those things that add up, so all I'm saying is that the engineering is giving you the construction cost estimate and there are a lot of other costs.

Roblyn Hunter:

- Which I would like to speak to because with the conference centre, it really doesn't serve the community the way that the dams do.

Al Kenning:

- That's your opinion and there are a lot of people who believe the conference centre does serve the community.



Roblyn Hunter:

- Can you explain the options to look at replacing the top one first, doing it in stages?

Lorne Gale:

- It just means we have an option here to explore, to check on the financial aspect, etc.

Tom Hickey:

- Cost estimates for remediation or rebuilding?

Lorne Gale:

- And when you do it quickly, so you're not going to waste further design costs for the possible deconstruction.
- Is that a summary or a conclusion?

Tom Hickey:

- Moving parallel with both.
- It's up to Council to take on the cost estimates for remediation.

Lawrence Rieper:

- And staff would recommend this option?

Al Kenning:

- What I was saying was that I understood you were going to recommend it, and I'm saying I'm not going to oppose it as long as it doesn't slow down our

Lawrence Rieper:

- I hear that too, but there will be minutes of this meeting so presumably, again, what will staff recommend?

Al Kenning:

- I'll recommend no objections so long as the work can be done concurrently.

Tom Hickey:

- It would be your request to Council to do a cost estimate.

Al Kenning:

- My personal opinion is that I think that the costs of building a new dam are very, very high and even though you don't believe it, I think they are going to be higher than you think and I think that spending that much money on a recreational dam even though it's a wonderful recreational asset, is a lot of money for a community that has a lot of other things on its priority list.

Lorne Gale:

- That's true.
- That's all we can ask.
- Let's do the study and see if we can prove that how much more it is.

Al Kenning:

- I hope it's less because we'd all like to see it stay as well.

Lorne Gale:

- Even if it's more there's a certain value that's given to retaining, I'm sure you agree, and Council agrees.
- There's some socio and historical value.

Al Kenning:

- Well the history will be gone, of course, with new dams.

Steve Hill:

- Also, you have to include the fact that there could be an income stream from those dams.

Jeff Solomon:

- Yes, please keep that in mind.

Al Kenning:

- With respect to the income stream, we are building an energy recovery facility at Reservoir No. 1 which is going in at the other end of the dam and there is a payback over seven years of the investment.

Bill Sims:

- \$90,000 a year, it's about seven years.

Al Kenning:

- So it pays back the cost of adding that electrical new building in seven years, so it's not like it's going to generate income for operation anytime soon.
- First off it's going to take 10 years to pay back the money you spend.
- It adds to the cost so first you have to pay that back.

Chris Grapel:

- Then in the summer time you don't have a swimming hole.

Steve Hill:

- The dams already have spillways on them and surely there must be some protective things on there to keep people from slipping into the spillways.

Paul Neilson:

- There's hardly any water flow in the summer time.

Chris Grapel:

- If you go into doing dam construction in that part, you're going to change the park.
- It's not going to be everything remains as is, there's going to be roads carved hither and to, there's going to be a lot of activity, there's going to be trucks in and out, the park becomes an industrial site for a couple of years.

Tom Hickey:

- From what we've heard today and what we've heard previously, I don't think remediation is a strong option.
- It will likely be removal or rebuild.

Chris Grapel:

- To build new ones will be disruptive.
- This heavy equipment doesn't tiptoe through the site.
- You put a blast rig in there and decide you have to move a bunch of rock ...

Roblyn Hunter:

- I think if the dams were done one at a time, so that half the park is available that would take care of part of that.

Chris Grapel:

- That would drag it out.

Tom Hickey:

- There are financial implications to that.
- It would cost more if you did it one at a time.

Al Kenning:

- Another thing we need to talk about is if they are expensive as I am afraid they are, we just don't have that money sitting in the bank.
- We're borrowing money to do this deconstruction.
- Because it's a relatively small amount we can do that without a referendum.
- I think we might have to expect that if we're going to build those dams new, it might have to go to referendum.  
*[A referendum is required if the borrowing term is longer than five years.]*

2. Staff Reporting Back to Council:

Tom Hickey advised that the notes of this meeting would possibly be ready Tuesday and would be emailed to Jeff Solomon. A report will be worked on with a target date for the Council meeting to be held Monday, 2012-DEC--17 and he suggested that this group be on as a delegation.

3. Adjournment:

The meeting adjourned at 5:21 p.m.