JOINT REVIEW PANEL PUBLIC HEARING

IN THE MATTER OF Application Nos. 1844520, 1902073, 001-00403427, 001-00403428, 001-00403429, 001-00403430, 001-00403431, MSL160757, MSL160758, and LOC160842 to the Alberta Energy Regulator

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GRASSY MOUNTAIN COAL PROJECT - BENGA MINING LIMITED

VOLUME 16

VIA REMOTE VIDEO

November 16, 2020

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Proceedings Taken via Remote Video

November 16, 2020 Morning Session

A. Bolton	The Chair
D. O'Gorman	Hearing Commissioner
H. Matthews	Hearing Commissioner
M. LaCasse	AER Counsel
B. Kapel Holden	AER Counsel
K. Lambrecht, QC	Joint Review Panel Secretariat Counsel
T. Utting	IAAC Staff
E. Arruda	AER Staff
D. Campbell	AER Staff
T. Turner	AER Staff
T. Wheaton	AER Staff
A. Shukalkina	AER Staff
M. Ignasiak C. Brinker	For Benga Mining Limited
R. Warden T. Howard	For Ktunaxa Nation

K. Poitras	For Métis Nation of Alberta Region 3
Chief B. Cote	For Shuswap Indian Band
B. Snow	For Stoney Nakoda Nations
R. Drummond S. McHugh	For Government of Canada
A. Gulamhusein	For Municipality of Crowsnest Pass
M. Niven, QC R. Barata J. Nijjer (Student-at-Law)	For MD of Ranchland No. 66
B. McGillivray	For Town of Pincher Creek
D. Yewchuk	For Canadian Parks and Wilderness Society, Southern Alberta Chapter
R. Secord I. Okoye	For Coalition of Alberta Wilderness Association, Grassy Mountain Group, Berdina Farms

		Ltd., Donkersgoed Feeder Limited, Sun Cured Alfalfa Cubes Inc., and Vern Emard
	R. Cooke	For Crowsnest Conservation Society
	G. Fitch, QC C. Agudelo	For Livingstone Landowners Group
	M. Sawyer	For Timberwolf Wilderness Society and Mike Judd
	(No Counsel)	For Barbara Janusz
	(No Counsel)	For Jim Rennie
	S. Elmeligi A. Morehouse S. Milligan M. Boyce	For Alberta Chapter of the Wildlife Society and the Canadian Section of the Wilderness Society
	J. Gourlay-Vallance	For Eco-Elders for Climate Action
	L. Peterson	For Trout Unlimited Canada

R. Campbell	For Coal Association of Canada
(No Counsel)	For Alistair Des Moulins
(No Counsel)	For David McIntyre
(No Counsel)	For Fred Bradley
(No Counsel)	For Gail Des Moulins
(No Counsel)	For Ken Allred
(Not Present)	
(No Counsel)	For Monica Field
S. Frank	For Oldman Watershed Council
A. Hurly	
C. Forster, CSR(A)	Official Court Reporter

(PROCEEDINGS COMMENCED AT 8:58 AM)

Discussion

THE CHAIR: Good morning, everyone. Just a reminder that live audio and video streams and video recordings of this proceeding are available to the public through the AER's website and YouTube. Anyone

in the virtual hearing room with their camera or microphone turned on will be captured, and images and recordings of you and your surroundings will be broadcast to a publicly available YouTube video. If you have any concerns about this, please contact counsel well in advance of the time you are scheduled to participate to explain your concerns. We will make best efforts to try and accommodate your concerns considering the need for an open and transparent public process.

So this morning we're going to finish up the vegetation and reclamation session with some direct evidence from the Livingstone Landowners Group, and then once that's completed and the cross-examination is completed, we'll move to the water session.

Are there any preliminary matters before we get started?

Hearing none, Mr. Fitch, are you ready to proceed?

MR. FITCH: Yes. Thank you, Mr. Chairman. Mr. -- Dr. McKenna, can you hear me?

DR. MCKENNA: Yes, I can.

MR. FITCH: Thank you.

Madam Court Reporter, can we please have the LLG's next witness sworn or affirmed?

GORD MCKENNA, Affirmed

MR. FITCH: Thank you, Madam Court

Reporter.
Direct Evidence of Livingstone Landowners Group
(Vegetation, including species at risk, terrain and
soils, conservation and reclamation, closure, and
biodiversity)

Q MR. FITCH: Good morning, Dr. McKenna.
I'd like to begin by having you confirm that you were
retained by the Livingstone Landowners Group?

A Yes.

Q And you were retained to review Benga's application and
environmental impact assessment to look at, among other
things, the issues of reclamation and closure?

A Yes, that's true.

Q And, sir, you prepared a letter report that is dated
September 21st, 2012, that is titled "Engineering
Review of the EIA Design, Operation, and Reclamation
Plans for the Proposed Grassy Mountain Coal Project";
correct?

A That's correct.

Q And for the record, that is CIAR Document 552,
beginning at PDF 3.

Dr. McKenna, was that report prepared by you or
under your direction?

A Yes, it was.

Q Okay. And do you adopt it as your evidence in this
proceeding?

A Yes, I do.
Q And, sir, you acknowledge that you are an independent expert witness and that you are under a duty to provide opinion evidence that is fair, objective, and non-partisan?
A I do.
Q Thank you.
MR. FITCH: Now, Zoom Host, we have -- Dr. McKenna prepared a PowerPoint presentation that we provided to the secretariat on Friday. I confess I'm not sure what the CIAR number is, but hopefully we can locate that document and pull it up. Thank you.
Q MR. FITCH: So, Dr. McKenna, you have prepared a PowerPoint presentation to act as an aid to your evidence this morning; correct?
A That is correct.
Q All right. And I take it that there's -- that the -- what's in your PowerPoint presentation, effectively, is a distillation or summary of what you put in your letter report?
A Yes, it is. The -- there's two distillations. There's this one and then one coming up in the later part as well. Together they cover the letter.
Q Okay. Great.
Sir, can I ask you to proceed with your presentation, then.

A Thank you, Mr. Fitch.

Good morning. I'm pleased to be here to highlight aspects of my report as that relate to reclamation and closure. My goal is neither to promote or oppose the mine here but, instead, to provide the Panel my expert opinion to aid in their decision and recommendations. My main focus is on highlighting what I believe are significant deficiencies in the current reclamation and closure design.

Next slide.

Thank you.

I provided an outline of my presentation on this slide. The information from the presentation is based on my report dated September 21st as Mr. Fitch mentioned, and it's filed under your system under CIAR 552.

The presentation provides information on my background, the process of landform design, and highlights nine observations from my report that relate to reclamation and closure. I'll cover most of the other recommendations in the session on selenium and water over the week. The last slide provides my overall conclusions.

To give away the ending, I conclude that Benga should be required to provide a more detailed closure and reclamation design to address the outstanding

shortcomings listed in the letter before the application can be fully considered.

THE COURT REPORTER: Excuse me. Can I see the witness on the screen, please? I don't have him on the screen.

MR. FITCH: I can see him.

THE COURT REPORTER: Okay. Okay. Thanks. I can see --

A DR. MCKENNA: I'll continue.

THE COURT REPORTER: I can see you now.

A DR. MCKENNA: Okay. Good. Thank you.

Next slide, please.

I've included my background information here, and, in brief, I'm a geotechnical engineer and a geologist with 33 years of mining experience with a focus on mine waste management. I have a PhD in geotechnical engineering from the University of Alberta.

I worked as a geotechnical engineer at the Syncrude oil sands mine for 17 years before becoming an international geotechnical consultant based here in Vancouver in 2004.

I've held several adjunct professor positions, and I'm currently an adjunct professor of civil engineering at the University of Alberta.

I sit on several geotechnical review boards. I've sat on a number of panels related to mine waste

management. One of these panels was the strategic advisory panel on selenium management for Rocky Mountain coal mines in Alberta and BC, and that ran back in 2010 through 2012.

Last year I founded the Landform Design Institute to help support and grow that discipline.

Next slide.

Thank you.

Grassy Mountain application through a lens of landform design. I would characterize the present Grassy Mountain Coal Project mine and reclamation plans as traditional reclamation planning. I was expecting to see plans and designs that better reflect the challenging nature of this property. Bedrock geology model and the mine plans related to ore mining are quite well developed as they usually are for most mines, but I wonder if Benga fell into a trap of thinking that the waste rock dump designs and reclamation plans need only be conceptual in nature. Time and again we find that conceptual plans usually contain fatal flaws and don't provide a good basis for decision-making by the mine, the regulator, or local communities. Through -- though such designs are expected to change over time, I found that to be successful they still need to be done to a feasibility level even before mining begins.

Many of my clients have adopted this landform design approach for their mining projects. Designs done by integrated multidisciplinary teams that work with regulators and local communities has had clear design and performance goals and create and implement the designs to reliably meet the stated objectives.

I reviewed Benga's EIA through the lens of landform design.

What do we mean "landforms"? Landforms are defined as distinct topographic features formed by natural or artificial processes. Taken together, they make up the surface of the earth. Examples include mountains, peninsulas, islands, sand dune and streams.

Landform design builds on this knowledge collected over hundreds of years and -- this knowledge of natural landforms by different disciplines, and it applies it to the design and construction and reclamation of mining landforms such as waste rock dumps, tailings ponds, mined-out pits, et cetera. Together these landforms form the mining landscape, which is designed, constructed, and maintained to perform as intended over the coming thousands of years, long after the coal is consumed and to fit into the mining region and to be able to leave a positive legacy for local communities as has been promised in EIAs.

This chart shows how it's done. A

multidisciplinary team is formed usually with about a dozen different specialists and generalists, the types of people already working on the Benga application and, I guess, the people reviewing it as well. Governance is established. A design basis document is created with agreed-upon vision, goals, design objectives, design criteria. The landform is then designed by this integrated team to meet these goals. Then a full engineering risk assessment is done. And, crucially, for areas where there's a risk of not meeting these commitments, fold contingencies are developed and implemented as needed.

This is different than the trial-and-error approach that the proponent is offering under the name of adaptive management. Instead, it follows a process developed in the 1960s called the "geotechnical observational method". The contingencies are developed in enough detail that they can be quickly and affordably implemented if performance does not meet expectations.

Next.

As the mine advances, each of the landforms is constructed, usually four or five at a time, and areas of these landforms that are no longer needed for mining are resloped with dozers, the surface water drainage system established, a cover soil is applied, and the

area's revegetated. This is called "progressive reclamation", as you know.

The monitoring program starts before mining begins and ends decades after. Results from the monitoring are used to assess whether the site is meeting the intended performance and is set up so that the contingencies can be put in place before environmental damage occurs.

Sometimes the contingencies take a few years to construct and to commission, get running well, so the monitoring program and the design takes this into account to make sure that we have timely data.

We use this observational method for tailings dams and hydro dams around the world, and it's being applied to mining landforms like waste rock dumps and pit lakes. You might ask, Is this new? Is this just state-of-the-art? Well, on one hand, this observational method for geotechnical engineering -- used for the Apollo moon shots about when I was born. So that's not new. The application to mining and mine reclamation is less than 20 years old and has been adopted internationally for tough sites like Grassy Mountain. So it's somewhat new.

I argue that the traditional design methods used by the proponents fall short in terms of protecting the environment and meeting other goals. The current

design lacks many of the elements on the flow chart in favours of big trial-and-error approach.

You might ask, How come all this detail? Why now? Why can't it come later? You might ask rhetorically, Isn't 17,000 pages enough? Well, it comes down to designing with the end of mine, planning ahead, being thorough from the beginning. Avoiding this level of design almost always leads to a fatal flaw in the design, the mine overcommitting on performance it can't control, increased costs down the road, and a greater risk of early abandonment and environmental performance that's less than promised.

At this site, achieving the goals and protecting the fish requires more design effort than is currently being provided.

Next slide, please. Thank you.

The report I prepared for the Livingstone Landowners Group provides 17 observations and my suggestions for addressing each one. Let me focus today on the nine shown here in yellow, the ones that relate to closure and reclamation, and there's one slide for observation.

Next slide, please.

This first slide says that the EIA presents optimistic goals, many of which will be hard to achieve. Just about all mines overpromise to get their

permit. In many cases, they are -- feel compelled by miners' inherent optimism but also by the system to make these commitments towards lofty, ill-defined, or otherwise high-risk goals to get their permit.

This notion of equivalent capability, which is the heart of -- of Alberta's regulatory system for this, is one such promise which is both ill-defined and a high risk. That the ecoscience will be restored to a future regulator's satisfaction in a timely manner in this harsh environment with limited cover soils is very optimistic.

I'm certain the mined land can be well reclaimed with good design, execution, monitoring, and oversight by the regulator and members of the local community, but most mines end up disappointing even when they reclaim well.

Last week, a colleague of mine summed up today's typical mine reclamation approach as: We do our best and cross our fingers. But we can do better than that. We need to do better than that here at this mine.

I think we should start by promising less and then putting plans in place to reliably deliver on reasonable goals and objectives. People talk about smart objectives -- S-M-A-R-T, standing for specific, measurable, achievable, relevant, and time-oriented.

The objectives for Grassy Mountain generally fail

most of these criteria.

Then there are the numerous and often onerous commitments made in the EIA, SIRs, and hearings such as this.

Another colleague you'll know, an ex-Alberta environmental -- environment regulator, Mr. Chris Powter, points out that the documents such as applications and EIAs are typically given the lowest weight in the regulatory process behind policy, standards, decision reports, authorizations, acts, regulations, and rules. Most mines end up focusing, sometimes exclusively, on what is written in their permit.

Local communities put great weight in the commitments made in the EIA such as this and the hearings, and it's important that such commitments be gathered up and clearly written and included as part of any permits. Sometimes a permit approval will say that the proponent shall do all the things promised in their EIA and the permitting process, but I see that overarching statements like this are -- are usually hard to enforce and -- and often just melt away.

This lack of clarity in goals manifests when a mine manager is asked to sign cheques for expensive reclamation without clear objectives, and then again it appears when the mine applies for a reclamation

certificate for the first plot of reclaimed land.

Almost no one gets a certificate for their reclaimed mine land anywhere in the world. Even fewer get their financial assurance return. My count, it's a fraction of 1 percent get their money back.

There is 1 square kilometre of reclaimed land in oil sands that I led the effort to achieve such a certificate. This landform was chosen in 1997 to trial the process for oil sands, building on some of the success of the prairie coal mines. A fairly boring hill was selected, one made mostly with clay, with a metre of soil, 10-metre high trees, and it still took ten years of negotiation and rework to achieve the certificate. And getting the certificate was in doubt right to the end.

There are a couple of coal mines with some certified land to celebrate, but around the world people are hard-pressed to come up with examples of -- of successful sign-off.

There's lots of reasons -- and circling back to this slide here, there's lots of reasons, but one of the main ones is disagreement on what the commitments actually are and whether they have been met. Often these requirements prove impossible to meet. So I would encourage a reset on the goals and objectives at -- at Grassy Mountain.

On to Slide Number 2, please -- or the next slide.

This slide allows us to talk about the high risks that full reclamation will not be achieved. Partly because there's almost never sign-off and there's few economic incentives, few mines ever get fully reclaimed, most are less than half reclaimed. I'm not aware of any fully reclaimed mine site even amongst the hundred mines I've visited and worked at around the world. My list of fully reclaimed sites is limited to a few small quarries near cities. Clearly, if a proponent were to offer to only reclaim half a mine site, permitting would be difficult, but this is kind of the ongoing reality on the ground.

Usual pattern is at the end of mining, the partially reclaimed mine site goes into care and maintenance with very little additional reclamation done. If the mine goes into receivership or goes bankrupt, the property reverts back to the original landowner, typically the Crown, and the reclamation activities were also minimal at that point, and the land is simply put into care and maintenance; users are continued to be denied access.

In this modern era -- oh, sorry. This means that at every mine opening the local communities are accepting risks that the land won't be reclaimed, and they may never get back on the land again.

In this modern era, mines post financial assurance to cover the risk of default. Some combination of cash, bonds, lines of credit or corporate assurance are common. But the amount of money held by the government is typically a small percentage of the estimated cost of reclamation and the cost of long-term care and water treatment.

But, worse, the estimated cost of mine closure is almost always underestimated by a factor of 4 to 10. So let me give you some numbers that -- that highlight this. These are from the Faro Mine in the Yukon some I've been involved with for the last decade. This large lead-zinc mine closed in 1998. The reclamation bond was $28 million. So far, Canadian taxpayers have spent over $500 million on care and maintenance of the Faro site even though there's been almost no land reclaimed over the last 20 years. The cost estimate of reclamation and care and maintenance over the next 20 years is expected to be over $1.5 billion. This is all taxpayers' money. This is compared to the $28 million bond. This is, unfortunately, fairly typical.

Furthermore, I'm not aware of any mine that has paid for its own reclamation. It seems to always require the mine owner to use revenues from other mines, or the site is abandoned to the taxpayers.

And I've never heard of regulators say that they were glad to get a mine -- mine land back and that they had adequate funding for reclamation, and often governments don't feel compelled to rush reclamation or even to meet the original permit conditions for reclamation opting for safe and stable, little else. Users are usually excluded from the mine land indefinitely.

So given this track record, I've recommended that the project be asked to provide a more complete cost estimate for closure and long-term care and that the Province secure adequate financial assurance for all phases of the project. A review of the security by a third party would help reduce risk and uncertainty.

Next slide, please.

The proponent's updated conservation and reclamation plan is still lacking in key items and should be redone with greater detail before a decision is made. A list of deficiencies is provided here on the slide. The report provides more detail, and the coming slides focus on specific deficiencies.

Next slide, please.

Observation 11, my point is that surprisingly little effort has been expended on the end-pit lake design. Yes, it's a long time until the end-pit lake will be constructed, but the design of the lake and its

watershed should be developed now so people can be assured the lake will be viable and meet the goals and objectives set out. Right now, there is almost some design provided, despite lots of available guidance. And I've put screenshots of four textbooks on the slide. It's unclear that the Grassy Mountain pit lake will be safe and -- and sustainable.

I note there appears to be an error in two EIA tables regarding the size of the watershed that feeds the lake, which is listed as -- the watershed's listed as 1,032 square kilometres. This must be an error. It's much too large.

Given that the -- it is recognized that, for a successful lake, the design of the reclaimed watershed is at least as important as the design of the lake. And this typo is perhaps indicative of lack of attention to the lake design at this point.

Here's a detail that's telling. The table indicates 10 percent of the lake will be designed as a littoral zone. This littoral is a very shallow water zone in the lake that allows for productivity that's important to the lake ecology. 10 percent is often regarded as the textbook minimum for a productive lake if that's indeed what's promised. But there's no details on the function of this littoral zone for this lake or how it will be constructed or how deep the

water will be. Typically, the littoral zone is difficult to plan and construct unless planned from the very beginning. More detail is needed.

Furthermore, the water quality of the lake is assumed to be good, and this hasn't been demonstrated. The presence of even low levels of selenium in pit lakes, which are quiet or lentic environments, can have a profound impact on birds and fish. The watershed and the lake need to being designed for sufficient water quality and quantity and contingency plans put in place and a monitoring plan to rectify any poor water quality right away. This is a major design consideration for pit lakes in the region.

What is especially odd is the plan for tunnels through the mountain as an overflow outlet for the pit lake. I've never seen anyone propose to drain an end-pit lake through a tunnel through a mountain. How would these tunnels be constructed and maintained? How can they be self-sustaining? How would the mine or the government do -- or what would the mine or the government do if they were to collapse at some point? How can the inlets be kept from blocking? How can kids be kept out?

Every other pit lake I know has an armoured outlet channel that is very robust, and these outlets can be the weakest part of the -- of the lake design. The

outlet should be cut into the bedrock, even though this is -- this expensive cut is large enough to affect the mine plan; and such cuts often expose more ore, complicating the mine plan. The waste rock from this cut would need to go somewhere. None of this is planned or costed. Better to plan for than have the taxpayers get into the mining business, digging a hole in the side of a mountain to replace the tunnels.

So the plan should be updated with more pit lake design details. I think a pit lake with a tunnel outlet or elevated selenium would be considered a fatal flaw for this end-pit lake.

Next slide, please.

The point I'd like to discuss now is that almost no effort is being devoted in the -- in the plan to the design of the surface water drainage system for the mine site for -- for closure. In my practice, water is the main issue in mine reclamation, surface water, groundwater, soil moisture. When I worked at Syncrude, we would pay our consultants tens of thousands of dollars to work up a surface water drainage design for each closure plan. We needed this design to understand how to design the mine, the individual landforms, how to design with the end in mind. We have to keep the water flowing safely downhill, so we note that water only flows uphill, to money.

As part of hydraulic designs, mine declare the return period for major design storms. We would design the erosion -- design these channels to limit erosion in, say, a 1-in-10-year event or 1-in-a-thousand-year event or -- or, in critical cases, a 1-in-10,000-year event. And same as we would do for the outlet of critical dams.

The costs to meet these different criteria vary greatly, so we need to declare these criteria up front. We needed to make sure that there's enough gravel and -- and Riprap to armour the channels. One rule of thumb says that for mines in Alberta the drainage density of about 1 kilometre of watercourses for each 1 square kilometre of disturbed land. The density does vary with geography. I'm not -- I don't think it's been determined what the right density is for the Grassy Mountain.

But to give you a sense, if that density applies here, it would amount to about 15 kilometres of watercourses, which seem reasonable. And look at the plan, and -- and on the slide here, all I see instead of this design report and -- and all this work are little blue arrows on the map called "drainage direction" with no indication of what the design storm would be, how the channels would carry the water, how much they would cost, how the land would be protected

from uncontrolled erosion. Channels to safely carry runoff water from waste rock dumps or a feature of textbooks in the 1970s would have been forgotten by the -- a lot of mines today, including Grassy.

Here's what I've seen happens when you don't have a well-designed and well-constructed surface water drainage system. Water ponds on the landscape sinking into the waste rock and causing chemicals to leach from the waste rock dumps. Where the ponded water slops over a dump crest, floods down, the soil cover is washed away, big gullies, and deposition is alluvial fans at the toe of the slope, sometimes blocking a watercourse down there too. Mine waste is often inadvertently dumped where the channels are supposed to be constructed, and who is going to move a dump to fit a channel in later? When it comes time for the reclamation certificate, the regulator may wonder where all the channels are and why they weren't built. The miner doesn't want to cut down the trees that have grown and disturb the land to build channels. I know. I've been there with the S4 dump certification at -- at Syncrude. It's too late. There's increased cost, increased risk, and decreased environmental performance results.

The surface water drainage is serious business. It's designed by professionals. It's constructed with

the greatest of care. It's repaired and maintained so it acts as intended. The Grassy EIA provides commitments regarding erosion but no designs to manage it.

The diagram here in the upper right shows a modern waste rock dump designed to control acid rock drainage or selenium oxidation. I want to use the diagram to focus on the kinds of surface water drainage that we're talking about here. On the right, a run-on channel above the waste rock dump kind of at the toe of the mountain slope is used to keep clean water clean and stop it from leaching materials from the waste rock dump. Line channels on top of the waste rock dump plateau are used to avoid ponding water. The watershed berm at the edge of the dump crest is used to keep water from gullying the crest. The Australians use these widely; they call it a "bund". The toe creek is used to collect the surface water and perhaps the groundwater. These elements all need to be built into the design from the start even -- it's important to have these in the design even at this early stage as now.

Down to my last four slides here. Next slide, Number 13.

There's opportunities to improve the -- on the commitment and mine plans for progressive reclamation.

The mine is promising progressive reclamation. Even mines with good intentions generally fall short on implementation of progressive reclamation. The permit should reflect this commitment in a measurable way, perhaps indicating that all areas of the mine that are no longer required for operations shall be reclaimed in, say, two years. This helps hold the proponent to their commitment.

There's an opportunity to be the more aggressive in the progressive reclamation plans making more land available sooner for progressive reclamation, for example, by adjusting the waste rock dump sequencing such that a smaller area of active dumping is required at any given time.

The mine is planning direct placement of reclamation material, which is good. This is where the reclamation material from active stripping is handled once so it doesn't need to be stockpiled and is loaded, hauled, dumped, and spread, typically within hours. This approach not is only [sic] cheaper than stockpiling and rehandling. As importantly, it preserves the soil microbes, the seeds, and the propagules in the soil that greatly speeds the recovery of the vegetation community. The permit condition should be written to maximize the direct placement every year, not just as practicable or when possible

or -- or at the mine's discretion.

Benga should establish some large field trials to -- for reclamation research, building covers and revegetation plots planted or seeded at commercial scale. It would have been good to start such plots during the exploration period, but 2021 is also a good year to start. These are to answer the question: What covers and planting techniques are needed to establish the promised ecosites in different areas of the reclaimed landscape?

A simple example: There remains uncertainty whether whitebark pine can be established and thrived in mine reclamation at this kind of site. Fair enough. Common practice to establish vegetation plots to answer these kinds of questions and questions like: What cover thickness does it need? What -- for whitepine? What kind of substrate? Should it be contoured to block the wind or -- or perhaps to trap snow? Should a nurse crop be used? How should the seedlings be planted? How can the mine demonstrate to regulators and local communities the vegetation design for whitebark park [sic] is likely to succeed?

Right now, the reclamation plan waits until Year 15 to start planting these whitebark pine. Instead, Benga should establish vegetation plots next year and test the conditions needed to promote

whitebark pine. The needed knowledge will then be in place prior to reclamation, and we can all be assured then the plan is a good one. Or if we find it proves impractical, Benga can ask for an exemption from the whitebark pine commitments. Better to find this out now in the next few years than to wait until 2040.

Next slide. Three more slides to go. I apologize to the Panel; I'm taking a couple extra minutes here.

The proponent indicates a commitment to establishing equivalent capability, which always begs the question: Equivalent capability for exactly what? If it's equivalent capability for re-establishing the ecosites prior to mining, having the grasses, trees, and shrubs grow at similar rates to pre-disturbance, what really matters here is the cover soil, the depth, the layers, the material properties, how it's placed.

I'm not a soil scientist, but I've worked for 25 years in multidisciplinary teams designing, constructing, and testing reclamation material prescriptions for cover soils in mines in Alberta and internationally. Here's what I observed regarding Grassy Mountain.

The current mine plan reclamation plan uses a very simplistic design. The proponent has determined there's about 3.3 million cubic metres of available reclamation material needed to cover or to put on 15

million square metres of reclaimed land. That's 1,500 hectares. Long division provides the design in this case: 20 centimetres cover soil depth. This is the amount placed on all substrates at all elevations, on windy polygons and calm ones, on old roads, on waste rock dumps alike. This is the kind of mining engineering and design promoted in my 1973 version of the mining engineering handbook. This thinking is long out of date and insufficient to meet the lofty goals like equivalent capability, especially given the site conditions, not to mention the need to control the ingress of water and oxygen into waste rock dumps which impacts selenium generation. It's unusual to propose this one-size-fits-all blanket approach.

Normally for vegetated covers, the goals are set, the landscape is divided into polygons, soil scientists figure out the soil moisture regime and the soil nutrient regime and plot these on an adaptive grid as shown above.

They use this to figure out what ecosites will flourish in various -- with various soil prescriptions. In particular, the water-holding capacity of the soil often governs vegetation performance. Will there be enough water during a drought to sustain the plants? The model results are tested in long-term vegetation plots that we talked about in the last slide. The soil

prescriptions, the depth, the layering, the material properties are adjusted and designed to support the desired ecosites and land uses and net percolation requirements.

If the designs don't meet the requirements, the designs are adjusted. This is a practice of Teck coal mines elsewhere in the Rockies under Alberta regulations. It's embedded in oil sands mine design reclamation. This -- I expected to see this in the report, but I didn't.

Yes, all this does have to fit into a reclamation material balance. There's only so much soil to salvage, and especially in a mountain mine. And this is why it's so critical to get this right ahead of mining. If the requirements need more material than is available to be salvaged, then more overburden needs to be stripped, taking a deeper cut down in the glacial tills before mining.

If you don't do this during initial mine development, the material is lost during excavation of the mine pits or buried in waste rock -- under waste rock dumps. The designs can't wait. The point is soil prescriptions and mine waste covers are so much more than dividing two numbers together. And even if this were a good idea, the reclamation plan fails to show how this rudimentary prescription will meet the goals

for equivalent capability in each part of the reclaimed landscape. And the lack of analysis in design and planning means that certain doors will be closed even before mining starts. There needs to be a proper design before mining begins, before permitting, and with a plan and eventually field trials to show that it's all going to work.

Next slide.

This one overlaps with Slide Number 14 before. There's been little effort to design the covers, to control net percolation for the waste rock systems. Much of this discussion's covered in the previous slide on soil covers, except the design methods are more involved when needing to limit net percolation.

There's several international guides to show the design of cover systems, two of which I've contributed to. Most of these covers are designed as some combination of growth media, erosion protection, and control of percolation into dumps with adverse geochemistry. It's a multidisciplinary undertaking involving modelling, design, field trials, and close controls and construction.

My presentation later in the week on water management, selenium control will get into the covers in more detail. They need design. I believe the -- the source control for selenium is a precondition to

success at this site. Lack of selenium-source control is likely a fatal flaw to the design. Having adequate covers can change a lot of things to do with the mine design and especially the reclamation closure plan and needs to be done up front.

Next slide.

The proponent has promised to develop a reclamation monitoring program, but this seems to be more of a bolt-on than part of the design. The monitoring program is fundamental to engineering design. As engineers, we wouldn't think of issuing a design, say, for a roller coaster without a full inspection and maintenance plan. It's integral to the design. Monitoring is also integral to the landform design process and the observational method. The plan can't wait till a future date. The Panel ought to require the integrated monitoring plan in fair detail in support of the design to -- to -- that is being set out. You need the monitoring program to tell you when to tweak your designs and practices, when to implement the contingency measures, and start to gather the data needed to manage and operate the site and some day make -- serve as the basis for the application for a reclamation certificate.

It's not a nice-to-have thing. A monitoring plan is an integral element of the design operation, not

something to leave behind. My report provides some detail and references on -- on how to accomplish this at this stage of mining.

Last slide, please. Thank you.

So as noted at the beginning, I'm neither for or against the Grassy Mountain Coal Mine, while I am advising that the current level of design falls short of the standard practice for this kind of sensitive mine site, even during this early permitting period.

One might ask if landform design is too new or state of the art than the state of practice? Is it -- the new formation of the Landform Design Institute proof of that? Yes, perhaps. But regardless of what it's called, this kind of approach is especially needed for mines operating in tough conditions where there's doubt that the lofty goals will be achieved, where people struggle with high-altitude reclamation in less windy conditions, where there are creeks and fish populations sensitive to even minute changes in water quality coming from the waste rock dumps, but landform design has packaged these activities into a framework to help ensure success.

One might say that the EIA terms of reference only require conceptual plans, blue lines on a map, as it were, instead of an engineering design. But only having conceptual plans usually masks unknown fatal

flaws. Mines and regulators are learning -- and I think what local communities have surmised all along -- that plans that lack detail are the root cause of mines failing to meet the reclamation commitments. The devil is in the details. Conceptual plans don't have enough detail in this respect to protect the environment.

More details need to see the light of day during permitting. Waiting a few years or decades to work the details means lost opportunities, increased cost, decreased performance, and more risk to the regulator, local communities, and the environment. Mines need to be ahead of the curve. If only we had known what we know now. The cost -- well, a well-run mine with a good plan and good operations typically spends a few percent of its life-of-mine budget on the sum of all environmental and reclamation activities, a lot of money but a small percentage. A mine that finds itself behind the eight ball always ends up playing catch-up and can find itself spending 10 to 20 percent of its budget on such activities and may find the mine life shortened or may find that it has to keep mining to avoid confronting newly discovered environmental liabilities. It's in everyone's best interest to do this front-end-loaded engineering, keep cost down, keep opportunities open. Overall engineering design costs are usually just about 1 percent of the mining budget.

It's a lot of money during this permitting stage, as -- as we all know, but important nonetheless.

These planning shortcomings may not only impact the mine economics and the long-term performance of the reclaimed landscape, but may have important implications for selenium management, as I'll discuss in my upcoming presentation.

I believe the current level of detail for the site is insufficient to judge the merits of the project or to be able to rule out a potential fatal flaw of the designs or to provide a reasonable cost estimate for reclamation.

I believe that prior to full consideration of the application, closure and reclamation plans should be significantly upgraded. In particular, the design of the soil covers, the revegetation plans, adding a surface water drainage system, designing of the end-pit lake and its watershed, and design and implementation of landscape performance monitoring are all still required. My report provides details, including potential solutions, for each of these observations.

Thank you, Mr. Chair and Panel Members, for the opportunity to highlight these concerns today.

Q MR. FITCH: Thank you, Dr. McKenna.

MR. FITCH: Mr. Chair, Dr. McKenna is available for questioning.

THE CHAIR: Thank you, Mr. Fitch.

Mr. Ignasiak or Mr. Brinker, does Benga have questions for Mr. -- Dr. McKenna?

MR. IGNASIAK: Thank you, Mr. Chair. Yeah, just a couple.

Mr. Ignasiak Cross-examines Livingstone Landowners Group

Q MR. IGNASIAK: Good morning, Dr. McKenna.

A Good morning.

Q My name is Martin Ignasiak. I'm counsel to Benga in this proceeding. Thanks for your presentation.

I was looking at your CV. You've obviously got a lot of experience in this area, and I understand you chair -- and I think you founded if I have it right -- the Landform Design Institute?

A That's correct.

Q And I think you describe that on the website as: (as read)

Landform design as an emerging process to reconstruct mine landscapes with confidence and pride.

Is that right?

A That's true.

Q And the mission of the institute is to make landform design routine in the mining industry worldwide by 2030; is that right?

A That is correct.
Q Okay. Now, looking at your CV, I was looking at PDF -- it's PDF 39 of the -- of the submission by LLG, which is Document 552. But looking at it, you list on that page 22 -- there's 22 bullets listing projects, and I see you've got experience not just in the oil sands, but also with process timber lights of diamonds, gold, and coal; is that right?
A Yes, that's true, and other metals as well.
Q Okay. And it states there that you've led the design and construction of 23 large mining landform projects totalling 44 square kilometres, including 37 wetlands and 101 kilometres of watercourses; right?
A That's true.
Q So you would have led -- so what would your involvement be with those projects? You would have kind of led these teams responsible for the overall design or --
A Yes. And usually there's a -- a lead designer that I mentor and -- and help with, and I take overall project management and guide -- help him or her guide the team through -- through these processes through design and all through -- also through construction and -- and monitoring.
Q Okay. And so one of the projects I understand you've had considerable success with -- and I know you've written some cases studies about it -- is what's

referred to as "Suncor Pond 1" or the "Wapisiw Lookout"; is that right?

A That's right.

Q Okay. And that -- so -- and I understand you were working on that from 2008 to 2010?

A Yes, and a little bit beyond that.

Q Okay. And as I understand it, that's the first tailings pond that was ever built in the oil sands industry; right? It was created by something called "Tar Island Dyke" in 1967?

A That's correct.

Q And it's about 2.2 square kilometres in size?

A Right.

Q And I understand from the case studies you've written that it reached a maximum height of about 92 metres in 1985 and then continued operating thereafter; is that right?

A That seems right.

Q And Suncor decided in 2007 that they would stabilize and reclaim that landscape by the end of 2010; is that right?

A That's right.

Q And I understand with your -- when you got involved in 2008 work, and that you managed to successfully reach that objective; right?

A Yes.

Q Okay. Great.

So just switching gears, then, one other topic I had was at PDF 11 -- it's in your report; I think you probably remember -- you talked a bit about the north dump and the south dump and -- and the fact that the south dump was separated by a power line; right?

A Yes.

Q So -- now, one of the things you've recommended is looking at relocating that power line as if it wasn't there, I guess. But one of the things -- like, you wouldn't have any -- you haven't done any assessment of how much of that power line would have to be moved and what the utility would price the movement of that power line at; right? Like, you haven't done any type of assessment like that?

A Actually, I read where the -- in the EIA documents where the mine had done that assessment and made the decision to leave the line there.

Q Okay. And do you know what -- what the cost of moving that power line would have been?

A I don't know if that -- I can't remember if it was included or not.

Q Okay.

A It would be high. It would be a lot of money.

Q Okay. All right. Thank you, Dr. McKenna. Thank you very much.

MR. IGNASIAK: No further questions, Mr. Chair.

THE CHAIR: Thank you.

Ms. LaCasse or Ms. Kapel Holden, any questions?

MS. LACASSE: We don't have any questions, Mr. Chair.

THE CHAIR: Thank you.

Mr. Lambrecht?

MR. LAMBRECHT: Mr. Chair, federal staff do not have any questions, and I thank this witness for his evidence and participation in the Joint Review Panel process.

DR. MCKENNA: You're welcome.

THE CHAIR: Thank you.

Mr. Matthews, any questions?

Alberta Energy Regulator Panel Questions Livingstone Landowners Group

Q MR. MATTHEWS: Thank you, Dr. McKenna. I just have a couple of questions.

You mentioned about care and maintenance. Is it a normal practice for an operator to -- when they go into care and maintenance, do they -- are they bound by environmental commitments? Like, are they bound by monitoring and ongoing environmental work?

A Yeah. Typically, the -- the care and maintenance -- its Number 1 duty is protect the mine site -- or

protect the environment away from the mine site, any receiving streams or -- or other areas. It -- often also to protect people from coming onto the mine site and falling down old shafts and things like that. But there isn't much work or commitment that's -- that's required for reclaiming the areas on-site. And so those -- the minimum is typically done.

Q Okay. And another -- my last question here is regarding -- you mentioned that, on dumps, they often have covers as part of their closure and reclamation plan. Are you aware of any coal mines where they have complete liners, like, underneath the -- the dump?

A Yeah. That's an emerging trend. I'm not aware of any old dumps that have that. There's questions about the -- the longevity of -- of such a liner, especially if it's geosynthetic, or even just cracking if it's a cliff-compacted clay liner. So it's -- and it also has some -- it -- it can form a weak layer geotechnically under the -- under the dump. And so it is used in some tailings ponds in -- in some jurisdictions, even over large areas. It's of course used in landfills and that, but it -- I'm not aware of any -- personally aware of any coal mines that are -- that are using it for under -- for lining a waste rock dump. The covers are -- are becoming more common, the stuff that's on the top, but the liners aren't.

Q Okay. Great. Well -- great. Well, thanks a lot. Thanks, Dr. McKenna. That's all I have to say -- ask.

THE CHAIR: Mr. O'Gorman, any questions?

MR. O'GORMAN: Thank you, Mr. Chair, and I do have just a couple of quick questions for Dr. McKenna.

Q MR. O'GORMAN: Thanks very much for that presentation. It's quite -- it's quite informative. I just wanted to clarify a couple of things, please.

You spoke in your -- in your presentation about a successful end-pit lake. You talked about the littoral zone, for example, that would be associated with that. I wonder if you could just give us a bit more explanation of, in your view, what are some key elements that would make an end-pit lake successful, which was the word you used?

A Very good. Well, I -- I'll tap into two sources. One is -- is I was one of the lead authors on the end-pit lake design guide for the oil sands that came out in 2012, and we had quite a bit of information on what constitutes success. And I also worked with a couple end-pit lake experts who have written the textbooks that I featured on there and can tap from that.

The main -- the main item for success is actually meeting the goals that you set out that you are going to meet, so having very clear goals and clear objectives and then showing that you've met them.

That's -- from a procedural point of view, I think that's critical.

From a purely environmental view, you need to keep the water quality good, which means having enough watershed of -- of relatively clean water that can flush the -- any contaminants in the lake; or if the lake doesn't have enough water, it tends to evaporate and accumulate salts and that. So having lots of clean water coming from the watershed. Having a lake geometry that keeps the water clean. There's all sorts of -- it's outside my expertise, but where you -- you can get stratification within the lake and -- and overturning, which is hard on the -- hard on the lake ecology. And having a -- a -- if you're offering a productive lake -- not all the mountain lakes -- natural or -- or end-pit lakes are -- are productive -- (UNREPORTABLE SOUND) -- but the -- sorry about that. But having a -- a good littoral zone that's very shallow -- it tends to be less than a couple of metres deep -- and stays shallow so that you don't, you know, build your littoral zone and -- and have it even flood out or -- or drop -- settle and -- and become too deep. That's common -- both of those are common in pit lakes for -- for that to happen. So having a -- a suitable littoral zone that's good for the fish to -- to rear and -- and feed and stuff like that. Those are all

critical elements of it.

Having a safe and stable shoreline and having a safe and stable outlet are also really critical, especially the outlet.

Q Okay. Thanks, Dr. McKenna. And, actually, you take me to the -- the thing that I wanted to go next on this vein, which was the outlet.

So you -- you talked in your presentation about the idea of outlet and outflow via a tunnel. You also talked about your preference for outflow -- no, "your preference" might not be fair to say. You talked about outflow via an armoured channel. And, of course, another option might be outflow strictly via evaporation.

In a -- in a hypothetical end-pit lake in which there were no outflow channels but relied strictly on evaporation, would that be a kind of design that would be more or less likely to produce a successful end-pit lake?

A I think it would be quite a lot less successful or -- or were that. They -- textbooks refer to what you describe as a "terminal end-pit lake" and -- and was common in some desert metal mines and that. It tends -- they tend to go -- they evapo-concentrate anything that's in the water there, and the water in those metal mines, often pH 2 -- and -- and the

Berkeley Pit comes to mind as the poster child of -- of perhaps the worst end-pit lake around, or one of them.

And so these terminal end-pit lakes with -- with no physical outlet and -- and just allowing the water to -- you know, would sit low and -- and find its own level for -- between evaporation and water losses or gains to groundwater seepage. I wouldn't think that that would have much chance of -- of providing an end-pit lake that would be acceptable to people in Alberta.

Q Okay. Thanks.

I have one final question. You -- you include quite a few recommendations with your report. I guess I'm curious to know what you think of the idea of this Panel, in potential approval conditions, including those as recommended conditions in an EPEA approval, for example. Do you think those would make sense, particularly around -- and I'm particularly thinking now about the end-pit lake design and the requirements for more details on that. Just curious your views on -- on those as potential conditions.

A Yes. As I -- as I wrote the letter for Livingstone Landowner [sic] Group, I thought, well, the -- the mine will -- will either be -- the permit will either be denied or it will be approved with conditions, and so I tried to think of -- of you and the Alberta Regulator

and the local communities and the mine as I was putting together the recommendations.

I -- I was hoping that you would sift through them and -- and find the ones that -- that you found most important to success and either include them or reword them in -- in support of your work, yes.

Q Okay. Thank you very much, Dr. McKenna. I don't have any further questions, and thanks for appearing and -- before us and submitting your report.

A You're welcome.

THE CHAIR: Thank you, Mr. O'Gorman.

Dr. McKenna, I don't have any further questions for you, but I just want to echo my colleagues' views. Thank you very much for your written submission and your presentation today. Very helpful for the Panel.

A You're welcome. Glad to oblige.

THE CHAIR: Mr. Fitch, any re-direct?

MR. FITCH: No, sir.

THE CHAIR: Okay. Thank you.

(WITNESS STANDS DOWN)

THE CHAIR: So that brings us to the end of the vegetation and reclamation topic area. Next we're going to move to the water session, and so that will include surface and groundwater management, quantity and quality; selenium management; and aquatic resources, including fish, fish habitat, and fish

species at risk.

I'll maybe suggest we take a 15-minute break, our morning break, to let the panel get ready, and then we'll hear direct evidence from Benga. So it's 10:00. We'll come back at 10:15.

(ADJOURNMENT)

Discussion

THE CHAIR: Okay. Go ahead, Mr. Ignasiak, whenever you are ready.

MR. DRUMMOND: Just before that, Mr. Chair.

THE CHAIR: Sure.

MR. DRUMMOND: It's -- it's Robert Drummond from Justice Canada. I did want to raise something to the Court's [sic] attention. This morning the Canadian Science Advisory Secretariat issued a science response in respect of an assessment of the ecological impact of this project on the westslope cutthroat trout. I have sent it off to the Panel manager, Panel counsel, and to counsel for Benga. DFO does not consider this to be new evidence; however, it is a new report synthesizing previously available information, and I wanted to bring it to the Panel's attention. I think we'd seek to enter it as an exhibit because I think it might be useful for the Panel, and I -- I also did not want to cause any unfairness to Benga in respect of this report. And I leave it to the Panel, but I'm -- I

would not object if -- if, say, Benga wished to review this and give further direct evidence as it sees necessary at some subsequent point. But I leave that in the -- in the Panel's hands.

THE CHAIR: Okay. Thank you.

Mr. Ignasiak, have you had a chance to look at this yet, or do you need some time?

MR. IGNASIAK: I just opened it up, sir, and it's a -- it's dense document; it's 23 pages. So if we could just -- and, of course, our experts in this area are currently busy appearing before a panel, so if we could have the day maybe to look at this and get back to you, that would be great.

THE CHAIR: Yeah. That would be fine.

MR. DRUMMOND: Absolutely, sir.

THE CHAIR: Yeah. Report back when you've had a chance to look at it.

Okay. Thank you, Mr. Drummond.

So, Mr. Ignasiak?

MR. IGNASIAK: Yeah. Thank you, Mr. Chair.

So this witness panel for this topic block has some of the usual suspects, so maybe I'll ask them to first just confirm that they still consider themselves under oath or affirmed as the case may be.

So, Mr. Houston, can you confirm that you're still under oath?

GARY HOUSTON, DANE MCCOY, MIKE YOUL, MIKE BARTLETT,
Previously Affirmed

A MR. HOUSTON: I do.

MR. IGNASIAK: Mr. Youl?

A MR. YOUL: I do.

MR. IGNASIAK: Mr. McCoy?

A MR. MCCOY: Sorry. I was on mute. Yes, I do.

MR. IGNASIAK: Mr. Bartlett?

MR. BARTLETT: I do.

MR. IGNASIAK: Okay. Thank you.

And so, Mr. Chair, then the -- the other witnesses who still -- who haven't yet appeared before the Panel as indicated in our letter of October 28 are Mr. Cory Bettles, aquatic resources, with Hatfield Consultants; Mr. David DeForest with aquatic resources, Winward Environmental; Mr. Stephen Day on geochemistry, with SRK Consulting; Ms. Nancy Grainger, hydrogeology, with Millennium EMS Solutions; Dr. Dan Bewley, hydrology, with Hatfield Consultants; Mr. Soren Jensen, hydrology with SRK Consulting; Mr. Martin Davies, surface water quality, with Hatfield Consultants; and Dr. Leif Burge with -- fluvial geomorphologist with Stantec.

So if we could get those individuals sworn or affirmed by the court reporter, Mr. Houston will then

be ready to deliver the opening statement.
CORY BETTLES, DAVID DEFOREST, SOREN JENSEN,
MARTIN DAVIES, LEIF BURGE, Affirmed
STEPHEN DAY, NANCY GRAINGER, Sworn
Direct Evidence of Benga Mining Limited (Water, including surface and groundwater management, quantity and quality, selenium management and aquatic resources, including fish and fish habitat and fish species at risk)

A MR. HOUSTON: So, Mr. Chair, I'm not sure if Dr. Bewley, who was previously before this Panel, reconfirmed that he is still under oath.

MR. IGNASIAK: Yeah. Sorry, Mr. Chair. I failed to recall he's already been in front of the Panel.

DAN BEWLEY, Previously Affirmed

MR. IGNASIAK: So, Dr. Bewley, can you just confirm you're still under -- you consider yourself to be bound by your oath?

A DR. BEWLEY: Yes, I do.

MR. IGNASIAK: All right. So I think that's everyone, Mr. Chair, unless -- unless someone advises otherwise.

Mr. Houston, I think you're free to go.

A MR. HOUSTON: Good morning, Mr. Chair and members of the Joint Review Panel. Water and aquatic

environment are of paramount importance to the successful implementation of any resource project and especially so for the Grassy Mountain Coal Mine.

There are many aspects that I'm sure will be discussed over the coming days, but we would like to focus this morning on two broad topics that seem to define this project. The first is protection and recovery of the westslope cutthroat trout, in particular the Gold Creek stock; and the second is the management and mitigation of selenium.

The westslope cutthroat trout is a species of concern and the fish species of focus for the environmental assessment because of their provincial and federal status in the local study area. Westslope cutthroat trout inhabiting upper Blairmore Creek watershed are defined as a conservation population per the Alberta recovery plan due to hybridization levels with non-native rainbow trout exceeding the 99 percent genetic threshold. Westslope cutthroat trout in Gold Creek are genetically pure and have maintained this status in part because of a man-made barrier that prevents the invasion of rainbow trout. The Gold Creek stock of westslope cutthroat trout is listed in Schedule 1, Part 3 of the federal Species At Risk Act as a threatened species.

Unfortunately, the same barrier that protects the

westslope cutthroat trout in Gold Creek confines the local population to an area of suboptimal habitat. Because of the project and research conducted by Benga, more is known now about this community of westslope cutthroat trout and the limitations of Gold Creek than ever before.

While Gold Creek has been classified as critical habitat per the recovery strategy, it is not good habitat due to multiple existing stressors that are a direct threat to the sustainability and persistence of the local westslope cutthroat trout stock.

Mr. Chair, I would like the Zoom host to pull up Registry Document 89, which is Addendum 8 to the EIA, and to go to PDF page 907.

This is an aerial photo of a section of Gold Creek adjacent to the proposed mine. The yellow line is the original location of Gold Creek prior to flooding events in recent years. The flooding caused the creek to change its path near the historical townsite of Lille.

Now, if the Zoom host could focus in on Photo C, which is the lower photo on the right side of the page.

So the quality's not great in this photo because of the scale, but what it shows at this location on September 14th, 2016, is that there is no water in the creek. The surface water is absent and goes subsurface

and then comes back up to the surface further downstream in the vicinity of the Morin Creek confluence.

Benga has identified two additional areas in Gold Creek where fragmentation like this area has occurred and Gold Creek becomes completely disconnected at key times of the year. At these three known points, the main stem of Gold Creek is braided, runs through treed areas where habitat is extremely poor, and, in fact, westslope cutthroat trout have been observed stranded in disconnected isolated pools that are rapidly running dry.

Mr. Chair, as part of its fisheries offset plan, Benga is proposing to re-establish connectivity for the westslope cutthroat trout so that they can move freely along the entire length of Gold Creek in search of suitable habitat.

I would now like the Zoom host to bring up PDF page 864 in this same document and focus on the graph, please. Yes.

Mr. Chair, this is a graph showing the area weighted suitability of Gold Creek for various life stages of westslope cutthroat trout. Of note on this graph is the dramatically smaller area available for overwintering. Typically, high-quality overwintering habitat for westslope cutthroat trout is comprised of

deep pools that are unlikely to freeze either due to depth or maintenance of suitable conditions through influence of groundwater influx.

And now if the Zoom host could turn to page PDF 867 in the same document.

This is a map of Gold Creek showing the location of potential overwintering habitat along the length of Gold Creek.

If the Zoom host could zoom in on Photo A at the top, we can see another location similar to the one I mentioned on the previous map where the creek is dry during parts of the year. Again, there is no way for trout to cross this barrier to seek appropriate habitat.

Finally, I would ask, Mr. Chair, for the Zoom host to focus in on Photo C on this page and the bottom left corner. This is the man-made weir that was built to supply water to the old town of Frank. This is the lower barrier on Gold Creek that blocks non-native species from swimming upstream, and it is also the barrier that prevents the westslope cutthroat trout from moving downstream to the Crowsnest River.

Zoom Host, you can take these down now.

Mr. Chair, Benga will not directly touch the main stem aquatic habitat of Gold Creek with the proposed mine. In fact, we will maintain a hundred-metre

setback from the creek. As we have discussed in other documents, there will be about a 10 percent decrease in surface flows which results in a modest reduction in aquatic habitat. We have also discussed that the mine footprint will interact with tributaries to Gold Creek and, therefore, will affect riparian habitat.

Benga has proposed to restore Gold Creek habitat in documented areas we have seen and to improve habitat connectivity and overwintering habitat to counterbalance the predicted effects of the project.

As part of the draft fisheries offset plan, an initial estimate of the benefit from this work could offset loss by a factor of approximately nine times. Since then, additional fragmented segments in the Gold Creek have been documented, thus there are other opportunities to provide additional offsetting benefits to westslope cutthroat trout in Gold Creek.

Benga has further proposed to offset the loss of riparian habitat by focus on -- focusing on enhancing previously disturbed riparian areas. Enhancing these currently compromised riparian habitats will benefit westslope cutthroat trout by increasing the capacity of these areas to trap sentiment and filter nutrients and contaminants contained in the surface runoff, provide shade that maintains cool water temperatures, and provide improved habitat for terrestrial insects which

serve as food for juvenile westslope cutthroat trout.

Proposed areas for this work are included in the draft fisheries offset plan, but other candidate areas are available if the size of offsetting needs to be expanded. Buffers of undisturbed riparian habitat will be made -- maintained on creek main stems and tributaries in accordance with the most updated recovery strategies.

In summary, Mr. Chair, the westslope cutthroat trout in Gold Creek are surviving, but they are not thriving. Fish surveys were conducted in 2016 as a basis for the EIA, and follow-up annual surveys have been conducted since that time, producing several years of fish population and habitat data.

We provided annual survey information to CPAWS in response to an information request, and that information was included in the CPAWS submission to the Panel in Registry Document 555. This information has recently been updated with 2020 survey results and has also been filed with the Panel. They were submitted yesterday and are now posted as Registry Document 843.

To summarize the findings for multi-year surveys, observations of westslope cutthroat trout in Gold Creek have decreased dramatically since 2016 and now seem to have a population density that is only 10 to 20 percent as compared to five years ago.

Benga has proposed a fisheries offsetting plan that is intended to replace or counterbalance changes in fish habitat caused by the project and to improve habitat functionality and suitability with focus on improving those limiting factors that have been documented over several years of study.

The proposed habitat registration initiatives are not novel and will help stabilize and sustain the local stock of westslope cutthroat trout. Although certainly not a finalized offset plan, the draft does aim to align with the criteria and conditions set out in the westslope cutthroat trout strategy and Fisheries Act offsetting guidance, and we are confident that the outcome will result in a more resilient stock.

Benga -- Benga fully understands that prior to approval by regulators, including DFO and AER, there needs to be further study and engineering design work completed to develop the current offsetting approach to meet Species At Risk Act and Fishery Act [sic] requirements, and Benga commits to embark on that work immediately following this regulatory review to allow for early implementing of the offsetting proposals.

Turning now to selenium management. We will be focusing on three main issues: capture of contact water, treatment of contact water, and appropriate -- and -- and appropriate site-specific water quality

objective for selenium in Blairmore Creek.

Before I get into these three subjects, Mr. Chair, I will reiterate that contact water, which means water that potentially contains elevated selenium, will be treated and returned to Blairmore Creek. Gold Creek will not be affected.

Now, in terms of capture of contact water, I would like to turn to Registry Document 42, Section A, PDF page 161, if you will, Zoom Host.

This is a topographic map that we discussed with Mr. Fitch a week ago relative to the location of the ex-pit rock dumps.

Could I ask the Zoom host to focus on the top portion of the map and specifically the area labelled "The North Rock Disposal Area". That should be good.

As we discussed with Mr. Fitch, this is an area that is isolated from any cross flow of water and is characterized by steep slopes. We discussed that there is an elevation difference of some 200 metres across this part of the footprint.

Mr. Chair, it is pretty clear that water does not pool in this area today. If a raindrop falls here, it flows down slope and into the small rivulet which runs along the base of this elevated valley and then towards the outlet.

Benga will be utilizing this natural topography to

facilitate capture of the contact water that percolates through the rock dump. We will remove any organic materials, do additional grading to further improve drainage, and construct under-drains in the lower elevations. We will capture the natural drainage from this waste rock in the northwest surge pond, which will be in the same place where water naturally exits the -- the area today. As the dumps are created, the waste rock will be compacted in layers to further encourage water exodus from the waste rock dump.

Our water quality modelling is based on humidity cell tests and regional experience to determine the propensity for selenium leaching from expected mass of waste rock. The model makes the simplifying assumption that 5 percent of the contact water may seep into the groundwater and immediately enter the creeks. The model further assumes that there's no attenuation of seepage or leaching rates with time. All of these assumptions are conservative. Given that, Benga has committed to maximize in-pit storage of waste rock and expects the quantities of ex-pit waste rock storage can be reduced from the quantities assumed for the application. Also, any seepage that does occur will move relatively slowly at the rate of 1 to 2 metres per month, taking a number of decades to reach the creeks.

During the lengthy journey through the groundwater

system, it is possible that selenium content will be attenuated naturally following a biochemical process similar to that which Benga will be managing in the saturated backfill zone, or "SBZ". And, finally, observation of selenium levels at some reclaimed mines has demonstrated a potential for decreasing and leaching of selenium over time. So all of those factors tell us that our assumptions for the EIA in terms of modelling are -- are conservative.

Benga has committed to monitor groundwater down gradient from the dumps to detect if there is significant seepage through the ground -- groundwater. Monitoring will be immediately adjacent to the ex-pit dumps and also adjacent to the receiving environment at Blairmore and Gold Creeks.

Zoom Host, you can take this map down now.

If there are indications that seepage of contact water is greater than predicted by the models, Benga will be alerted by this -- to this early through the monitoring wells adjacent to the ex-pit dumps. If this should occur, Benga will have a number of tools to return to acceptable seepage rates, including installation of seepage capture wells, down gradient from ex-pit dumps -- these are described conceptually in Addendum 5, Appendix A3 -- reducing the quantity of water that infiltrates and percolates through the waste

rock to encourage runoff by implementing more aggressive final slopes and revegetation of the ex-pit dumps; and by promoting selenium reduction within the ex-pit dumps using processes similar to those used within the SBZ.

In summary, Mr. Chair, Benga has proposed a layer -- layered approach to the capture of contact water that will ensure the desired results are achieved.

Now I'm going to turn to contact water treatment.

Mr. Chair, Benga has proposed to treat contact water using a saturated backfill zone, or "SBZ". The process used to remove selenium, anaerobic biological reduction, is not new technology, and we have provided numerous examples of its application in our filings. We have referred several times to the application of this technology by Teck and Elk Valley, which is the closest comparator, including in terms of specific size and operating methodology.

We note that Teck has recently announced on its website that it will be doubling the size of its existing installation, which has been in service since 2017, and that it will be building several more such installations over the coming years. Teck indicates that they prefer the SBZ over other methods for treating selenium and nitrate because they are less

complex to operate, they have lower capital and operating costs, they treat larger volumes of water, use less energy, and they require smaller surface footprints. Benga agrees with this assessment.

Mr. Chair, based on similar technology installed at Teck and other industrial examples, Benga's confident that it will achieve treated water concentrations lower than the 15 micrograms per litre that were used for the project water balance models. Again, we have listed these examples in our various filings on this subject.

We heard the concerns expressed by Ktunaxa on Monday regarding the need to do site-specific field scale tests to properly evaluate the SBZ design and operating parameters for this project. Benga has committed to doing just that and will be implementing a field-scale pilot during the construction phase of the project to develop the necessary engineering parameters required for the final SBZ design.

Mr. Chair, the SBZ is not the only possible solution for treatment of selenium, and Benga has elaborated on the alternative or additional measures of both a treatment plant and a gravel-bled [sic] reactor solution in its IR -- IR responses in Addendum 11. Benga has committed to implementing one or both of these additional technologies in the unlikely event

that the SBZ does not meet expectations.

To be clear, there is room on the site for all of these technologies if necessary.

Again, Mr. Chair, we heard the views of Ktunaxa on Monday that implementation of a selenium water treatment plant could take longer than expected. Benga considers that such an installation would be very similar to the West Line Creek plant that Teck has installed and which appears to be functioning well today. By following the Teck lead on this technology, Benga considers that installation times could be considerably shorter for Grassy Mountain.

Mr. Chair, Benga has proposed a site-specific water quality objective for selenium in Blairmore Creek. In its review of this approach in its filings, ECCC concluded that a sulphate-adjusted guideline for selenate is based on sound science. However, ECCC is concerned that if selenate is not the only selenium species, environmental effects may be greater than predicted.

Benga agrees with ECCC that the proposed site-specific water quality objective is valid and based on sound side -- science, provided that the vast majority of the residual selenium is in the form of selenate. Based on the latest information and results shared by operators of other similar selenium treatment

systems, Benga believes this will be the case.

However, Benga is not merely assuming that the residual selenium will be selenate. Benga has committed to ensure that this will be the case. As stated in response to Information Request 6.20:

(as read)

> Benga will implement advanced oxidation processes with powerful oxidant, like hydrogen peroxide injection, or ozone addition, if necessary, to further the conversion of selenite to selenate.

A recent presentation by Teck on this issue has indicated that a similar process has been successfully implemented at its West Line Creek selenium treatment plant. Therefore, the science behind the site-specific conclusion of no significant effects of predicted selenium levels of up to 9.5 micrograms per litre on aquatic biota in Blairmore Creek is supported.

Additional checks for this range of selenium concentrations being protective in Blairmore Creek have been made, including development of a risk-based selenium bioaccumulation model for Blairmore Creek presented in Registry Document 89. We also compared our findings against a range of existing site-specific in-stream objectives for selenium accepted by regulators for other settings in Western Canada. These

comparator sites, which are summarized in Benga's October 5th filing, Registry Document 571, show permitted selenium objectives downstream of coal or metal mines in British Columbia that are in the 10 to 20 microgram per litre range for smaller streams similar to Blairmore Creek and 3 to 5 micrograms per litre in larger streams similar to Crowsnest River.

Site-specific objectives in rivers draining Elk Valley mines are considerably higher, but these objectives are generally targets for remediation of previously affected streams and, therefore, not directly applicable to our case.

In conclusion, Mr. Chairman, there are many other points for discussion under the heading of "Water and Aquatic Environment". We have addressed all of these in our filings on the registry to date; however, we felt that it would be helpful to have this discussion of westslope cutthroat trout and selenium management in order to set the table for the coming days.

Mr. Chairman, Benga's panel is now available for questions.

THE CHAIR: Thank you, Mr. Houston.

So first up for questions is CPAWS. Mr. Yewchuk.

Mr. Yewchuk Cross-examines Benga Mining Limited

Q MR. YEWCHUK: Hello. Thank you for that opening statement, Mr. Houston. That was a little more

thorough than I thought, so my questions are going to be very fast, but I have some.

I'm counsel for the Canadian Parks and Wilderness Society. I have met some of you before.

I will start. Does Benga accept that the extirpation of the westslope cutthroat trout in Gold Creek would jeopardize the recovery of the species?

A MR. HOUSTON: It would be a setback for sure, Mr. Yewchuk.

Q Maybe a slightly clearer answer? Would it jeopardize the recovery of the species?

A We have -- in Gold Creek, we have an opportunity to -- to develop a -- a population of westslope cutthroat trout that is sustainable, and so I -- I think not taking advantage of that opportunity would be a setback.

Q Thank you.

Mr. Youl, where are you there? There you are. Good to see you again.

On November 6, you mentioned that you won't be storing coal for long periods of time because the coal oxidizes and loses its quality. Do you remember that?

A MR. YOUL: I do.

Q Perfect.

Does the coal heat up as it oxidizes?

A Not normally. It -- in some deposits it can, but from

the observations we've made for our project, it hasn't shown any instances of -- of heating.

Q No heat from the oxidation reduction -- reaction?

A Well, we -- we've -- we've not seen that in our explorations or our test work.

Q Did Benga take a conservative approach for selenium management, or did Benga take a more risk-accepting approach?

A MR. HOUSTON: Mr. Yewchuk, Mr. Chair, there -- there are many elements of our evaluation of selenium that are -- are conservative.

Q Are there some of them that aren't conservative?

A I would say that we've taken a precautionary approach to selenium management.

Q Have all aspects of the approach been precautionary or conservative?

A Well, for example, the development of a site-specific guideline for selenium in Blairmore Creek has been based on a -- a detailed scientific investigation, so that's an area where we saw that we need to go -- we needed to go deeper and have a more precise evaluation of the conditions and -- and so we've done that. So that might be a -- an area where you would say that the very conservative approach was -- was not helpful and -- and that we had to dig deeper.

Q Was not helpful for what?

A Well, it didn't -- I -- I -- I guess in the specific case of selenium guidelines for creeks, the typical guidelines that are -- are prepared for any water body, whether it be a lake or a marsh or whatever, are -- are developed to be conservative in all of those circumstances.

When we took a look at Blairmore Creek, we realized two things. One, that those very conservative across-the-board measures wouldn't be achievable with our project, but we also recognize that there are many factors -- site-specific factors in Blairmore Creek that indicated that a higher level of selenium could be tolerated in that environment due to a number of factors, and so we invested in the science to look at that because, in the end, we want to be protective, but at the same time, an investment in science allows us to be confident that we can be protective and also function at the higher levels of selenium that we're -- we're proposing for this project.

Q Did Benga hire a particular expert because that expert takes a less precautionary approach?

A No. I would say Benga hired experts that we felt were -- were leading the field in this area.

Q Leading the field in taking a precautionary approach or leading the field in taking a risk-tolerant approach?

A Leading the field in terms of having developed a

systematic and scientific basis for evaluating in detail the -- the -- the environment and the capacity of that environment to tolerate selenium levels.

Q When considering other projects for inclusions in the cumulative effects assessment, did Benga consider projects that were officially announced or only announced?

A Could you repeat that question, Mr. Yewchuk? I think the wording is important here.

Q Yes. When considering other projects for inclusion in the cumulative effects assessment, did Benga consider projects that had been officially announced or only announced?

A And -- and are we speaking strictly of water, Mr. Yewchuk, when you're talking about the cumulative effects assessment?

Q I'm focused on water, but, I mean, you can answer in other regards as well.

A So we -- we looked at projects that were reasonably certain to appear, and -- and generally that requires that the project has some definition around it in terms of -- and -- and that generally appears in a formal application to a regulator.

Q So if there was no formal application to a regulator, a project was not considered?

A In general, that's the -- that's the trigger. And --

and, again, it -- it's going to come back to whether a project is sufficiently defined to be included in the -- in the cumulative effects assessment, Number 1; and, Number 2, that there is a reasonable expectation that the -- the developer, if you will, is determined to move to the next step.

MR. YEWCHUK: Can I get Document Number 42? It's Addendum 8, and I want PDF page 375, please.

Q MR. YEWCHUK: And the words "officially announced" appear on the table when it comes up. I just want to know if Benga has any distinction between things that are officially announced and things that are -- are just announced. If you could explain how you draw that distinction.

A So what was the PDF page number?

Q PDF 375. It should be marked "Table 2-1", if I have the right page. It's the first box under "Temporal Boundaries".

A Yeah. So there -- there we talk about projects that have been defined and officially announced.

Q Yeah. And do you draw a distinction between "announced" and "officially announced"?

A It's easy for anybody to say, Hey, I want to build a coal mine, but putting forth -- putting in the effort to do the work, prepare an application, and submit that to the regulator is -- is really a -- a kind of test in

terms of determination to see the project through.
Q At what date would you say Benga was -- Benga officially announced Grassy Mountain?
A It was in 2015.
Q When they -- when you -- Benga submitted the EIA document?
A We -- we submitted a -- a first version in 2015, yes.
Q Okay. That's when you would have considered your project to be officially announced?
A If we were looking at another project at that step, that -- that's what we would look for. And -- and it -- it's not just the announcing the project, but putting some boundaries around it, talking about the -- the area to be affected, the location, the -- the technologies that are expected to be used. There -- there are many things that help to include a project in -- in a cumulative effects assessment that just aren't available if -- if all you know is that I would like to build a coal mine.
Q Is it enough if you know a coal mine has started gathering their baseline information to prepare for the regulatory application?
A No. No.
Q Perfect. Then let's move on.

Does Benga use the terms "saturated backfill zone" and "suboxic saturated fill zone" to refer to the same

structure?
A The saturated backfill zone, I think, would be the more common title that you would see throughout the documentation. The suboxic zone is a more technical description of what we're trying to achieve within the saturated backfill zone.
Q But it -- it would be two terms for the same thing?
A Yes.
Q Okay. Perfect.
What about the term "suboxic saturated treatment zone", is that the same thing again?
A I -- again, yes. And I would take it that you would see those words in a -- in a more technical description of what we're trying to achieve.
Q Okay. What about "saturated rock zone"?
A Again, same thing.
Q Yeah. "Fluidized bed reactor"?
A That would be a different animal. That would be a -- a plant, let's call it -- a plant that you would have in a building with vessels and pipes and pumps, and it -- it would be more like the West Line Creek installation that Teck has implemented for treatment of selenium.
Q What about "gravel bed reactor"?
A Again another technology. Gravel bed reactor is again an engineered structure. Typically you have geomembranes to isolate the water within a rock --

isolate water, and you would have graded rock fill that you would put into that as a medium, and then you would create the suboxic zone inside that engineered structure to remove selenium.

Q So the gravel bed reactor is not the saturated backfill zone?

A A gravel bed reactor is -- uses the same biochemical process, but it would be an engineered structure closer to the surface and separated from the environment by geomembranes, for example.

Q So it's the same approach to some new removal but includes geomembranes?

A Yes. And -- and it's -- yeah, it's -- it's -- it's an engineered structure that, you know, has very -- has standards for size of rock substrate, for example, within the -- within the process, and -- and I think what it does is, with a very much smaller volume, it allows you to treat a similar amount of water as the saturated backfill zone, for example.

Q Does the saturated backfill zone have a particular size of rock substrate used?

A No. No. It's -- it is literally the mine pit that has been backfilled with -- with the waste rock.

Q So just still checking that I know what this thing is. Is the basic idea of a saturated backfill zone to produce a zone of low acidity and neutral oxidation

potential with microbial life that causes the selenium to precipitate out as selenate and remain in the SBZ?

A I'm -- I'm going to ask my -- my colleague, Mr. Jensen -- you are using a lot of long words that I think we need Mr. Jensen to comment on.

A MR. JENSEN: Yeah. I'm happy to comment. Can you hear me okay?

Q Yeah.

A Okay, I'm happy to comment on that. I will ask you if you could please repeat the question.

Q All right. And you can correct my -- my understanding here if I'm off, but is the idea of a saturated backfill zone to produce a zone of low acidity and neutral oxidation potential with microbial life that causes the selenium to precipitate out as selenate and remain in the SBZ?

A No. So there -- there's a number of -- it's a bit of a long definition, but generally that's -- that's not accurate. The -- aside from -- from the end -- selenate is not the end product of the process that occurs within the saturated backfill zone. Selenate is reduced to (INDISCERNIBLE) become selenite that can absorb on to minerals or --

THE COURT REPORTER: I'm sorry. Can I get you to speak up?

A MR. JENSEN: Oh, I apologize.

THE COURT REPORTER: Just repeat that -- repeat the last part, please.

A MR. JENSEN: Yeah. So the process that occurs within a saturated zone is that typically selenate, which is a -- is a dissolved selenium species, becomes reduced to either selenite, which can absorb onto the minerals within the -- the saturated zone, or to elemental selenium, which is a solid, that likewise become trapped within the rock matrix of the saturated rock fill.

The -- whether it's -- I mean, it -- it does occur under neutral conditions. There's no explicit considerations around neutrality. In -- in typical systems like this, there's plenty of -- of buffering capacity that -- that really the acidic or non-acidic considerations are in some ways not terribly important.

It is important that it's -- it's circumneutral, water within the facility, but it's not a specific design primary, typically. I hope that answered your question.

Q Yes. That was wonderful.

Is the SBZ a contingency plan, or is it Benga's initial plan?

A MR. HOUSTON: So, Mr. Yewchuk, the SBZ is our -- our plan. That's what we've proposed in our application.

Q Does Benga have a Plan B if the SBZ does not work out?
A We've -- Mr. Chair, we've explicitly stated a number of times -- I -- I believe I stated in my statement this morning that Benga has committed, if the SBZ doesn't work out, to implement another technology; and we've put a significant amount of detail in our response to IR questions around what -- what a fluidized bed reactor plant, for example, might look like and also what a -- a -- a gravel bed reactor treatment process might look like. And I think I also mentioned that all three of those technologies can fit on the project footprint.
Q Has Benga selected between the gravel bed reactor or the fluidized bed reactor at this point?
A Mr. Chairman, no, we have not. That's -- we've looked at both technologies in some detail. In fact, I believe in one IR we submitted a preliminary design for a gravel bed reactor that -- that would be suitable for this project, but we -- we haven't selected between the two processes, and -- and I think it's premature to do so. We would be talking about an additive process or a parallel process to the proposed saturated backfill zone, and implementation of one or the other contingency plan would -- would kind of be informed by what we were seeing through the treatment results that we were getting from the saturated backfill zone.

Q That -- there was a no, actually; right? You haven't selected between the two of them?
A That's correct.
Q Yeah. That's fine. Perfect.
Okay. So I'm going to use "SBZ" or try to go forward because it's got a lot of names, but now we've established what it is.
A Okay.
Q Is the SBZ, in Benga's view, experimental technology?
A Mr. Chair, what we've stated is that the -- the process -- the underlying process is well-known and well-documented. I think the specific application in -- in terms of flow rates and establishment of operating parameters is relatively new, but it's been in operation at Teck since 2017. So, in one sense, the technology is fairly old and well-understood, but the specific application is -- is relatively new.
Q When would you say the general technology, as you described it, was -- was discovered or first used?
A Again, I'm going to ask Mr. Jensen to -- to take that question.
A MR. JENSEN: Okay. Thank you.
So I'm touching -- the -- the first instance that I'm aware of where this process was used for treatment of selenium dates back to the -- the early 2000s. The application I'm most familiar with of -- of an earlier

implementation is the work that was done in North Carolina by Duke Energy.

THE COURT REPORTER: I'm sorry. You are going to have to speak up.

A MR. JENSEN: Okay. Yeah. I'm not sure what -- maybe I'll -- using my microphone's quite good. Give me a second. I'll just see if I can -- hello?

MS. ARRUDA: Mr. Jensen, it's Elaine Arruda here.

A MR. JENSEN: Okay.

MS. ARRUDA: If you just click the "up" arrow beside your mute and unmute.

A MR. JENSEN: With your permission, maybe I'll just switch headsets real quick here.

MS. ARRUDA: Sure.

A Are you able to hear me better now?

THE COURT REPORTER: Yes. Thank you.

A MR. JENSEN: Okay. Let me just get -- so now I can't hear you. I -- I do apologize for this. I just can't hear the --

Q I will shift ahead to another topic for a moment if Mr. Jensen's headset is in trouble.

Did Benga find all historical mine tunnels on the Grassy Mountain site?

A MR. HOUSTON: Mr. -- Mr. Youl, maybe -- maybe you could talk to that.

A MR. JENSEN: I don't ...

A MR. YOUL: Whether we found all remains to be seen. What we do have are historical maps dating back from the 1950s through the 1960s which show the extraction from the two -- the seams that were mined in those times. We have drilled holes through the area. A few of those holes intersected voids.

But a -- I guess a technique that I was very interested in a few years ago was ground-penetrating radar, and we've used that over part of the initial pit area with considerable success, which has shown the areas that have actually been partially mined. And typically the miners in those days would extract the lower part of the seam with a coal roof because the thickness of the seams was such -- and given the ditch, that -- I think they didn't have the technology or the equipment to extract the full seam. So they mined out a portion of the seam, get to the end of the tunnel or a crosscut, and then retreat and try and remove the remaining sort of coal before the conditions sort of became unsafe.

So we've used that ground-penetrating radar, "GPR", as we call it, to identify areas of primary extraction and also areas where we've seen secondary recovery where sections of the seam have collapsed. So we'll look at increasing the density of that technique

as we move into the detailed short-term planning. But it's showing a lot of promise.

And the final check, if you like, before we start excavating into the old areas is blast-hole drilling that will -- very short space -- closely spaced drill holes, typically 9 metres square approximately, which will give us the last piece of information we need to ensure that we can conduct those operations safely.

Q That was a longer answer than I expected, but that's -- that's fine.

Are there -- does Benga expect there are historical mine tunnels on-site that they haven't found yet?

A We don't expect so. The maps that we have are very detailed and, based on what I've just said, appear to accurately represent, you know, what was recovered. But using the -- the techniques I've described in greater density will help fill in any gaps that remain.

A MR. HOUSTON: Mr. Yewchuk, I believe Mr. Jensen's headset is working now, if -- so I'll leave it to you to go back there when you want to.

Q Perfect. I'm wrapped on that topic, so we go back to you, Mr. Jensen.

Do you remember the question?

A MR. JENSEN: Yes, I do.

And just a sound check. We're good?

THE COURT REPORTER: Yes.

A Perfect. Thank you. I apologize for that.

Yes. As I was describing, the -- the technology or the process specifically -- I mean, it -- in many ways, it -- it's not new. It's a natural process that's been occurring in -- in nature for -- probably since microbes were around, but in the -- in the engineering sense, the anaerobic bioreactor for removing selenium specifically -- the development of that process began in -- in the early 2000s. And as I was stating, the -- the application I'm most familiar with, the early application, is Duke Energy in North Carolina at their Roxboro plant implemented a -- a GE -- a system engineered by GE called "ABMet". That was one of the -- and that was in 2007, I believe. They implemented that after a number of piloting was done. I've been to visit that plant, and it's been operating since. And -- and since then I know Duke Energy has installed a number of these plants, and they're becoming more and more common worldwide.

Now, GE is not the only supplier of these plants. Envirogen is another company that -- that supplies these. And, in fact, now Veolia and most major treatment companies will now offer some version of this precise same process. So it's -- it's becoming more and more well-established, and -- yeah. And I guess

that's my summary of -- of my understanding of -- of the history of -- of the process.

Q When would you say they were first shown to be effective for selenium attenuation?

A Well, I would say -- like I said, I can't give you an exact date, but early -- sort of early -- in the early 2000s, I believe, the -- they became -- like, they were implemented commercially.

Q So did you say the -- the one built by Duke Energy started 2007?

A Yeah, that's correct. Well, that -- that's -- that's just the one I'm most familiar with in the -- in terms of a detailed implementation of it. I've been there. I've visited it. I understand, you know, the process, the -- I've -- I've studied that plant in some detail, so I'm referring to that because that's the one I'm most familiar with.

Q Okay. But there were active ones in the early 2000s that were working properly?

A I believe so.

Q The Duke Energy one that you were describing, did that one work properly?

A Yes.

Q Is Teck a more experienced metallurgical coal mining company than Benga?

A MR. HOUSTON: So, Mr. Chair, I -- I would

say that Teck, particularly in Canada, has a long track record in -- in coal mining; and -- and, as we've discussed, Benga's fairly new on the scene.

Q Has Teck taken what Benga considers to be an adaptive management approach to their selenium problem in the Elk Valley?

A Mr. Chair, I -- I think that Teck is dealing with a -- a selenium issue that originates decades ago at a time when there maybe wasn't a focus on selenium, and -- and they've, as a consequence, been pushed into an area where they have invested a lot of money in research and development of -- of technologies and methodologies for dealing with selenium. But -- but I would say the -- the issue that they're dealing with -- the difficulties they're dealing with are related to projects that were started three and four decades ago.

Q Okay. I didn't see that one actually connect to my question very much, but has -- have they taken an adaptive management approach, in your view?

A I -- I think they are adapting to a situation, and -- and they're doing a lot of good work to look for solutions to an issue, yes.

Q Is there a difference between adaptive management and just adapting?

A You know, I -- I think when we're talking about best practices, Mr. Chair, in an ideal world -- and this is

the case with -- with the Grassy Mountain Mine. You're aware of what the issues might be in advance. You develop a primary conceptual design that is based on conservative assumptions and implementation of -- of known technologies. But you also do a risk assessment to -- to try to understand where there could be issues, and you develop contingency plans.

So I think that's the -- the best description of adaptive management, is to understand the issues, do a proper design, and then also do a risk assessment and develop contingency plans in the -- if -- if things don't work out the way you have planned.

Q Is Teck in the Elk Valley using an SBZ or a fluidized bed reactor?

A They're using both. They have a fluidized bed reactor, the plant installed at West Line Creek, and that is in operation and appears to be functioning well.

They also have what they call -- and this is going to drive you crazy, Mr. Yewchuk, but they call it a "saturated rock fill", and that's what we've called a "saturated backfill zone", which they've been operating since 2017. So they have both technologies installed.

And what's more, they have extensive long-term selenium management plans that look at deploying both of those technologies at additional sites going forward.

Q Do you know why Teck is using both?
A They are planning to use both. As I mentioned in my opening remarks, I think their tendency is to prefer the saturated backfill zones for many of the reasons that I mentioned in my opening remarks.
Q So Teck's saturated rock fill is directly comparable to Benga's proposed SBZ?
A Yes.
Q And their fluidized bed reactor would be comparable to your potential fluidized bed reactor if you went that route because you had problems with the SBZ?
A That's correct.
Q Perfect. I wish these things didn't have so many names.

So the saturated rock fill -- Teck's saturated rock fill, how long has that thing been operating?
A Since 2017.
Q And one of Teck's systems caused a fish kill; right, in about 2018 or so?
A What -- I'm -- I' not sure what you're referring to there.

MR. YEWCHUK: So can I get Addendum 10, Package 5, PDF 498, I believe. And I think this will clarify where I'm going.
A Addendum 10.

MR. YEWCHUK: 498, I believe.

A 498. This is the biblio -- the reference section?
Q MR. YEWCHUK: I've given you the wrong page. I will come back to that later.
So who here was working with Teck on their saturated rock fill -- has been working with Teck on the saturated rock fill? You're sure some experts; right?
A That's correct. Mr. Steve Day has been working with Teck extensively, as well as Mr. Jensen.
Q And Teck now expects their saturated rock fill system to consistently allow them to meet all water quality targets?
A So what I understand, Mr. Chair, is that Teck is satisfied with the results of the water treatment through the saturated rock fill zone, and -- and that -- for that reason, they're proposing to build more of the -- more of the same and larger sizes.
I -- I think in terms of meeting in-stream selenium levels, that -- that's a broader issue. So -- so this particular technology is treating water and delivering the results they're expecting, but whether that in and of itself will be sufficient to meet water quality guidelines, I don't -- I don't think we can say here.
Q Do you know what level of selenium attenuation Teck's system is achieving?

A I think maybe I'll ask Mr. Day to -- to comment on this.
A MR. DAY: Yeah. I'd be happy to do that.
Mr. Yewchuk -- Mr. Yewchuk, you can -- I think the best way to do that is to look at the presentation that -- that Teck gave about this time last year at a conference. And I believe it's in -- I'm going to need some help on the -- the reference.
Can somebody else remind me of what that is? I think it's 5 -- 571, maybe.
But there's a presentation there that Teck gave summarizing the performance of the saturated rock fill that they're operating, and that -- that showed that concentrate -- they can achieve selenium concentrations around about 15 parts per million, and lower at times.
Q Did they have it as a -- a percentage attenuation; right?
A You know, I couldn't -- I couldn't tell you that, actually. I'd have to -- somebody would have to -- somebody else would have to get you -- get that for you. But you could probably -- actually, if you look at that figure -- and I don't know -- maybe it's worth -- Zoom Coordinator, if you could maybe pull up the -- I had a note of this.
UNIDENTIFIED SPEAKER: I think that's --

A MR. BARTLETT: Steve, it's -- Zoom Host, it's -- I believe he's looking for CIAR 503.
A MR. DAY: Yeah. 503, PDF page 42.
Yeah. So here you can see a chart from the -- the presentation that some people at Teck gave. And, Mr. Yewchuk, I don't -- I can't tell you what the attenuation is there, but you can see -- you can see that they have influent concentrations of between a -- I mean up to -- you see up to 200 parts per million. Variable -- and -- and then the effluent concentration you can see down there in the -- the green line at the -- the bottom. So that gives you a sense of the degree of the attenuation.
Q But you -- you can't -- you can't sort out the average attenuation rate from this?
A I -- well, I could. I mean, I -- I just -- I don't have the number for you at this point.
Q You -- you haven't previously calculated or are not aware of what the attenuation rate for this system is?
A I'm not involved in that -- that aspect of the performance monitoring of the -- of the SRF that Teck operate.
Q Does anyone else on the panel happen to know that? Doesn't seem.
So this document you brought up and we are looking at now, is this a peer-reviewed paper?

A This is a presentation at conference proceedings. It is a -- if -- there's a great deal of peer review that goes on to support the -- the operation of the facility.

A MR. HOUSTON: So, Mr. Chair, Mr. Yewchuk, I just wanted to jump in a little bit here. You're mentioning attenuation rate, Mr. Yewchuk. But do I understand you're looking for a percentage removal or something like that?

Q Yes. That was the -- the kind of figure I was seeing in some of the documents that I was hoping to work with.

A Okay. So I'll ask for one of my colleagues to talk to this. But I think what's more appropriate to look at is a -- an effluent concentration of selenium. Because of the process, the natural process tends to reduce the selenium down to a concentration. So talking about a percentage removal, that would be something that's more suitable if we were, you know, installing a filter or something like that.

What's more appropriate would be to talk about the concentration achieved in the effluent. And I think Mr. Jensen can maybe add to that.

A MR. JENSEN: Yeah. That's correct, Mr. Yewchuk and Mr. Chair. It's -- when we look at these systems, it's -- it's -- we have to look at

the -- the process to (INDISCERNIBLE) behind what's going on with -- with the selenate, the reduction. It's not -- it comes down to -- once the conditions are present such that you can achieve reduction of these species and you can have them either absorb a selenite, or a metal selenium, or some other selenium -- reactive selenium species that will absorb into the matrix.

Those conditions persist same way if you have a 200 -- 200-degree hard -- a 200-degree Celsius part. You simply wouldn't have any -- over time you wouldn't have any liquid water left in there 'cause the conditions are such that now it will all evaporate.

When it comes to the very low limit of -- of concentrations -- when we're talking 15 parts per billion or less, there's some other mechanisms that come into play, and it's -- you know, I think I will go into a -- into too much of a rabbit hole if I go into it here.

But simply thinking of it as a simple percent removal is -- is not a sufficient description of a system like this.

Q So based on the table we are looking at now, what amount of selenium in micrograms per litre comes out of Teck's system?

A MR. HOUSTON: Mr. Chair, it's in the order of 10.

Q Do you know if Teck -- sorry, I'll take a word that we agreed on. Their saturated rock fill system has biofouling problems since it started operating?

THE COURT REPORTER: Sorry, could you repeat that word, please?

Q MR. YEWCHUK: Has Teck's saturated rock fill system had biofouling problems since it started operating?

A MR. JENSEN: I would say, Mr. Yewchuk, not to my knowledge.

Q So you just don't know?

A That's correct. I mean, not to my knowledge.

MR. YEWCHUK: Trying to get a document up here. Can I get Number 313? This is Addendum 11 at PDF page 220.

Q MR. YEWCHUK: While we're waiting for that, does Benga have a --

A Excuse me. I'm sorry, Mr. Yewchuk, to interrupt. I'm being informed by my colleague they indeed have had some -- some biofouling incidents. I'm not aware of those, though, so ...

My statement stands "not to my knowledge", but it doesn't mean it didn't happen.

Q So which of your colleagues knew about that?

A MR. DAY: It's me, Mr. Yewchuk, Stephen Day. They -- I wouldn't say it's been a

problem. They have had to manage biofouling.

Q Okay. So did Benga have a plan to deal with biofouling?

A MR. HOUSTON: Yeah. No, Mr. Chair, we've proposed to do a pilot test, you know, once we get an approval and get on to the site, so that we can clear an area and commence a pilot test. And the intent of that pilot test would be to evaluate things such as rates and carbon demand and the propensity for -- for things like biofouling.

Again, some of these issues have been encountered by other companies working with this technology, and -- and issues have been managed.

Q So what does the system need to deal with potential biofouling? Mr. Day, do you have any idea since you're aware of this?

A I think Mr. Jensen has -- has some ideas to share with us, Mr. Yewchuk.

A MR. JENSEN: Yeah. So biofouling, it's a well-known phenomenon when it comes to these types of systems, and it -- biofouling really -- what it refers to is the build-up of biomass. So as these material microorganisms, as they multiply, they form what we refer to as a "biomass", which is nothing more than a collection of -- of cells that it's -- the system is -- requires that these cells thrive and grow; and as they

do, they tend to fill out void spaces. So it's being dealt with in -- in different ways for different systems.

In the -- in the active water treatment systems and fluidized bed you have constant purging of these -- of this biofouling. In gravel bed reactors that Mr. Houston described earlier, you -- you employ different strategies for -- for managing biofouling. One is to inject your feed water at different locations and cycle through different locations so you allow biomass to flourish, and then die back.

You can -- you can pace your -- the addition of your carbon source at different rates. So instead of having a constant drip of methanol, say, into a specific intake, you send in a slug of methanol. And what that does in the immediate vicinity of your injection point it might kill off, for lack of a better word, because of high concentration some of the biomass, so you prevent -- and then once you have attained more dilution downstream, you now have the appropriate conditions for the microbe to thrive.

So there's many -- it's a well-known problem. It's an engineering -- it's an engineering problem from a process engineering point of view, and it's -- there's many different approaches to managing it. So it's -- it's -- I would say it's well-understood.

Q Does Benga know what approach they will take to deal with biofouling?
A MR. HOUSTON: Not at this point, Mr. Chair.
Q Does Benga have an estimate of how much work -- how much it will cost to deal with biofouling in the SBZ per year?
A Mr. Chair, I think you've just heard Mr. Jensen talk about some of the various processes or methods to deal with biofouling. None of those are really things that would generate a cost that is not within, you know, a margin of error.
Q Mr. Jensen, is that correct, this work is within a margin of error, cheap?
A MR. JENSEN: Yeah. That's absolutely correct. It's an integral part of the design, so it's not -- it's already anticipated, and it will be built into a design from Day 1. It's -- it's not an addition.
Q And how long does the biofouling treatment need to go on for the saturated backfill zone?
A MR. HOUSTON: Mr. Chair, this is something that will be an ongoing part of the process. Again, we'll develop parameters in the full-scale field test to inform the engineering design of the SBZ, and that design will incorporate procedures and design aspects that are intended to deal with biofouling. But it's --

it's an aspect of the process that will be dealt with on an ongoing basis.

Q I think I may have asked this one, but just checking: Will the rock for the SBZ be crushed to uniform size before being placed into the SBZ?

A No, Mr. Chair, it will be the regular backfill that we use to backfill the mine pit.

Q Is there any risk the saturated backfill zone will convert the selenium into more dangerous selenium species?

A So my understanding, Mr. Chair, is that other operators haven't seen that. I think it's important to understand the difference between the fluidized bed reactor, for example, and the saturated rock -- saturated backfill zone.

The fluidized bed reactor is designed to treat as much water as possible in the smallest space in time as possible, and that, by its very nature, can -- can lead to not -- not a full reduction of the selenium to the -- the base state.

When we're talking about a saturated backfill zone, we're talking about a very slow process that operates over months instead of hours, and for that reason there is time for the selenium species to fully -- reduce to species or elemental selenium that will be deposited and filtered through the rock

substrate.
Q What does Benga expect to inject into the saturated backfill zone to keep it functioning?
A In terms of a carbon donor; is that what you are talking about, Mr. Yewchuk?
Q What does it need?
A A carbon donor. So typically you would use something like methanol, or molasses, or another simple hydrocarbon as to -- as a carbon donor. And that drives the low oxygen levels that we're looking for, Mr. Yewchuk.
Q Thank you.
Does it need anything else in order to operate?
A So possibly. Possibly. Especially to -- to get the initial biological mass to -- to generate. We may -- may consider injecting other things like perhaps nitrates to -- to encourage that -- that mass to develop quickly.
Q Does the saturated backfill zone need any acid?
A MR. JENSEN: No. No acid is required, Mr. Yewchuk.
Q Does the saturated backfill zone produce waste residuals?
A MR. HOUSTON: Can you tell us what you mean by "waste residuals"?
Q Does it produce a sludge?

A Mr. Chair, the saturated backfill zone is ultimately when -- at full build-out is a huge space, and -- and the space between the rocks, if you will, is -- has an enormous capacity to absorb and filter any -- anything like sludge that -- that may be generated by the biological activity, so we wouldn't be removing any sludge.

MR. YEWCHUK: Could I get what I believe is Number 251, this is Addendum 10. I want Package 5, at the bottom of PDF page 50. And can I just scroll to the bottom of this page, please.

Q MR. YEWCHUK: So based on those last two paragraphs, I was expecting you to say you needed glycolic acid and phosphate. Has that changed?

A So this -- -- this. Maybe I'll ask my colleague Mr. Day to speak to this.

A MR. DAY: Sorry, could you repeat the question, please?

Q So I had asked you what you need to inject in the saturated backfill zone to keep this thing working. Are you going to need to add glycolic acid and phosphate?

A I am not aware of the need for glycolic acid, and I -- and I -- okay, let's -- let's just think about the process you need to get for -- so a full-scale operation of this facility.

There's going to be a bunch of lab testing. There's going to be pilot-scale testing and not -- and a whole bunch of -- kind of studies that go on to support getting this thing going. And so it's -- and it's possible you may need to add some things to help the bacteria to do their -- to do their work, but I don't think that's been determined yet for this -- this facility.

Does that help?

Q Kind of.

So in that last paragraph it mentions Teck indicated that phosphate was a required additive at the Line Creek operation. You see that; right?

A Yes, I do. Yeah.

Q Is the Line Creek operation the saturated rock fill or is that the fluidized bed reactor?

A That's the fluidized bed reactor.

Q So -- and the sentence before that refers to the saturated backfill zone?

A MR. HOUSTON: So maybe I can help here, Mr. Yewchuk. We refer to the chemicals injected at the Line Creek operation as a possible requirement to inject into the saturated backfill zone. But as Mr. Day mentioned, we have to go through a lot of testing in the -- to inform the design.

And this is just an example of what has been

required at the fluid -- in the fluidized bed reactor process, which -- which, as I mentioned, is -- is the same biochemical process but operating on a different scale in terms of size and speed.

Q So the -- Teck's initial plan is to saturate the backfill zone, and then their two secondary plans would be the gravel bed reactor and then the fluidized bed reactor?

A Mr. Yewchuk, you mentioned "Teck". I think you meant Benga. And, yes, that's correct.

Q Yes. Thank you.

Those all use basically the same process?

A That's correct.

Q Okay. What if that process doesn't turn out to work, do you have another plan?

A Mr. Yewchuk, as Mr. Jensen mentioned, the process is well-understood. The chemistry and biology is well-understood, and there are dozens, if not -- well, there are dozens of plants and applications of the process in operation at other mines.

So, you know, I don't think it helps us to have a hypothetical question: What if -- what if it doesn't work?

Q Okay. So the first one of these that was working was in 2007?

A That's -- that's the one that Mr. Jensen was familiar

with.
Q It's slightly later than that; early 2000s?
A Yes.
Q Right. And Teck didn't build one until 2017?
A A fluidized bed reactor?
Q The saturated backfill zones?
A Okay. So, again, we're -- we're mix -- we're mixing up applications of the technology and the technology itself but ...

So I believe Teck first started working on a -- their fluidized bed reactor in 2015, perhaps, with the design. But the saturated backfill zone, again -- I know they started working on this, and Mr. Day could probably help with the exact time, but they -- they worked on a number of preliminary pilot tests, laboratory tests. So they would have been working on that -- the development of the concept two or three years in advance of 2017, before they first got their saturated rock fill up and running.

Q So how was the Duke Energy plan that Mr. Jensen is familiar with different from what Teck built in 2017?
A MR. JENSEN: Just a couple of -- Mr. Yewchuk, a couple of, I would say, minor differences. The process is essentially the same. Duke, as I -- as I said, they -- they use an ABMet process, which is a packed bed. It's a -- it's a bed

of -- it's a packed bed made of granular-activated carbon that is very high surface area.

The fluidized bed reactor is fundamentally different in that it fluidizes. It's a different mass transfer-type reactor. So -- but, you know, ultimately, the process is -- is much the same.

And if I may add, I mean, the -- this is more related to your previous question, which is: When was this first realized as an engineered solution? It really went hand in hand with the recognition of selenium as a problem. That had -- that wasn't terribly well-understood until -- I don't want to put an exact date on it, but it was -- it was an awareness that grew, I'd say, from the '90s into the 2000s; and once it was understood what the potential was, that's when technologies were developed to address it.

I will say that it's the exact same process that's been used for decades to -- to address nitrate contamination. You know, that -- and that -- at least that dates back to the '70s and '80s when you would inject in situ carbon sources into the subsurface to achieve the exact same thing. At the time it was -- it was to remove nitrate. But functionally, there's no difference in -- in the -- in what sort of process was used.

So, in part, it comes down to understanding what

the problem is before you go and develop a solution.
Q So the risks of selenium weren't known until the early '90s?
A MR. DAVIES: May -- Mr. Yewchuk, it's Martin Davies here. I can take this question.

My understanding of it is that the -- the awareness of selenium as -- as an issue in the environment, you know, it built through probably the 1970s, but its awareness -- a broader awareness of it in the mining industry as a -- as a potential concern, to my awareness anyway in Canada, really started in the 1990s.

Q So the selenium problem was discovered in the '70s and the mining industry didn't worry about it until the 1990s?
A MR. HOUSTON: So, Mr. Chair, I don't think we should put the mining industry into the -- into the corner here.

I think, you know, as -- as society, regulators, environmentalists, mining companies, and other industries as well, were all -- were all learning about the stuff at about the same time.

Q It sounded like I was just told that environmentalists knew in the 1970s and then the mining industry didn't do anything until the 1990s. I mean, that could -- not like the same time, Mr. Houston. That sounds like

20 years.

A So I -- I'm trying not to put people in categories or groups in categories, Mr. Chair. I think that recognizing the problem, understanding the problem, developing solutions for -- for the problem, those things all happen along a time frame, and we're all playing our parts in that development.

Q Does anyone know when a guy named Dennis Lemley discovered selenium was a problem?

A MR. DAVIES: Yeah. Mr. Yewchuk, this is -- his were some of the most -- some of the original papers looking at this, and this is in the 1970s.

Q Okay. So back to the SBZ. When can the SBZ be removed from the project footprint, or when does Benga plan to have it removed?

A MR. HOUSTON: Mr. Chair, the SBZ is fundamentally the pit shell that has been backfilled with rock. The surface will be reclaimed, as we discussed last week. And the -- the pit will always be full of water because the natural groundwater table will -- will rise after -- after mining is -- and dewatering are -- are stopped. So the pit will always be full of water. It will always be full of rock that has been broken, and it's now submerged with water.

When -- when will the SBZ cease to be actively managed? That will depend on when monitoring

demonstrates that the -- effluent from the SBZ because the -- the water will forever decant through the mine pit. It will -- it will come into the mine pit due to precipitation, and it will decant from the lower levels of the mine pit out into the environment.

So when monitoring shows that process, that flow through the mine pit is delivering water that is -- meets -- meets downstream requirements, then we can stop actively managing and monitoring the SBZ.

Q This was probably stated before, but do you have a guess as to when that would be? When that modelling ... (INDISCERNIBLE).

A Mr. Chair, that's one of the issues that we don't have a good handle on. And, again, it's due to perhaps not having enough years of case studies that -- that will tell us how this is going to turn out or how long it's going to take for -- for us to achieve that. And so it's something that we can't be definite on.

Q So the longest anybody's ever run one of these things is three years?

A In terms of the SBZ, yes.

Q Where does the selenium end up when it's removed from the water in the SBZ?

A Mr. Chair, the selenium will revert primarily to selenite, which has an affinity -- and will get caught up in the rock matrix. Or elemental selenium, which

again will deposit in the rock matrix.

And as I mentioned before, one of the benefits of this approach is that the backfilled rock in the -- in the SBZ or in the mined-out pit acts as a huge filter for these less soluble forms of selenium.

Q So where is the selenium as --

A The selenium -- the selenium -- Mr. Chair, the selenium originates in the rock. It leaches out of the rock primarily in the ex-pit rock dumps, and it goes back into the rock. It -- it attaches to the broken rock in the mined-out pit or gets caught up in the biological network that develops there. So it -- it stays in the mined-out pit.

Q Is the mined-out pit -- that's not the mine pit, that's the saturated backfill zone?

A In the end, Mr. Chair, obviously, the entire mined-out pit becomes part of the saturated backfill zone.

Q Sorry, the -- not the mine pit; right?

A The mine pit.

Q The mine pit --

A That's correct.

Q -- becomes a giant saturated backfill zone?

A Yes. It's a -- it's a huge -- it's a huge treatment facility, yes.

Q Isn't the end-pit lake on the mine pit?

A So I -- yes, you're right, and that's not part of the

saturated backfill zone.

But the end-pit lake ultimately will decant into the -- the rest of the mined-out pit and flow downstream through what is planned to be a saturated backfill zone.

Q I don't think I fully realized that.

So the saturated backfill zone stops being actively managed, but it's there forever?

A Yes.

Q Okay. And is the selenium in the rock in the saturated backfill zone?

A It's -- it's in a submerged part of the mine pit.

So, Mr. Chair, I think we all appreciate that while we're mining, we're actively pumping out of the mine pit to lower the groundwater table, and that's so that, obviously, we don't get our feet wet.

Once we stop mining, we stop pumping, and the level in the entire mine pit, the groundwater level, rises to a natural level, and so the majority of the rock in the mined-out pit will be below water. And, yes, you can consider that all part of the ultimate saturated backfill zone.

Q If there's some kind of landslide or earthquake disturbance in, say, 400 years, would the selenium release out of the saturated backfill zone?

A I can't picture that.

Q As in it won't happen, or you just can't imagine that far ahead? I don't understand the --
A Well, I can't imagine the earth rising up, the rock being spewed out onto the landscape, and the water disappearing. I mean, it -- this is not a highly seismic zone. And I guess, yeah, you can -- you can look at the landscape and know that that kind of event hasn't happened in millennia.
Q So it -- I'll think of something else here.

So if anything happens to disturb the saturated backfill zone at any point in the future, would the selenium come back out?
A Mr. Chair, the -- the only thing that -- we've tossed this around. The only thing that we can imagine that would do that would be if somebody came in and decided they wanted to re-mine the pit. Obviously, they wouldn't be looking for coal at that point because the coal would be gone, but they -- if they wanted to re-mine the pit for some other reason. And I would suggest if somebody were to do that, they -- they would have to determine how they're going to deal with the -- the selenium at that point in time.

I -- I can't imagine another scenario where, you know, the -- the groundwater table was -- would magically disappear. I can't imagine it.
Q So Benga expects the mine site to be seismically stable

forever?
A It is seismically stable. It has been for millennia. I -- I think that's a reasonable projection.
Q So yes?
A Yes.
Q Perfect.
THE CHAIR: Mr. Yewchuk, just let you know it's about noon, so whenever is a good time for you, we could take our lunch break.
MR. YEWCHUK: Now works just fine. Thank you, Mr. Chair.
THE CHAIR: Okay. It's just a little after 12:00, so let's resume at 1:00. Thank you.

PROCEEDINGS ADJOURNED UNTIL 1:00 PM

Proceedings Taken via Remote Video

November 16, 2020		Afternoon Session
A. Bolton		The Chair
D. O'Gorman		Hearing Commissioner
H. Matthews		Hearing Commissioner
M. LaCasse		AER Counsel
B. Kapel Holden		AER Counsel
K. Lambrecht, QC		Joint Review Panel Secretariat Counsel
T. Utting		IAAC Staff
E. Arruda		AER Staff
D. Campbell		AER Staff
T. Turner		AER Staff
T. Wheaton		AER Staff
A. Shukalkina		AER Staff
M. Ignasiak C. Brinker		For Benga Mining Limited
R. Warden T. Howard		For Ktunaxa Nation

K. Poitras	For Métis Nation of Alberta Region 3
Chief B. Cote	For Shuswap Indian Band
B. Snow	For Stoney Nakoda Nations
R. Drummond S. McHugh	For Government of Canada
A. Gulamhusein	For Municipality of Crowsnest Pass
M. Niven, QC R. Barata J. Nijjer (Student-at-Law)	For MD of Ranchland No. 66
B. McGillivray	For Town of Pincher Creek
D. Yewchuk	For Canadian Parks and Wilderness Society, Southern Alberta Chapter
R. Secord I. Okoye	For Coalition of Alberta Wilderness Association, Grassy Mountain Group, Berdina Farms

		Ltd., Donkersgoed Feeder Limited, Sun Cured Alfalfa Cubes Inc., and Vern Emard
	R. Cooke	For Crowsnest Conservation Society
	G. Fitch, QC C. Agudelo	For Livingstone Landowners Group
	M. Sawyer	For Timberwolf Wilderness Society and Mike Judd
	(No Counsel)	For Barbara Janusz
	(No Counsel)	For Jim Rennie
	S. Elmeligi A. Morehouse S. Milligan M. Boyce	For Alberta Chapter of the Wildlife Society and the Canadian Section of the Wilderness Society
	J. Gourlay-Vallance	For Eco-Elders for Climate Action
	L. Peterson	For Trout Unlimited Canada

R. Campbell	For Coal Association of Canada
(No Counsel)	For Alistair Des Moulins
(No Counsel)	For David McIntyre
(No Counsel)	For Fred Bradley
(No Counsel)	For Gail Des Moulins
(No Counsel)	For Ken Allred
(Not Present)	
(No Counsel)	For Monica Field
S. Frank	For Oldman Watershed Council
A. Hurly	
C. Forster, CSR(A)	Official Court Reporter

(PROCEEDINGS COMMENCED AT 1:01 PM)

GARY HOUSTON, DANE MCCOY, MIKE YOUL, MIKE BARTLETT, CORY BETTLES, DAVID DEFOREST, SOREN JENSEN, MARTIN DAVIES, LEIF BURGE, DAN BEWLEY, Previously Affirmed

STEPHEN DAY, NANCY GRAINGER, Previously Sworn

THE CHAIR: Okay. Welcome come back, everyone.

Mr. Yewchuk, you can continue.

Mr. Yewchuk Cross-examines Benga Mining Limited

MR. YEWCHUK: Perfect. So can I start with Addendum 10, Package 5 again on the screen?

Q MR. YEWCHUK: And while that comes up, I wanted to double-check something about the addition of acid to saturated backfill zone. Will that not be happening -- will be happening, or are you yet not sure?

A MR. HOUSTON: We don't believe it'll be necessary, Mr. Yewchuk.

Q Okay. What method will you be using to deal with biofouling if it occurs?

A I -- I think Mr. Jensen mentioned a couple of other methods. One -- one was to introduce a slug of methanol instead of a -- a -- a measured amount. What that would do was kill the biological material around the input.

The other method -- I think that was the -- the primary method he mentioned. The other method was to have multiple inlets, wells so that you could cycle between them, and -- and that's been shown to help reduce the problem of biofouling.

MR. YEWCHUK: And can I get PDF page 36 on

the bottom of the page? Oh, sorry. 35. Bottom. So just up a little bit. My PDF counter is working slightly -- there you go. So this one.

Q MR. YEWCHUK: Can Benga confirm that they were asked to provide examples of saturated backfill zones with this question?

A MR. HOUSTON: So we were asked to provide -- to -- to be complete -- a -- a detailed summary of case studies that have been completed and that investigate selenium attenuation in saturated backfill zones in British Columbia and elsewhere.

Q Great. Okay.

MR. YEWCHUK: And can we go down to PDF page 39, I think, the bottom of the page. It is -- no, it's 38, bottom of the page. I'm having the same problem I was earlier. So just up a little bit.

Q MR. YEWCHUK: And is Example E of the saturated backfill zone a fluidized bed reactor?

A MR. HOUSTON: So it's a -- it's an example of using the same biochemical technology in a fluidized bed reactor. But, to be clear, what was asked was to show any case studies, including laboratory tests or -- or scale pilot tests, that pertain to the saturated backfill zone technology.

Q Well, you just read it, and I think you -- I don't think it had the word "pertained" there, but ...

A Yeah. I -- I didn't read the first sentence of the question, which -- which talks about case studies and laboratory analysis.
Q Do you want to go back up and read it, or do you -- do you --
A If it's helpful.
Q Okay. So let's -- let's go back up to that page. I believe it was bottom of 35.
A So you see the brackets where it says: (as read)

> ... including small-scale laboratory tests or other large-scale pilot projects.

Q Yeah. And if you read: (as read)

> ... that have been completed and that investigate selenium attenuation in saturated backfill zones in British Columbia and elsewhere.

A So -- so the -- the Case Study E does pertain to the same biochemical process that we're using in the saturated backfill zone.
Q Okay. So you consider the -- the FBR to be close enough that it's useful for this purpose?
A I -- I think it inform -- it -- you know, it's informative. It's helpful.
Q All right.
MR. YEWCHUK: And can I get PDF page 37? I'm looking for Example B.

Q MR. YEWCHUK: Now, the -- the last sentence in paragraph, for example, (b), can you just read that to me?
A MR. HOUSTON: Example B, there's three paragraphs. The first paragraphs [sic]?
Q Yes.
A (as read)

> The columns were filled with fine coal rejects from the mine with an average particle size of approximately 1 millimetre.

Q Okay. Is an average particle size a gravel bed reactor, or is that a saturated backfill zone?
A This is a laboratory test. When it talks about six column bioreactors, that -- that's a laboratory setup to investigate aspects of the -- again, the same biochemical process that we're talking about.
Q Is this column test for a gravel bed reactor or for a saturated backfill zone?
A It could be for either. Again, we're -- you're testing rates of reaction, effects of -- I'm not exactly sure what they're testing for here, but you could test for rates of reaction, resistance to cold weather. I mean, you could test many parameters that help to inform further field-scale pilot tests or -- or a full-scale installation.
Q Are the saturated backfill zone, the fluidized bed

reactor, and the gravel bed reactor very similar technologies?

A The -- the basic biochemical reactions are -- are the same. The differences lie in the rate of water treatment and -- and -- well, a -- a number of other factors. But, basically, as you go from the water plant -- water treatment plant, which is in a building with vessels, you're -- you're talking about moving water through a lot more quickly, and -- and for that you need to have higher state of engineering.

For the gravel bed reactor, it's a -- a little bit less quick, but still, compared to the saturated backfill zone, a fast process. And so engineering is required to achieve that.

And then the saturated backfill zone, as we've talked about, is quite a slow process in terms of taking months as opposed to hours or days.

Q So Teck's three plans -- first, second, and third plans to control selenium are -- are just variances of the same thing?

A It's the same basic biochemical reaction, yes.

Q Do FBRs have a problem where they produce sludge? The "FBR" being the fluidized backfill zone [sic]. I'm switching to "FBR".

A Yeah. And that's because the reaction's taking place in -- in a vessel. And because of the volume of water

that's going through a small place, you -- you need to have time in the process to remove the build-up of sludge and -- and dispose of it.

Q Do saturated backfill zones produce sludge?

A So they'll produce the same biological mass. The difference is the enormous space that's in the saturated backfill zone. And so that enormous space allows for the development of sludge, and it's -- it's -- actually becomes part of the treatment, if you will. But it remains in situ.

Q Is the saturated backfill zone just going to take longer to fill up with sludge because it's bigger?

A I think the dimension of the -- you know, the -- the scale is -- is orders of magnitude bigger, and I think -- I think that what you'll find is that the -- the sludge, which is primarily biological material, has a finite volume.

Q Why?

A Because it's based on how much selenium you feed in. The selenium is the food, if you will, for the -- for the biological material. Selenium and nitrates, both of them.

So that's the food for the biological material. And when you run out of food, the -- the growth slows. And so as you move further and further away from the inlet on the -- at -- in the saturated backfill,

your -- your degree of biological material is going to be less.

If you will, let me just consult with my colleagues here. I think we may want to add something here.

So Mr. Jensen's going to add a bit of colour to what I just said.

A MR. JENSEN: Yeah. So, I mean, it's biological the -- they go through a life cycle, the -- the microorganisms that develop within a -- within a saturated backfill or really anywhere, and part of that -- part of that cycle is you have initial growth; then you have a period, generally speaking, where it's sustained. And then it dies off.

So you keep going -- in -- in effect, the biomass will cycle itself within the -- within the biomass. So that's one of the things we are hoping to -- not hoping to -- we do achieve by switching feed wells, is that if you inject your feed and interwell for a certain amount of time, we expect it to foul up with biomass. What we then achieve by switching to a new well and operating that for a while is that the biomass no longer gets sustained by incoming nutrients. So it'll die back and, in fact, contribute to electron donors or carbon in and of itself. It'll help to keep that -- the reducing conditions reducing. The -- much the same way

we don't want phosphates and other things going into lakes 'cause then you get a lot of algae bloom. That algae bloom sinks to the bottom, and it starts to decay. I'm sure that process is familiar to some.

That decay -- so lakes don't just fill up with biomass. And, you know, in the end of -- and all of a sudden they're not lakes anymore. Wetlands might. But most lakes don't, and that's because it gets recycled. So it's much the same process.

Q But some lakes do?

A Yeah, some lakes do.

Q That would be the algae bloom-type example you just gave; right?

A No. No. I mean, when they do, it's -- it's hydraulically controlled. It's -- that -- that's when it turns into a wetland. And even wetlands don't grow into the sky. Like, they -- they have their own recirculation of -- of organic material that -- you know, cycles of growth and decomposition that they, too, attain a steady state. I hope that makes sense.

Q Does Benga expect the SBZ to have a 99 percent attenuation rate?

A MR. HOUSTON: So what we talked about earlier this morning was that we expect the SBZ to produce an effluent that has less than 15 micrograms per litre of selenium.

Q So that was 15?
A 15 micrograms per litre. That's -- that's a -- a conservative estimate of what the performance will be.
Q Okay. As a percentage attenuation rate, what is that?
A Yeah. It -- we talked about this this morning as well. Mr. Chair, percentage attenuation rate is -- is more appropriate for a filtration system. And -- and I know at one point in our -- our documents we -- we talked about that. But the more -- more appropriate use -- the more appropriate definition of "performance" is to talk about what the expected effluent concentration of selenium will be at a maximum, and that's 15 micrograms per litre.
Q Can you just look at the page we already have up and the second paragraph under selenium attenuation Example B, the last sentence of the second --
A M-hm.
Q -- paragraph there, an average removal rate of 97 percent?
A Yes.
Q Okay. So if I -- if I try to take you through your documents to show you all the places you refer to attenuation rates and removal rates, would that take us the rest of the day?
A I -- I know it -- it -- it is a way we use to talk about it, and that's sometimes a function of the way

the laboratory tests are -- are set up.

What -- what we've understood is that the -- if -- the attenuation rate or the percentage reduction has very little to do with how we should be measuring the success of this process. It's -- it's very much related to the -- the concentration of the effluent.

And -- and that goes back to the -- the idea that -- our understanding that this is -- the SBZ is -- is a huge reactor compared to, say, this column test that you're looking at here. So it's a huge reactor. There's months of time. And so achieving that -- that lower level of performance or that -- that level of performance that we're expecting is -- is -- is really dependent on the end limits of the process as opposed to the -- the space and time that's available.

Q Does Benga think it's going to be easier to run the enormous outdoor SBZ than it is to run these column tests?

A Well, the column tests -- so when we're talking about a "column", these -- these columns might be -- I don't have the specifics here, but they might be, say, 8 inches or 10 inches in diameter and 2 or 3 feet tall. So they're -- at least the column tests I'm familiar with are -- are of that size. So it -- it's quite a different thing when you're talking about running them.

MR. YEWCHUK: So -- here. Can I get

Document Number 555, PDF page 48 -- 84, please. Page 84, sorry. And I think this will just illustrate what we're talking about.

A MR. HOUSTON: 555?

MR. YEWCHUK: PDF page 84. Maybe go down one. This is not exactly page I want.

A MR. HOUSTON: Are you looking for the picture?

Q MR. HOUSTON: Yeah. That's the one.

A Yeah.

Q There it is. 87.

A 87. Okay.

Q So this is what a column test looks like; right?

A Yeah. That's right. It's a laboratory experiment.

Q How large is the planned saturated backfill zone?

A Well, as we've talked about, it gets built up in phases. But at the ultimate extent, it's virtually the entire mine pit.

Q Did the column test that we are looking at right now meet the selenium attenuation expectations that Benga had?

A So, Mr. Chair, we're -- we're using these column tests to test the -- the behaviour of the biochemical reaction (a) with the specific materials from the -- the site, and -- and (b) as they react to changing levels of selenium input, nitrates, temperature. So

we're -- we're not intending to achieve the 15 micrograms per litre in -- in these column tests. We're -- we're really looking to see how the process varies with variation in input parameters.

Q So the point of these tests is not to show that the SBZ or -- or GRB technology or whatever actually works? That's not the point?

A It's -- it's to -- we -- we know the technology works, and -- and so what we're trying to do is understand, from an engineering design parameter point of view, how the process varies with -- with changes in input parameters.

Q Now, in the column test that we are looking at now, was the selenium precipitated out as expected, or did it remain suspended in the water?

A Again, this is a very short column test. The -- the selenium's moving through at a fairly -- or the -- the -- the water with the selenium is moving through fairly rapidly, and so what we're looking for are rates of -- of reduction under varying input conditions. And -- and it's those rates of reduction that we're -- we're looking at to see how does the biochemical reaction accelerate or -- or slow down or react to changes in the amount of methanol, for example, that's put in, or the temperature -- ambient temperature of -- of the process.

Q Okay. So for this test -- and I'd like an answer from Soren Jensen. You actually ran this test; right?
A No. No, Soren didn't run this test.
Q Who did?
A It was Geosyntec, another consultant.
Q Okay.
MR. YEWCHUK: Can I get Document Number 571, PDF page 21? This is Benga's response, I hope. I'm having a rough time with these today.
A MR. HOUSTON: What is the PDF page, please?
Q MR. YEWCHUK: 21.
A 21.
Q Bottom of 21. I think that should be it.
A Yeah.
Q These are the selenium limit comparisons you -- you provided; right?
A Yeah. Yes.
Q Okay. Do you know what years those first four mines in this table were permitted?
A One moment, Mr. Chair.

So we're trying to get the collective wisdom of the panel to bear here. We -- we think that the Red Chris Mine may -- may have received its selenium objective 2015 or 2016.

The -- which was the other -- the Brule Mine? Yeah. The Brule Mine -- the Kemess Mine. I'm sorry.

That -- that selenium objective might have been set in 2018 or 2019. We -- we can't speak to all of the rest.

Q All right. That's good enough.

Mr. Day, did you work on the permitting for the Red Chris Mine?

A MR. DAY: Yes, I've worked on that, yeah.

Q Perfect.

Do you continue to do work relating to the Red Chris Mine?

A I do, yeah.

Q Did that mine get a noncompliance advisory letter from the BC Ministry of Environment in 2017?

A I don't know.

Q Not sure about that.

Do you know if there was no surface runoff control works installed at parts of the mine where the Red Chris Mine permit required them to have those?

A That wasn't the area that I was working on, so I'm not familiar with those, Mr. Yewchuk.

Q What were you doing?

A I -- I work on the geochemical characterization of the rock and tailings.

Q Do you do any work relating to selenium at Red Chris?

A I do, but it's on the source aspects.

Q Okay. Did selenium levels in fish start to rise in the

lake beside the Red Chris Mine in 2016?

A Yeah. I'm not familiar with that.

MR. YEWCHUK: Can I get Aid to Cross 3?

Q MR. YEWCHUK: And, Mr. Day, did you see this Aid to Cross 3 before -- did anyone bring it to your attention?

A MR. DAY: Mr. Yewchuk, I don't work on the fish tissue aspects, so this wouldn't be something I'd be involved in.

Q Right. So you do work for Red Chris, but you've just never heard of this at all?

A Well, I hear it peripherally, but I don't -- I'm not -- this is not my expertise, so I don't get involved in this aspect.

A MR. HOUSTON: Mr. Chair, I think Mr. Day made it clear that he works on the source terms for selenium on this project, and without -- without getting into exactly what he's doing, working on the source terms means that you're looking at the rock and the rate of leaching out of the rock and -- and what that might produce. So the -- the other end of the chain, the fish, Mr. Day wouldn't be involved in that at all.

Q Mr. Day, have you ever visited the Mount Polley mine site?

A MR. DAY: Yes, I have.

Q Did you visit it prior to the dam failure?
A Yes, I did.
Q Okay. What was the most recently you visited it before the dam failure?
A Before the dam failure, I couldn't -- I couldn't tell you. I -- I was in and out of there a few times over the years.
Q You worked for Teck on their selenium problem in the Elk Valley?
A I worked for Teck on -- again, on the source geochemistry aspects, yeah.
MR. YEWCHUK: Can I get Aid to Cross Number 6?
Q MR. YEWCHUK: And if I set this upright, this should be an article on selenium in the Elk Valley that you coauthored. We will know once it comes up.
Am I right this is an article you coauthored?
A MR. DAY: Yes, that's right.
Q Okay. And it is on selenium and selenium pollution?
A It is specifically on where does the selenium reside in the rock.
Q Does this article cite DeForest?
A I -- I couldn't tell you. I don't know, no.
Q Okay.
A You have to look in -- look in the reference list.
Q Okay. Well, let's go to the last page of this, I

believe PDF page 7. No. I guessed. Up one should be there.

So you can check and get back to me -- you can check if it -- if it has Mr. DeForest. Do you know if you cite Dennis Lemly?

A I don't know. I -- yeah.

Q Can you check Footnotes 4 and 12? Is that too small for you to read or --

A Oh, I'm sorry. Oh, I see. Okay. Yeah. I see, yeah, Lemly is, yeah, Reference 4 and -- yeah. Okay. I see him there, yeah.

Q Okay. Thank you.

And now on to someone else. Can I get Aid to Cross Number 4, and, Mr. Davies, is this a study you coauthored?

A MR. DAVIES: Yes.

Q Right.

A Well, when it comes up, I think it is.

Q Who provided the funding for this study?

A This was the Kemess Mine.

Q Okay.

A It was done at the requirement of the provincial government.

Q What was the connection between Northgate Minerals' Kemess Mine and the Dolly Varden char?

A The creeks in the area are generally dominated by

either the Dolly Varden char or bull trout. And so it -- you know, this is what they -- what they need to manage.

Q Okay. Was Kemess Mine dumping waste rock into the habitat of the Dolly Varden char?

A I wouldn't characterize it that way. They -- the -- the upper portion of this -- of this creek was a permitted discharge area -- or not discharge area. Sorry. It was a permanent waste rock storage area, and it was, you know, managed through a -- a fisheries compensation program.

Q So can you just read me this two sentences underneath "Materials and Methods" on that first page? We'll have to scroll down a little.

A The first two sentences there?

Q Yeah.

A (as read)

> The Kemess Mine is an open-pit gold and copper mine and mill complex located 430 kilometres northwest of Prince George, British Columbia, Canada.
>
> Since 1997, non-acid-generating waste rock has been placed in the upper portions of Waste Rock Creek, a 3-kilometre second-order creek that contains Dolly Varden spawning and rearing areas.

Q Okay. Was Kemess placing waste rock in Dolly Varden char habitat since 1997?
A By that time, it had been -- it had been compensated for, and it was no longer considered fish habitat.
Q Okay. Was the conclusion of this study that the Dolly Varden char was more tolerant of selenium exposure than any other fish species tested up to that day?
A Not exactly. I think if you see the -- if you read the conclusions there, it looks that way to start. It was a bit of a surprise to us, honestly. But -- oh, sorry, I got a -- can you still see me? I've lost my video here.
Q I'm not too worried about it.
A Okay. Yeah. I'm -- I'm still here. Believe me. The -- you'll see in the -- the conclusions of the study that there is another study that was done with brook trout, which is a very closely related species. Like, Dolly Varden, bull trout, Arctic char, and -- and -- and brook trout are all -- almost the same species, honestly. Where if you dive down into the brook trout study, the results were actually quite comparable.
Q So --
A I -- I can find that in the -- in the paper, if you like.
Q Is the overall conclusion here that the Dolly Varden

char is very tolerant of selenium?
A I would say the Dolly Varden char are more tolerant than -- than trout.
Q What about the bull trout?
A We didn't do direct studies of bull trout in this. Like, they're very -- they're so -- so closely related in this area that they hybridize, and so, you know, you might think that it's similar, but we haven't done any direct studies of it to see.
Q Is the implication of this study that the Kerness -- the Kemess Mine doesn't need to worry as much about their selenium releases?
A No, not at all, actually. One of the advantages -- one of the things that allowed us to do this study the way we did -- 'cause we were taking samples of -- of eggs that had been -- from Dolly Varden char that had been raised -- or not -- sorry, not raised -- that had grown in the creek -- in these creeks that had very high exposure to waterborne selenium. And so it gave us an opportunity to actually look at a real-life setting where there were high concentrations of selenium and fish eggs. And what we found is that the concentration -- this EC10 concentration that we put forward as a -- a potential tissue threshold -- there's probably about -- depending on the year of monitoring, about maybe a -- a -- a third or half of the fish, in

some years more, that are above that threshold. So certainly there -- there were effects in this environment. And I think that this -- this study helped to confirm that.

Q Okay. Thank you.

Mr. Jensen, have you visited the Mount Polley mine site?

A MR. JENSEN: No, I have not.

Q Did you do any work related to the Mount Polley mine site?

A Yes, I have.

Q Okay. But you never did a site visit?

A That's correct. I did not.

Q Mr. DeForest, are you responsible for the work on the site-specific selenium threshold sought by this project?

A MR. DEFOREST: Yes, I am.

Q Do you believe Alberta's selenium release limits are overconservative?

A By Alberta release limits, is that the guideline of 2 micrograms per litre, or is that different? I --

Q I think that's the one.

A It's -- I believe it's conservative for certain water minings. It's designed to be a conservative value that's protective of waters with the highest --

THE COURT REPORTER: I'm sorry. Can I get you to

speak up?

A MR. DEFOREST: Yeah. Sorry.

What I was saying was I believe the guideline is conservative for certain water bodies, and it was designed to be a conservative guideline that would be protective of water bodies throughout the province that have high bioaccumulation potential.

For a -- a flowing or loaded receiving water like -- as is the case here, we do expect that selenium bioaccumulation potential would be lower than those high bioaccumulation sites that are really the basis for a lower water selenium guideline.

So -- so I guess to answer your question, I do believe that the 2-microgram-per-litre guideline is conservative for this receiving water for this project.

Q Okay. Mr. DeForest, is there an unsettled controversy regarding appropriate selenium thresholds for the protection of fish populations?

A Are you referring to thresholds in water or fish tissue or other?

Q Both.

A I -- I suppose that there's probably still disagreement, for sure. Like, there are -- like there is in almost anything, I suppose.

There are, I guess, different interpretations of what the level of protection should be and how to

interpret the available effects-based data for selenium. So I know in the literature that there -- there are still differences of opinion in that regard.

Q Could it be fairly characterized as a dispute between a group of researchers who think the appropriate regulatory thresholds can be set higher and a group who believe they need to be set low?

A No. I -- I think the difference is just differences in interpretation of the available data independent of sort of, quote/unquote, one thinks it should be lower or one thinks it should be higher.

I think a lot of the more conservative guidelines are developed from studies that came out mostly in the '80s and early '90s following the events at Belews Lake. And starting in the late 1990s and past 2000, a substantial amount of research on the effects of selenium has been undertaken, and I think we know a lot more now than we did in the '80s; and I think, depending on how you choose to interpret the new information, probably influences different folks' opinions on -- on what a protected guideline should be.

Q Are you familiar with Dennis Lemly?

A I am.

Q Are you familiar with Joseph Skorupa?

A Yes.

Q Have Lemly and Skorupa favoured tighter limits on

selenium releases for environmental protection?
A Yes. I -- or can I have you repeat that?
Q Have Lemly and Skorupa favoured limits on selenium releases for environmental protection reasons?
A Yes, they generally have.
Q Have you favoured laxer selenium release limits?
A I have not favoured laxer limits, but the -- the limits or guidelines that I've recommended and work I've done in the past are higher than the ones that they've recommended and I think based on evaluation of the data available. And -- and I can just say too, you know, I'm not -- I'm not alone in that thinking. The US EPA's fish tissue-based criteria are actually very consistent with recommendations that colleagues and I made back in 1999, before even a lot more information became available, and I think it's just a -- a difference in interpretation of the data. I think it would be inaccurate to say that they're more lax. They're still conservative and protective values, in our opinion.
Q Do mining companies generally prefer your interpretation of the data to Lemly's?
A MR. HOUSTON: So, Mr. Yewchuk, I -- I -- I don't know if it's Mr. DeForest's place to talk about what mining companies generally think. That -- you know, that's asking him to put himself in somebody

else's position.
Q Mr. DeForest, do you agree that you are unable to answer that question?
A MR. DEFOREST: I'd agree. I can't say for sure what the different companies might be thinking.
Q Okay. In 1999, you cowrote a paper, the critical -- called "Critical Review of Tissue-Based Selenium Toxicity Thresholds for Fish"?
A Yes.
Q Did that paper conclude that the United States Fish and Wildlife Service thresholds were lower than they needed to be?
A That's -- yes, that's -- that's what we concluded.
Q Can I get Aid to Cross Number 14, PDF page 40? I believe it's on the bottom of the page. And if I called up the correct page, this will show a table of your proposed selenium limits compared to Lemly's and Skorupa's; right?
A Yes, that's correct.
Q Who funded this study?
A This was funded by Kennecott, a mining --
THE COURT REPORTER: I'm sorry?
A MR. DEFOREST: -- company in Utah.
Q MR. YEWCHUK: In 2013, you coauthored "Comment on Wildlife and the Coal Waste Policy Debate: Proposed Rules for Coal Waste Disposal Ignore Lessons

From 45 Years of Wildlife Poisoning"?

A Yes.

Q And that was responding to an article by Lemly and Skorupa?

A It was.

Q Was your position in that article that Lemly and Skorupa's suggestions for controlling selenium pollution were too strict and that lower standards for environmental protection would be safe?

A The -- the focus, I think, of that paper was more around acknowledging again how much the science on the fate and effects of selenium in aquatic systems has evolved. The particular paper that this was a rebuttal to was -- in part, look back at various case studies early on when there were cases of population level effects in receiving waters such as Belews Lake and Hyco reservoir that received fine-ash discharges from coal-fired power plants and -- and more just that this state of the science both, as I said, on creative effects, and effects have evolved and -- and also for managing selenium.

And that was really kind of the focus of the paper, was we can -- we can -- we can look back at those cases, but we can't extrapolate those to the future because we know a lot more now than we do -- than we did then.

And -- and just basically a -- a -- you know, a recommendation that -- given that knowledge that we have, that they have improved methods for evaluating those cases going -- going forward.

Q Who funded that study?

A That was the Utility Solid Waste Advisory Group, or "USWAG".

Q Solid Waste Activities Group?

A Thank you.

Q Is that a lobbying group for a consortium of electric utilities and affiliates that have a vested economic interest in keeping selenium release limits higher?

A I can't honestly say that for sure. I have to say that I have not worked with that group before, nor have I since. But my coauthor on that, Robin Reash, who I knew from a North American Metal Council selenium working group that we both participate in, he had reached out to me to work on this paper with him, and then the USWAG did provide the funding to support that effort. But I honestly don't know a lot about that group.

MR. YEWCHUK: Can I get Aid to Cross 1, which I believe is the article we've just been discussing.

Q MR. YEWCHUK: How many pages is this article?

A Just -- just one or two. A little over one.
Q So did you -- did you do new research for this comment?
A No. No. By -- by its very nature, it's intended just to be a -- as it's stated there at the top, a correspondence/rebuttal paper.
Q Okay. So how much funding did you need from the USWAG to write a little more than a page and do no research?
A It wasn't very much, but this was long ago. I -- I can't remember. But it wouldn't have been very much.
Q When you say "not very much", what -- what kind of range are you talking?
A MR. HOUSTON: So --
Q $5?
A So, Mr. -- Mr. Chair, I don't know if it's fair for Mr. Yewchuk to ask Mr. DeForest how much he got paid for a piece of work that seems to be out of bounds to me.
MR. IGNASIAK: Yeah, Mr. Chair, I obviously agree with that.
MR. YEWCHUK: I'm not sure I agree, but I'm not going to debate the point, so I'll move on.
Q MR. YEWCHUK: Mr. DeForest, in 2015, you coauthored "Biokinetic Food Chain Modelling Waterborne Selenium Pulses in the Aquatic Food Chains: Implications for Water Quality Criteria"?
A MR. DEFOREST: Yes.

Q Was one of the conclusions of that paper that the Environmental Protection Agency's draft intermittent selenium criteria may be overly protective for selenate pulses but potentially underprotective for selenite pulses?
A I think that's correct.
Q Okay. Who funded that research?
A Oh, boy. I'm not recalling off the top of my head.
Q All right. That's all right.
A It was --
Q Aid to Cross 12, PDF page 16.
A Thank you.
Q You've had a long career. I don't expect you to remember all these offhand, so ...
There you go. Acknowledgement. Who funded that study?
A Let's see. It's cut off a little bit on my screen. I know North American Metals Council, Evalley Coal [phonetic], Rio Tinto, and -- let me see. I've got to scroll over again. I'm sorry. I can't -- I can't read that. Oh, let's see. Oh, and Wharf Resources.
Q 2017 you cowrote the paper "Updated Species Sensitivity Distribution Evaluations for Acute and Chronic Lead Toxicity to Saltwater Aquatic Life"?
A I did.
Q Did that paper conclude that the United States

Environmental Protection Agency's ambient water quality criteria for lead was lower than necessary and that it could be safely increased?

A The conclusion of that paper was that it was to incorporate bioavailability-based considerations, and this has been an ongoing effort for metals in general beyond lead and -- and beyond work that I've been doing.

The USEPA and 'E' triple three -- or 'E' -- Environment and Climate Change Canada have also been exploring these same approaches for developing bioavailability approach -- based approaches for -- for guidelines or water quality criteria in the US.

And the objective of that is to derive criteria or guidelines that reflect the conditions that influence site-specific bioavailability.

In the case of lead, under many water chemistry conditions, the EPA criteria -- existing EPA criteria for lead might be, quote/unquote, overprotective. But it's also important to note that there are higher bioavailability conditions where these bioavailability-based criteria can be lower than existing criteria. The -- the -- the objective is not just to try to find out if a number should be lower or higher; it's trying to come up with criteria that are accurate to the defined level of protection, and

bioavailability that varies highly from conditions that are highly -- from site to site is -- is a key component of that.

Q Who provided the funding for that study?

A That was the International Lead Zinc Research Organization.

Oh, and I -- actually, I -- I should note -- I didn't have a paper -- did -- was that the saltwater paper -- did you cite, or was it freshwater?

Q This -- Aid to Cross 13. Let's pull it up so we're on the same one.

A Okay. Yeah. I apologize. I just want to make sure I'm responding correctly.

Okay. This is the saltwater paper. So I -- we had two papers come out in 2017 on lead. One was freshwater, and one was saltwater. And my previous response was relative to -- to freshwater. I sign up by availability.

For saltwater, the -- the data aren't available yet to develop a robust bioavailability base criteria. But this just represents updated information.

The -- the previous saltwater life criteria were developed in the mid-'80s, so this is just looking at all the additional saltwater toxicity data that had been compiled in the last 35 years and following EPA protocols for developing criteria. This is just the

result of what the updated saltwater criteria would be.
Q I'm going to re-ask my question now 'cause I may have asked -- you may have answered in regards to the wrong paper. Does this --
A Okay.
Q -- paper conclude that the United States Environmental Protection Agency's ambient water quality criteria for lead is lower than necessary and that it could be safely increased?
A It -- it -- it might. To be honest, I'm trying to remember the specific numbers here. And I thought the chronic criteria were actually fairly similar with the update, but they might be a little bit higher than -- that the -- again, EPA's criteria. That's 35 years old at the time that we did this.
Q Okay. Tell me if I'm reading this right. The 8.1 microgram per litre in the second line was your suggested level, and the old USEPA one was the 10 microgram per litre?
A The existing one is 8.1, and the value that we derived following US EPA methods was 10.
Q Okay.
A So it -- it went up from 8.1 to 10 micrograms per litre, so not -- not a substantial change.
Q And the acute one goes down 110 micrograms per litre?
A Yeah. The acute actually went lower with our update.

Q And who funded this study?
A The International Lead Zinc Research Organization.
Q And at PDF page 6. And acknowledgements there. You're just using the old name for them; right? They are now --
A Oh, this is --
Q -- (INDISCERNIBLE - OVERLAPPING SPEAKERS) Association?
A Yeah. This was about the time they changed, yeah. They're -- they're currently the International Lead Association.
Q Okay. Thank you, Mr. DeForest. I think that's all for you for a bit.
A Thank you.
Q So, Mr. Houston, does Benga believe this project will ultimately benefit the westslope cutthroat trout?
A MR. HOUSTON: So you ask a good question. What we believe is that there are environmental stressors in Gold Creek today that could be repaired and that if -- if that were to happen, that the westslope cutthroat trout in -- population in Gold Creek would -- would be more sustainable and -- and would -- well, be more sustainable.

So we -- we do believe that the offsetting mechanisms that we've proposed will -- will approve the situation for westslope gold -- cutthroat trout in Gold Creek.

Q Do the westslope cutthroat trout use a lot of coal or steel?
A Yeah. No. You're -- you're right. Not big steel users, and -- and so that wouldn't be something they'd be interested in.
Q Any plans to repair and improve westslope cutthroat trout habitat to offset the damage caused by the mine?
A First of all, "the damage caused by the mine" is -- is not a phrase I would use. As I mentioned in my opening remarks, we're -- we're staying a hundred metres back from Gold Creek itself. Benga's project will be intercepting tributaries, and so we will be -- we will be removing some riparian habitat.

I might add that that's a temporary feature, but you'll -- you'll tell me that many decades of removal is -- is a long time. So I -- I would agree with that.

But we are removing some riparian habitat and repairing other riparian habitat that is currently maybe degraded because of the previous coal mining in the region, and we're proposing to offset that with, you know, upgrading other areas of riparian habitat.

Q You said "Gold Creek itself". Were you --
A Yes.
Q -- differentiating Gold Creek from the tributaries to Gold Creek?
A I was.

Q Okay. Are the tributaries to Gold Creek critical habitat?
A Yes, they are.
Q Yeah. But you don't agree with the characterization that the mine will damage the critical habitat of the westslope cutthroat trout?
A No. You said the mine will damage Gold Creek, and I -- I wanted to be sure that everybody was clear that we're staying a hundred metres back from Gold Creek.
Q Right. So you'll -- you're damaging tributaries to Gold Creek?
A That's right.
Q Okay. How much does Benga expect to spend on that remediation work?
A I don't think we've got a full cost estimate for it yet, Mr. Yewchuk.
Q Do you have any kind of cost estimate or totally unresolved?
A It's totally unresolved. We've -- we've looked at the work that may be involved and -- but we haven't -- we haven't explicitly estimated the cost.
Q Could Benga have physically built the mine without doing that remediation work?
A Could -- could we have built the mine without doing the remediation work?
Q Yeah.

A We're --
Q Just (INDISCERNIBLE - OVERLAPPING SPEAKERS) --
A -- talking about --
Q -- right? Not -- not regulatory possible, but --
A Of course. And -- and we're -- when we talk about "remediation work", we're talking about the -- the re-establishment of the channel so that the -- the fish aren't isolated in the fall and -- and the -- the development of overwintering habitat, that -- that kind of stuff; right?
Q Yeah.
A So absolutely we could have built the mine without doing that.
Q Is it possible for Benga to have completed the remediation work in advance of constructing the mine?
A We would need an approval from the Department of Fisheries and Oceans to -- to go in the creek and do that work.
Q Okay. Is it physically possible to remediate the westslope cutthroat trout habitat and then not construct the mine?
A Yes. That would also be possible.
Q So the remediation work and the mine are two separate activities?
A That's right. I -- I -- I should add that a -- a lot of the remediation work is only possible because of the

research that we've done and the amount of time we spent studying Gold Creek. So in -- in a certain sense, yes, we've -- we've come to a point where one could proceed without the other, but to get here, there -- there had to be a -- a mine proposal.

Q Would the westslope cutthroat trout be better off if the habitat restoration was done and the mine was not built?

A I'm not sure. I -- I think one of the other benefits of -- of having the mine proceed is that you've got somebody who has got deep pockets and who is the caretaker of that creek for the next 30 or 40 years. So I think having that kind of a party act as a caretaker, monitoring, and if necessary, you know, tweaking the -- the habitat recovery and -- and monitoring the -- the health of the fish, I think there's a benefit to having somebody in the area that's hands on doing that work.

Q Does the federal government have deep pockets?

A Not today, if I -- if I understand the discussion around deficits and -- and borrowing. But they certainly have access to money.

Q Would the westslope cutthroat trout be better off if the mine were built and no habitat restoration done?

A I would not say so, no.

MR. YEWCHUK: So I propose to take a little

break, Mr. Chairman, to reorganize my papers, and then I'll finish my cross, if that's okay.

THE CHAIR: Sure. That's fine. Would you like 15 minutes?

MR. YEWCHUK: Perfect.

THE CHAIR: Okay. We'll resume at 2:15.

MR. YEWCHUK: Thank you.

(ADJOURNMENT)

THE CHAIR: Okay. Let's carry on, Mr. Yewchuk.

Q MR. YEWCHUK: When did Benga start consultation with DFO about the permitting for this project?

A MR. HOUSTON: 2051. Yeah, 2015, more or less.

Q All right. Does Benga believe it is likely the responsible federal minister will determine this project will cause significant adverse environmental effects?

A That's -- that's not up to us to say, Mr. Chairman. We've put forward the best case we can for the project based on the -- the science and -- and the evidence we've been able to collect. It's -- it's not for us to say what the government will determine.

MR. YEWCHUK: Can I get Document Number 555, PDF 261? And this should be a little PowerPoint slide

prepared by Riversdale. If I scroll -- you scroll down a little for me.

Q MR. YEWCHUK: The last box in the step there -- or the last two boxes, what do those arrows marked "likely" and "not likely" mean?

A MR. HOUSTON: I -- I guess that's just identifying the -- the pathways that are possible that -- for -- for this project and identifying that it's likely that the final decision will go through to the Governor in Council.

Q Does the final decision go to the Governor in Council because the federal minister determines if significant adverse environmental effects are likely?

A No. I don't think that's what this graph is saying. It's identifying there are two pathways after the federal minister determ -- makes his determination. And two pathways, one that can go to the Governor in Council, or it can go -- the federal minister can directly issue a -- a decision statement. It depends, I guess, on -- on the findings that the -- the federal minister makes in that penultimate box.

Q I apologize. I took you into the legal means on that one. That wasn't a good question.

A It's my -- it's my chart, so I need to be able to explain it.

Q So Mr. Bettles, when did you start the collection of

fisheries data for Benga?

A MR. BETTLES: I started collecting data in 2016.

Q Was Benga collecting fisheries data before that?

A Yes, they did.

Q When did Benga start collecting their baseline data?

A I believe it was, oh, 2014, 2015. Around that time.

Q Who was doing the work in 2014?

A I can't say. I can't say that.

Q Mr. --

A Actually -- actually, there's somebody else who could maybe speak to that.

Q Sure.

A Martin Davies can speak to that.

A MR. DAVIES: Sure. I can just add, Mr. Yewchuk, that we started to do baseline work in 2014, I believe, on -- on fisheries, but there were a lot of the work -- oh, sorry, am I -- my -- my -- am I back? Okay. Sorry about that.

But the -- the -- the fisheries work -- the baseline work in 2014 and 2015 was somewhat limited because there were -- it was difficult to get research licences to do work in these creeks, and that was resolved through 2015, 2016. And that's where, you know, the -- the work really stepped up at that point, in 2016.

Q Okay. And what was the purpose of all that work?
A MR. BETTLES: Which work are you referring to, Mr. Yewchuk? The 2014, 2015, or the 2016?
Q The fisheries baseline work through 2014 through 2016.
A Well, I think it was -- it was meant to collect existing condition information in both Blairmore and Gold Creek watersheds to help inform the environmental assessment.
Q Was it in order to prepare Benga to submit their environmental assessment and application?
A Yes, it was.
Q And is starting that early an ordinary part of the process for obtaining project approvals?
A Generally it's important to collect data early on in the -- in the process before submitting an application.
Q Okay. Is it ordinary for a party to hold meetings with the Department of Fisheries and Oceans about licence conditions before making an initial application?
A MR. HOUSTON: I would say that getting early relationship and -- and understanding the challenges and the points that need to be addressed in an eventual application, I think that would be normal.
Q Mr. Bettles, have you done other aquatic resource modelling relating to the westslope cutthroat trout?
A MR. BETTLES: Yes, I have.
Q For which projects?

A I've worked on some projects recently with Atrum.
Q Was that Elan South?
A Yes.
Q Okay. How early did you contact DFO about regulatory requirements for Elan South, or how early do you know anyone at Atrum did?
A MR. HOUSTON: Mr. Chair --
MR. IGNASIAK: Mr. Chair --
A MR. HOUSTON: Yeah. Go ahead, Martin.
MR. IGNASIAK: Yeah. Again, Mr. Chair, I think we're going beyond the scope of relevance for this proceeding.
MR. YEWCHUK: I think the answers to these questions determine the scope of relevance.
MR. IGNASIAK: No, I don't think so, Mr. Chair. Atrum -- the Atrum project's not subject to this proceeding.
THE CHAIR: How do you think they're relevant, Mr. Yewchuk?
MR. YEWCHUK: Whether or not at the Elan South project was subject to this depends on how far along they were in preparing their materials.
MR. IGNASIAK: Well, again, Mr. Chair, the Panel's already ruled on the cumulative effects assessment. We're not here to determine what should or shouldn't be included in that assessment. We're here

to determine, you know, the public-interest decision with respect to the Grassy Mountain Project.

MR. YEWCHUK: I don't think I have a further submission, Mr. Chairman. Would you like me to wrap up on this point?

THE CHAIR: Yes, please.

Q MR. YEWCHUK: Okay. Mr. Bettles, is baseline data necessary for the application of adaptive management?

A MR. BETTLES: I would say yes.

Q Okay. Did Benga collect genetic samples of the westslope cutthroat trout who were used in testing their genetic purity?

A There was genetic testing done in 2015 in Blairmore Creek, which -- those samples were submitted to Alberta Energy and Parks.

Q Alberta --

A Environment and Parks, yes.

Q So Benga collected the samples in 2015 and sent them to AEP. Benga didn't conduct any of the testing itself?

A No. That was a condition of the fisheries research licence with Alberta and -- Environment and Parks to submit them the samples.

Q Okay. Did Benga collect genetic samples in any other year, or was it just 2015?

A Just 2015.

Q Okay. Are you familiar with how hybridization threatens the westslope cutthroat trout?
A Yes.
Q Okay. Why are barriers that are impassable to fish important to the conservation of westslope cutthroat trout?
A Well, the barriers are important because it -- it helps to prevent other non-native species that do hybridize with them to -- to move up and occupy habitats that -- that the pure westslope are occupying.
MR. YEWCHUK: Can I get part of the enormous Document Number 42? I'm looking for Consultant Report 6 on hydrology. And as I'm sure one of Benga's representatives will correct me, this -- this document was partially replaced with an updated version, but it has a map that I need. PDF page 32.
A MR. HOUSTON: Yeah.
Q MR. YEWCHUK: I'm not sure. The consultant reports don't have any other number assigned to them that's faster to bring them up, do they?
A I -- I go to the file that holds the Document 42 and -- and go to the consultant report tab and then go to Consultant Report 6. We're in Document 555 here.
THE CHAIR: We need to be in CIAR 42. I think that's what you said.
MR. YEWCHUK: Yeah. It's the -- the general

environmental impact assessment, Consultant Report 6 on hydrology. It should be a map of the -- the barriers to fish passage on-site.

Q MR. YEWCHUK: So if you scroll down to see the legend, the -- the black 'X's are barriers to fish passage. Are these the barriers to fish passage that will be built during the project, or are these the ones that already exist?

A MR. BETTLES: Mr. Chair, they -- they already exist.

Q So just above Blairmore Creek Tributary 03, is there an impassable barrier to fish moving up Blairmore Creek?

A Can you -- can you scroll up on the map? I'm having a hard time. Maybe -- yes, I can see that now.

Can you repeat the question, Mr. Yewchuk?

Q Just above Blairmore Creek Tributary 3, is there a barrier to fish passage on Blairmore Creek?

A Based on our assessment, yes.

Q Is your assessment correct?

A In our opinion, we feel it's a full barrier.

Q Okay. Okay. How genetically pure are the westslope cutthroat trout above that barrier?

A Well, they're -- they're less than the 99 percent that some -- requires them to be deemed critical -- species at risk, so they're less than a hundred percent.

Q Do you know what percent they are?

A I -- that's a -- that's a difficult question. It varies based on the individual fish, but -- and based on the genetics of that individual fish. So I can't say for certain what percentage they are, but it's -- it's variable, and there's probably individuals that have obviously less than the 99 percent threshold.

Q So does the Department of Fisheries and Oceans assign critical habitat status based on the individual fish or on the general population?

A It's my understanding that is based on the population.

Q Yeah. So you don't know how genetically pure the population above that barrier is?

A Well, I mean, the information that was provided to us by Alberta Environment and Parks based on our 2015 samples do indicate that there are individuals that are comprised of hybrids between rainbow and -- and westslope.

Q Has there been any genetic purity testing since the 2015 stuff that was done with Benga's help?

A To my knowledge, no.

Q When did DFO determine Gold Creek is critical habitat for the westslope cutthroat trout and Blairmore Creek is not?

A To my knowledge, the 2014 recovery strategy for the species was the -- the timing around when Gold Creek was deemed to be a species at risk in critical habitat.

Q And there's -- there's a new recovery strategy and action plan, 2019; right?
A That's correct.
Q Yeah. So why, in your understanding, did DFO make Gold Creek critical habitat and Blairmore Creek no longer has any?
A I can't speak for DFO, but through some recent documents I've read from DFO is that DFO defines species of westslope cutthroat -- populations of westslope cutthroat trout as -- pure as being greater than -- or higher than -- or equal or greater than 99 percent genetic purity.
Q That's my understanding too. I don't -- I don't expect you to have knowledge of what goes on behind the scenes there.

So there was critical habitat in Blairmore Creek under the 2014 plan; right?
A In the Blairmore --
Q Right. In the tributary to Blairmore Creek; right? It was --
A Correct.
Q -- Blairmore Creek Tributary 04; right?
A Correct.
Q It's no longer critical habitat?
A Based on the 2019 recovery strategy from DFO, that would be correct.

Q And that change was because of the genetic information that Benga passed to Alberta Environment and Parks?
A Mr. -- Mr. Chair, I'm unaware of how they've come to that conclusion. Not sure exactly where that's come from, but DFO's determined it's not included.
Q So the only genetic testing done in between 2014 and 2019 was the genetic testing that Benga dealt with?
A I can't speak to that, Mr. Chair.
Q I thought you just answered that a minute ago. Sorry. I might be misunderstanding you.
A MR. HOUSTON: So, Mr. Yewchuk, what I heard -- what I heard him say was that he wasn't aware of any.
Q Oh. Yeah. You're right.

So -- and as part of your baseline data here, you didn't -- you didn't check? You didn't find any -- did you take any steps to find if other genetic testing had been done in Blairmore Creek?
A MR. BETTLES: No, we did not.
Q Okay. So, to your knowledge, the westslope cutthroat trout in Blairmore Creek are less than 99 percent pure, but you -- really, between 0 and 99, you -- you don't know?
A Well, I mean, based on the 2015 data that was provided to us by Alberta Environment and Parks, there's a broad range of -- of fish that have varying levels of

hybridization.
Q Is there evidence of new introgression of fish in the Blairmore Creek?
A To my knowledge, I don't know.
Q So can I get documents -- sorry. Let me -- yeah. This is Number 42. This is the first addendum, Appendix A1, or you can get to this through Number 44, Appendix 1 -- Appendix A1. Either one will get you the same document; is that right? And PDF page 63 is what I expect you want.

So how many trout -- how many fish were caught in the Blairmore Creek tributaries during the August '14 -- 2014 surveys?
A Sorry. I was on mute there.

I'm assuming you are referring to Table 4.3.
Q I'm referring to the whole page, but yeah.
A Oh.
Q How many fish did you catch in the tributaries to Blairmore Creek?
A Table 4.3 states 107.
Q Okay. What does the line beneath that say?
A Genetic samples, around 170 of those were collected from captured fish and provided to AEP in support of their -- their mapping program. Do you want me to keep going, or is that --
Q Well, now I'd like you to answer again. How many fish

did you catch in the tributaries to Blairmore Creek?
A Well, there's 107.
Q Okay. Now can you read the second sentence underneath that table?
A (as read)

> The majority of the sampled -- the majority of the sampled fish, which is 132, were identified as pure strain.

Q And the remaining 38 fish were identified as backcross hybrids?
A M-hm.
Q Okay. So did you catch 107, or did you catch 170 fish?
A Mr. Chair, the -- those -- those fish of genetic samples also included fish probably -- well, we know it's coming from the main stem of Blairmore Creek as well.
Q So that 170 number is fish from the main stem of Blairmore Creek and fish from the tributary of Blairmore Creek?
A To my knowledge, yes.
Q Okay. Now, can I get back to the document we were just in, Consultant Report 6, PDF page 34 at the bottom of the page? Sorry I'm asking you to jump from document to document so much.

> Now, how many fish did Benga capture in August 2014 in the main stem of Blairmore Creek?

A We have a total of 132 based on Table 3.6.
Q And in the sentence below that, what does it say?
A (as read)

> Genetic samples collected in August 2014 from 170 trout were collected from two sites in Blairmore Creek, which were provided to Alberta Environment and Parks to support their westslope cutthroat mapping program.

Q Okay. Now, is that paragraph that we're looking at the exact same paragraph we were looking at in the other document? You can --
A Yeah. Yeah. No, it's -- it's fairly accurate.
Q Sir, it's fairly accurate. And what is it actually telling me about?
A Mr. Chair, I think it's important to -- to point out that not all fish captured wherever we did sampling were -- were samples sent in for genetic analysis.
Q So did you send even the fish from the Blairmore Creek tributaries for genetic analysis?
A Mr. Chair, given the -- the Blairmore Creek tributary in question, BCT04, is away from the mine. To my knowledge, that -- that tributary was not sampled specifically for hybridization.
Q Can we jump back to the other document we were just looking at? So do you see Blairmore Creek Tributary 4 on there? Actually, 4A and 4B?

A I do.
Q Right. So were those fish taken for genetic samples?
A The hundred -- I -- I think it's important to point out, Mr. Chair, that the genetic samples is a separate issue -- or separate component to the actual sampling that we did. I wouldn't -- I wouldn't say that that statement below Table 4.3 is associated with the table -- the text below that.

I think the -- the previous document that, Mr. Yewchuk, you've referred to identifies that there were two sites collected in Blairmore Creek that did -- that samples were collected for genetic analysis.

Q So you -- how many total samples did Benga send Alberta Environment and Parks for genetic testing for Blairmore Creek?
A I think it's clear in the -- the document, Mr. Chair, that we submitted 170 samples in 2014, and those were identified as -- 132 then identified as pure strain and 38 were not.
Q So you didn't send any of the trout from Blairmore Creek tributaries for genetic sampling?
A To my knowledge, we sampled from two locations in 2014, and those two locations were, I believe, on Blairmore Creek main stem. That was before my time. But my understanding is from two locations.
Q Can I get the other document we were on a moment ago?

A I just correct myself. It was actually, I believe, five sites, not two sites.
Q So the five sites would be the five tributaries?
A I would not say that that's the case.
Q There's two sites listed for the main stem and five sites for the tributaries.
A You're -- you're -- I think you're getting confused, Mr. Yewchuk. As I said before, we did fish sampling on tributaries and the main stem, but that doesn't -- that doesn't mean that we sent all samples from every site that we sampled for genetic analysis.
Q Benga did not -- so did Benga send the Blairmore Creek main stem samples or the Blairmore Creek tributary samples or both?
A Mr. Chair, I think it's important to point out that the whole purpose of the genetic sampling is to understand its -- its purity and -- and whether or not hybridization is there and if it's -- at what -- at what level. I don't think it -- it matters whether it's a tributary or the main stem. I think the point is is that there's hybridization above this known obstruction, and, you know, fish freely move, what have you, and -- and -- and that's -- what we have is we have a hybrid population above -- above the barrier.
Q Based on an amount of genetic sampling that you're not sure about from locations you're not sure about?

A Well, that's -- that's not true. We collected from multiple sites where we did work in Blairmore Creek, and those sites were sent -- those samples were sent in for genetic analysis based on the fisheries research licence that was issued to -- to -- to Benga.

Q Which sites?

A MR. HOUSTON: Mr. Chair, I think Mr. Bettles has been fairly clear on this. And, first of all, this sampling -- the genetic sampling was done by somebody other than Mr. Bettles. It was done from multiple sites. 170 fish -- or tissue samples were sent to Alberta Environment and Parks. I think that's the relevant information here.

Q So the -- the paragraph below these two tables, this one in this document -- table and the other one, would Benga agree that you -- you just copy/pasted that paragraph that was initially about the main stem under -- in the main stem in the first document under a table that was above the tributaries in the second document?

A I -- Mr. Chairman, I -- I -- I think Mr. Yewchuk has captured the issue here. This -- this part of the report is -- is about 2014 fish surveys. This section contains a table that talks about westslope cutthroat trout captured in tributaries, and it contains a paragraph about genetic sampling. The two aren't --

they're -- they're juxtapose -- they're -- they're adjacent to each other in the text, but -- we're not trying to imply that the 170 samples were taken from the tributaries. They're two separate parts of that section of the document.

Q What is Benga's most recent estimate for the number of westslope cutthroat trout in Gold Creek and Blairmore Creek?

A MR. BETTLES: Just give me a second, Mr. Chair. I'm just going to pull up a document.

A MR. HOUSTON: Careful. We're not estimating the total number of fish.

Q You may have been supposed to be on mute.

A It happens from time to time, Mr. Yewchuk.

Q Yeah. I'm actually surprised it hasn't happened more, given how much we've got to click on and off in this thing. Actually, that answers a lot of questions. That saves time.

A MR. BETTLES: I'm still trying to find the document here that he's trying to ...

So, Mr. Yewchuk, you're looking for most recent 2020 information?

Q As recent as possible.

A So can you just repeat the question one more time for me just so I make sure I give you the -- the accurate estimate.

Q What is Benga's most recent estimate for the number of westslope cutthroat trout in Gold Creek and Blairmore Creek?
A Based on our most recent information in -- collected in 2020, for Blairmore Creek, we've -- based on snorkel surveys, we've estimated around 285 in visuals at index sites. And then obviously at Gold Creek, 2020 was -- is 55 index sites. But when you add up the non-index sites for Gold Creek with the index sites, your numbers are much higher. So Gold Creek you're looking at approximately a density of around 14.3 fish per kilometre, which works out to about -- about an estimate of around 215.
Q Was Benga careful not to estimate the total number of trout in west Gold Creek and Blairmore Creek?
A Sorry. Can you repeat that part of your -- I didn't understand part of your question.
Q Did Benga estimate the total number of trout in Blairmore Creek and Gold Creek?
A Mr. Chair, we -- we've been doing ongoing monitoring over the last number of years to -- to track and -- and -- and monitor the -- the populations of -- of -- of the westslope in both systems.
Q But you didn't generate estimates of total population?
A We did in 2016.
Q So how many were there in 2016, then?

A If you -- if you go back to our -- our technical baseline report from 2016, the mark-recapture estimate was around 1,600 in -- in Gold Creek.
Q 16 -- 1,625 and 3,210 in Blairmore; is that correct?
A That -- from 2016.
Q Yeah. And there's no comparable estimate for 2020?
A Mr. Chair, I think it's important to -- to recognize that -- that the mark-recapture we did in 2016 was -- was -- was an individual estimate that we made and that through the work that we've collect -- done over the last number of years and seeing some -- some differences in -- in numbers from year to year that we've -- we've expanded our surveys to a broader area within both systems to -- to get a better sense of where these fish are. So I would argue that our -- our estimates through the snorkel surveys we've done since 2016 are -- are a reasonable estimate of -- of the -- of the numbers of fish in those systems, and I would argue that they're -- they're -- they're conservative.
A MR. HOUSTON: Mr. Chair, if I could just add a little bit to that. And I've -- I've been learning in this area as -- as well as you've been, going through this -- fish surveys.

So my understanding of the process is that the -- the surveyors identify index sites. So they don't survey the entire creek; they survey specific reaches

of the creek snorkeling. And the idea is to compare year over year in those pre-identified spots how the population is -- is changing.

What we've noticed, and especially after the dramatic reduction in counts from 2016, we've determined that perhaps we need to look further afield. And so we've, over the years, been surveying longer and longer sections of the creek, but we -- we still do not do an exhaustive survey of the creek when we go out to do these snorkel surveys.

Q Did you do an exhaustive survey in 2016?

A MR. BETTLES: Mr. Chair, we -- we assessed based on what we felt was appropriate at the time. And I think the numbers of fish that we saw reflect that. And it's a standard protocol methodology that we applied for -- for monitoring westslope in these systems, particularly species at risk.

Q And whatever you did in 2016, it allowed you to produce an estimate of the total number of trout?

A MR. HOUSTON: One minute, Mr. Chair.

A MR. BETTLES: So, Mr. Chair, in 2016 we -- we did execute a mark-recapture program that we -- we felt was -- was appropriate. It's been -- we wanted to make sure that the stress of the fish were -- was minimized. The approach that was put forward was -- was discussed and approved with regulators at the time.

We -- we that executed program. And since then -- since that, we've been continuing on with -- with our snorkel program to -- to minimize stress on the fish and the systems using -- using acceptable standard protocol for snorkeling. When we started seeing the -- the numbers of fish decline in subsequent years, we expanded our surveys beyond the index sites in -- in the systems to -- to cover more length of habitat throughout both Gold Creek and -- and Blairmore Creek.

Q Why didn't Benga do more mark-recaptures?

A I think, Mr. Chair, part of the reason for that is -- is, again, as I had mentioned earlier, was just to minimize the stress on the fish. There's -- there's a lot of stress in terms of actively handling and capturing these fish to -- to mark and capture them and recapture them and what have you; and given the sensitivities of the Gold Creek population and given the -- the dialogue we had with regulators at the time, it was deemed that we wanted to be responsible and do the right thing and use snorkeling as our -- our -- our means of primarily monitoring and -- and tracking the fish. And that's --

Q You --

A Go ahead. Sorry.

Q Sorry. I cut off the end of your -- your response there. If you --

A I'm done. Thank you.
Q All right. Did DFO tell you you couldn't do mark and recapture anymore?
A No.
Q Did you apply for licences to do mark and recapture again?
A MR. HOUSTON: So -- so, Mr. Chair, I think what -- what I've heard Mr. Bettles say is that in 2016, we did an extensive program, mark and recapture, and we did snorkel surveys, identifying and -- these -- these index sites. And every year since then we've been back to do snorkel surveys as a means of gauging how the population was changing year over year.

I -- we -- we wouldn't want to do mark and recapture surveys every year because it does create a stress for the fish and -- and, quite frankly, the -- the -- the need is not there. We did it once, we learned what we learned, and we're using the snorkel surveys as -- as a year-over-year gauge of how the population is varying with time.

Q Mr. Houston, did you get caught on a hot mic a moment ago saying something along the lines of, Careful that we are not estimating the total number of trout?
A Exactly. What we're doing is we're doing snorkel surveys at index sites and using -- so -- so I wanted to be clear that we're not counting every fish in the

stream, that we're comparing index sites year over year. What we learned from that -- and when we saw the dramatic fall in the population from 2016 to subsequent years, what we learned from that is that maybe the fish are just moving from the index sites. And so we -- we extended our -- our surveys to cover more of the streams. But we're still not covering the entire streams. So even though in -- in the areas we're -- we're looking, the population seems to be 10 percent or 20 percent of what it was in 2016, and -- and we measure that on a fish-per-kilometre basis to get a comparable number year from year.

I -- I think it's wrong to take that fish-per-kilometre number and multiply it by the number of kilometres of stream length. So I -- I think that's the point that we are getting an indication of the change in population from year to year but not -- not an absolute count.

MR. YEWCHUK: Can I get Document Number 42, the first addendum, Appendix A1? I think we were in this one a moment ago. So -- yeah, the addendum -- the aquatic ecology effects assessment. Looking for Table 4.12. 73. Sorry. Seven three. Okay. And scroll down a little bit. 4.12.

Q MR. YEWCHUK: Now, this was your 1,625 and 3,210 estimates for Gold and Blairmore in August 2016;

right?

A MR. HOUSTON: That's right.

Q Okay. Why do some reaches appear in this table more than once?

A Well, we're sometimes doing angling, sometimes doing electrofishing.

Q So were you trying to count every fish in Reach 7?

A MR. BETTLES: Mr. Chair, we're trying to -- to get a -- we're trying to get a -- an estimate of -- of -- based on habitat type. And in some habitats you have to angle, and some habitats you have to electrofish to -- to gather different -- class -- different size of fish use different habitats. And some habitats you just can't electrofish them, and other parts you just can't angle.

Q So for Reach 7 did you angle or electrofish?

A We did both.

Q You did both. Which one did you use to get your total population estimate?

A Give me a second, Mr. Chair.

Mr. Chair, these are the -- the -- the estimate of fish density per reach based on -- on sampling method. That's all that this -- this table is -- is showing us right now.

Q Okay. What does that total -- fish total 1,625 mean?

A Mr. Chair, that is an estimate using the mark-recapture

process that we applied here that -- that is an estimator which give -- gives us the output of the 1,620 fish.

Q So the first row is how many fish were estimated to be in Reach 7 based on angling; right?

A That is correct.

Q And the second row is how many fish were estimated being in Reach 7 based on electrofishing?

A That's correct.

Q Okay. So what is your estimate of how many fish were in Reach 7?

A Mr. Chair, when we -- we did the mark-recapture, the estimate that we gave was an estimate for all of Gold Creek. So the numbers you see here for Reach 7, based on an angling and electrofishing, are -- are -- are presented in the table.

Q Okay. Did you accidentally sum the quantity of fish estimated for Reach 7 based on angling with the quantity of fish based on electrofishing to give you a total number that doesn't represent anything?

A MR. HOUSTON: Mr. Chair, the whole point of the -- the tag-and-release process is that if you catch a fish twice, you don't count it twice. So we used angling, as Mr. Bettles mentioned, in places where you can't use electrofishing. We used electrofishing in other places in the creek.

We didn't double count fish because we had previously tagged them, and that -- and that helps us, you know, if -- if a fish swam from one area to the other, we -- we would say, Oh, we've already caught this fish. So we -- we didn't double count.

And so the -- the total fish here are the total fish that we caught in Reach 7, 8, and 9. And then the density of fish is -- is a calculation of density based on the length of those reaches.

Q Mr. Bettles, is that correct? Did you catch 1,625 fish and pulled them up out of Gold Creek in 2016?

A MR. BETTLES: Based on the electrofishing that we did in Reach 9 -- well, throughout Reaches 7, 8, and 9, Mr. Chair, that's the numbers that we collected.

Q And --

A That's -- yeah, that's correct. Sorry.

Q Okay. So I had assumed that you picked a site, measured out the size of it, and then just electrofished it to get an average for that section of the reach and then used that number to calculate a fish density and get a guess at total fish. That's not how this worked at all.

A This density was determined by dividing the total number of fish observed through the snorkel surveys or captured through angling or electrofishing by the

survey length, and that's what the density estimates have given you. It's based on the total number of fish.

Q So if you scroll up on this page -- now, that's --

MR. YEWCHUK: Mr. Chairman, can I get about five minutes to look at this? I'm -- I'm a little stumped, and I'd appreciate a moment before I have to -- have to figure out if this is worth asking more about -- asking more about this.

THE CHAIR: Sorry. I was muted.

Yeah, let's take a five-minute break.

MR. YEWCHUK: Okay. Thank you, Mr. Chairman.

(ADJOURNMENT)

THE CHAIR: Okay. Go ahead, Mr. Yewchuk.

A MR. HOUSTON: Mr. Chair --

THE CHAIR: Yeah.

A MR. HOUSTON: -- we've been discussing the -- the last few answers about this mark-and-recapture program, and -- and I think it's worthwhile to review that and -- and discuss what -- what that mark-and-recapture program is, the process, so that everybody can understand the numbers in these tables.

So Mr. Bettles is going to just say a few words about that.

A MR. BETTLES: Thank you, Mr. Houston.

So just to -- just to clarify, a mark-recapture -- we broke out our population estimates into two different approaches, relative abundance and then mark-capture, which focused on the subadult/adult-size class, and we used a combination of angling and electrofishing techniques to capture the fish and snorkeling as the recapture method. And this was an approach that was -- it was scoped, and it was put together and -- and run through with -- with the -- with the agencies at the time, and that's what we applied in this.

And then we -- so we would -- we'd capture the fish, we would -- we would mark them, and then we would release them, and then we would try to recapture them. Then we would then, based on the -- the marking number of fish and the recaptured number of fish, we would use a calculation that would estimate the population.

So a couple of numbers that -- that came up in a table earlier that -- that Mr. Yewchuk had raised were actually not the total number of fish that we actually captured, but estimates.

Q MR. YEWCHUK so on that Table 4.12 -- we can pull it up again if you'd like to look -- did you double count Reach 7 in Gold Creek and Reaches 3 and 4 in Blairmore Creek?

A And pull up the table again, please.
Q Because the way I'm seeing this, you did an estimate of how many fish were in Reach 7 based on your angling results; then you did an estimate of how many fish were in Reach 7 on your electrofishing --
A M-hm.
Q -- results --
A Yes.
Q -- and you --
A So as a --
Q -- summed them?
A So, Mr. Chair, just to -- just to clarify, when we're electrofishing and angling, we're -- we're sampling different habitats. So, yes, the fish moved. These are not closed systems. But generally, given the habitat types and the size of fish you would generally be encountering, there's not a -- there may be some double counting but very little, I would -- I would say, is -- is being double counted because of the different habitat types that you're -- you're targeting with the -- the method of sampling.
Q So how large was the portion of Reach 7 that you estimated using angling, and how large was the portion you estimated using electrofishing?
A Well, that's the reach length that was sampled. Typically with the electrofishing, we're -- we're

sampling around 300-metre lengths per Alberta -- Alberta standards. And then the angling is based on areas that are opportunistic for angling. So it's not entirely reflected that the whole 2,874 metres was actually sampled for angling. That's the reach length. And that -- based on the number of fish we caught through angling, the density estimate was calculated based on the length -- overall length of the reach.

Q Okay. So how do you get to the total fish number on the end? Since you didn't actually catch all those fish, that was generating an estimate; right?

A MR. HOUSTON: So, Mr. Chair -- and maybe this helps to have this from a non -- non-specialist in the area because I -- I've -- I've been trying to understand it as well.

So my understanding is you -- you go out and you angle or you electrofish, and you capture a certain number of fish, you mark them, and then you go back out and do that again. And you capture another quantity of fish, and you note that a percentage of those have been marked. You use that percentage to estimate what the total population of that reach is.

There's a broad assumption in these numbers that the fish that are in the angling areas don't generally migrate to the fish that are -- to the areas that are -- are suitable for electrofishing. And -- and

that's based on the -- the desire of certain fish at certain stages to be in pools instead of swimming along a 300-metre reach of the -- the stream.

So the -- the -- the system's not perfect; there may be some double counting, but it's -- it's the -- the way it's done.

Q Can I get Document Number 843? And this should be Benga's recent westslope cutthroat trout population data, if it is the correct document.

And I think this one you'll agree too because we've discussed this already. The westslope cutthroat trout in Blairmore Creek dropped by about 60 percent from 2016 to 2017?

A I've not done the math, but in that order of magnitude.

Q Okay. And --

A And, again -- again, that's based on snorkel surveys at index sites.

Q Yeah. And the westslope cutthroat trout in Blairmore Creek dropped by about 90 percent from 2016 to 2017?

This is PDF 2. Thank you.

A So I think you've got those backwards, Mr. Yewchuk. In Gold Creek, the population at the index sites dropped 90 percent; and in Blairmore Creek, it dropped 60 percent.

Q Right you are. That is backwards.

And can we go to PDF page 5? And, Mr. Bettles,

why did you add the additional sites to the index sites?

A MR. BETTLES: Mr. Chair, we've -- since 2016, we started to -- as I mentioned earlier, we've expanded our -- our survey within those systems, in particular Gold Creek, to -- to survey more of -- of -- of the system through snorkeling. Because of the -- the index sites monitoring that we commenced in 2016, the numbers weren't there. And so we wanted to get a better handle of what was actually in the system, which required us to -- to be more exhaustive in -- in checking out the entire -- most of the other areas.

So the -- the Table 2 combines the index sites plus the additional area we've -- we've covered over the last few years.

Q Does the addition of the index sites give the impression that there are more westslope cutthroat trout in those years?

A MR. HOUSTON: So -- so, Mr. Chair, I -- Mr. Chair, again, when we saw the drop in the numbers from 2016 to 2017 at the index sites, having only a few years of data and seeing that magnitude of drop, I think it was reasonable for us to extend our -- our sites and to look at a greater length of the -- of the creeks.

Nonetheless -- and -- and when you do that, you

can't compare absolute numbers of fish because you're -- you're looking now at a -- at a longer length of the stream.

So we -- we tried to compare based on the fish per kilometre as -- as a broad number that will help us to look at the -- the -- to compare year over year.

And so if you look at the westslope cutthroat trout per kilometre number, Year 2016 -- and I'm looking at the very right-hand column of that table -- you see, again, a -- a very significant change of -- from 2016 to 2017. So even with the broader surveys, we -- we saw quite a substantial change.

And the -- the comparison between the index sites and -- and the extended surveys varies year over year. But I -- I -- I think what's important here is the dramatic drop from 2016 to the other years.

Q When do you think the westslope cutthroat trout population started dropping?

A Well, according to the information we've been able to gather, it happened after Year 2016. We -- we can't say what the population was in Year 2014 or '15 because we don't have the data.

Q So you don't know if the population was stable up until 2016?

A No.

Q You don't know if it was falling for decades before

2016? You just --
A No.
Q -- don't have any idea about that?
A Nobody really knows, Mr. Chair. And this is the first real data collected on -- on these -- on this stream.
Q So what do you think causes the population drop from 2016 to 2017?
A Again, Mr. Chair, we can't be certain about that. Again, not having a -- a comprehensive database, we -- we can say that the numbers dropped. 2016 was a particularly dry year, and -- and so one could speculate that that drought had -- had an effect.
Q So you think that a drought year might put a 90 percent dent in Gold Creek of westslope cutthroat trout populations?
A Mr. Chair, we -- we -- in my opening statement this morning, we talked about some of these sections of the creek that absolutely dry up during a drought year. The fish between those impassable spots will -- and especially to the extent that there's very little water in the creek, will have trouble finding adequate habitat, and especially for overwintering.

So -- but, again, Mr. Yewchuk, Mr. Chair, that's -- you know, we're -- we're presuming something without sufficient data to -- to demonstrate it. If we collect data and see the population recover back up

at -- to these levels and -- and then see the range of natural variability in the fish population -- but that's going to take a few more years of data collection.

Q Was Benga doing much work on the Grassy Mountain site in 2016?

A No. Very little environmental surveys primarily. Possibly a little bit of drilling.

Q Bit of drilling.

Benga electrofished in Gold Creek and Blairmore Creek in 2016?

A That's correct.

Q They marked the fish that they caught?

A Yes, that's right. Yes.

Q How do you mark them?

A Mr. Bettles, how do we mark them?

A MR. BETTLES: We used a method of -- it's called a "VIE", which was approved by the regulators, which is basically putting a little bit of dye around the eye of a fish that you would then use a light to detect, or you would do adipose fin clipping of fish. Because at the time, the -- it was -- it was hard to -- to detect the VIE in the fish, so the -- the regulators gave us approval to use fin clipping.

Q How many fish did you take a fin clip from?

A Give me one second, Mr. Chair.

So, Mr. Chair -- you want to tell him? Go ahead.

A MR. HOUSTON: Mr. Chair, we don't have the specific number here, but I could tell you it wasn't 90 percent of the population.

Q What stream does the end-pit lake ultimately drain into?

A Mr. Chair, the end-pit lake is currently designed to decant into the saturated backfill zone, and eventually that water will end up in Blairmore Creek.

Q Okay. Did the plan for the end-pit lake change since the project was first proposed?

A We had proposed an option in the original application to have some of the end-pit lake water decant into Gold Creek. We heard about that this morning. That option was basically set aside after we did the detailed instream flow needs assessment of Gold Creek in -- in 2016, which was filed in 2017.

Q Is the end-pit lake -- sorry. Is Benga planning to stock any fish into the end-pit lake?

A No.

Q Why not?

A Mr. Chair, we're not -- there's no need to stock fish in the end-pit lake.

Q Were westslope cutthroat trout short on habitat?

A Yeah. Mr. Chair, I'm not sure stocking a few fish in an end-pit lake is going to change the situation for

the westslope cutthroat trout.
Q Patching up a couple streams will?
A Mr. Chair, we've talked about Gold Creek. There is a population of westslope cutthroat trout in Gold Creek. If we want that population to persist and thrive, something needs to be done there.
Q What would happen if you tried to stock westslope cutthroat trout in the end-pit lake?
A I have no idea, Mr. Yewchuk.
Q What about the rest of the panel? Some of you are experts on water quality and --
A Mr. Chair, we're -- we're not planning on stocking westslope cutthroat trout in the end-pit lake.
Q I understand that. What would happen if you tried it?
A It -- okay. It's a hypothetical question, Mr. Yewchuk.
Q The whole project's hypothetical. You haven't built it yet.
A Yeah. And -- and -- and even if we do, we're not planning on stocking westslope cutthroat trout in the end-pit lake, so I ...
Q If somebody grabs a westslope cutthroat trout in a bucket and dumps it into the end-pit lake, would it live, or would it die of selenium poisoning?
MR. IGNASIAK: Mr. Chair, I think Mr. Houston's answered this, and the fact is Benga hasn't assessed this. So I don't think it's fair to

ask the witnesses to now, on the stand, on the spot, to make assessments of that nature.

Q MR. YEWCHUK: Has Benga assessed how much selenium is going to be in the end-pit lake?

A So, Mr. -- Mr. Chair, we've assessed in great detail the effects of selenium on westslope cutthroat trout or other aquatic biota in Blairmore Creek and -- and in Gold Creek based on science, based on what we know about the water quality that will exist in those creeks once the project starts. We have not assessed the effects of -- of -- or the viability of westslope cutthroat trout in the end-pit lake simply because it's not something we are intending to do.

Q Would it be safe for waterbirds to nest and live on the side of the end-pit lake? Would the birds be able to lay eggs that produce new birds?

A Mr. Chair, that's -- that's a question that might best be pushed over to the session on wildlife and human health.

Q Okay. Sounds good to me.

That wraps up my questions. I have hopefully come in a little faster than expected. I agreed to leave a couple issues for Mr. Secord. If it goes a touch over time, that's my fault. Thank you for your time, panel.

MR. YEWCHUK: Thank you, Mr. Chairman.

THE CHAIR: Thank you, Mr. Yewchuk.

It's 3:30. I didn't want to go too late today, but a question for Mr. Secord if he's here.

MR. SECORD: I'm here.

THE CHAIR: Or Ms. Okoye.

Mr. Secord, would you be interested in starting your cross and going for, you know, maybe 45 minutes or so and taking a break, or would you prefer to start in the morning?

MR. SECORD: I think it would be good to start now. And I notice Mr. Yewchuk only used up four of his five hours. There were some climate change questions that were not answered, so I might ask, sir, if we could start now, and I might borrow some of Mr. Yewchuk's unused time. Because I do think I'm going to need it all. If -- I mean, obviously if I get done sooner, great, but that -- I would say let's use the time now, and what we would then -- what, stop at 4:15? Is that what you are suggesting?

THE CHAIR: Yeah, sometime, you know, a little after 4. It doesn't have to be exactly 4 or 4:15, but I don't want to go too late, so certainly before 4:30.

MR. SECORD: Okay. But I'm -- yeah, I'm happy to start -- happy to start now if that's agreeable, unless you -- unless the court reporter needs a break.

THE CHAIR: Would you like to take a short break? Yes, I'm getting a nod. So let's take ten minutes, and then -- and then we'll start.

MR. SECORD: Thank you.

(ADJOURNMENT)

THE CHAIR: Okay. You can go ahead, Mr. Secord. And, yeah, if you can kind of look for a spot to break, you know, 4:15 to 4:30-ish, that would be great.

MR. SECORD: Thank you very much.

Mr. Secord Cross-examines Benga Mining Limited

Q MR. SECORD: Good afternoon, panel. My name is Richard Secord. I am counsel for the Coalition of the Alberta Wilderness Association and the Grassy Mountain Group.

Now, I take it you can confirm that SRK Consulting (Canada) Inc. did a groundwater numerical model in 2016 attached as Appendix C to CR Number 3 in CIAR Number 42?

A MR. HOUSTON: That's correct.

Q And is it agreeable if we refer to SRK Consulting (Canada) Inc. as "SRK" in this cross-examination?

A I -- I think they'd be okay with that.

Q Now, Mr. Soren Jensen, did I hear it correctly that you were introduced as covering the area of hydrology?

A MR. JENSEN: Yes. I will speak to the

aspects of hydrology but not hydrogeology.
Q But you're not a hydrologist?
A I'm an -- I'm an environmental engineer.
Q Right. I noticed you had a -- you got a BSc in zoology in 1977 from the University of Manitoba; correct?
A Mr. Secord, no, that's not correct. I was three years old at the time.
Q Okay. If we could turn up your CV, which I believe is in Exhibit 571.
THE CHAIR: Did you have a PDF page number, Mr. Secord?
MR. SECORD: I'm just getting -- I believe it's 209.
Q MR. SECORD: So I have you as having a -- sorry. I have you as having a BA -- bachelor of science, is it, from the UBC?
A No, it's bachelor of applied science.
Q Bachelor of applied science? And then you got a --
A Which is in engineering.
Q And then you got an MA from McGill; correct?
A That's correct, yes.
Q And I noted in your CV that one of your specializations is water quality and contaminant transport modelling; correct?
A That's correct.
Q Okay. And have you been involved in -- in previous

Joint Review Panel hearings as an expert witness?
A No, I have not. This is my first appearance before a Joint Review Panel.
Q Okay. Mr. Stephen Day, I understand you were -- you were introduced as covering the area of geochemistry earlier today; is that correct?
A MR. DAY: Yes, sir, that's correct.
Q And I notice also in your CV that you have expertise in the modelling of leachate chemistry?
A That's correct, yeah.
Q And you have been -- it looks like you've got a -- you have an MSc in geochemistry from UBC and also a BSc in geology from UBC; correct?
A Yeah. That's right.
Q Right. And are you located in British Columbia as we speak?
A I am, yes.
Q And how about you, Mr. Jensen, where are you located as we sit here today?
A MR. JENSEN: You mean --
Q Physically.
A Mr. Secord, you mean physically today? I'm --
Q Yeah.
A I'm in Calgary.
Q Okay. All right.
MR. SECORD: If we could please turn up

Consultant's Report Number 3 in CIAR 42 at PDF page 12. This is the Millennium hydrogeology report. That's PDF 12. Okay. Section 3 point -- Section 3.2. That's great.

Q MR. SECORD: So it states here under the "MEMS Field Investigation": (as read)

> The hydrogeological data collection program consisted of [at first bullet] drilling and installing 19 monitoring wells targeting either one of three coal seams across the project or the upper water table at the CHPP and near a future rock disposal area/water management pond in Blairmore Creek.

Do you agree that the impacts associated with the mine development on the groundwater are predicated on the SRK numerical model developed using site data?

A MR. HOUSTON: So, Mr. Secord, I guess I'm not really clear on what you're asking there. Are you -- you asking if the groundwater information we collected through these field investigation programs are predicated on our estimate of future rainfall or future hydrological climate? I'm not quite sure what you're asking.

Q Do you agree that the impacts associated with the mine development on the groundwater are predicated on the SRK numerical model developed using site data?

A Okay. I -- I --
Q That might be better for the SRK witnesses.
A Well, this report was done -- you've taken us to this report. It was done by Millennium.
Q Yeah.
A And -- and this particular part talks about drilling and -- and water sample collections. I was just trying to -- having trouble making the connection.
Q Well, maybe if you looked at the entire report, Mr. Houston, you would see that Appendix C attaches the SRK modelling results. So although it's a Millennium report, it attaches the SRK numerical modelling results; correct, as Appendix C?
A So that's correct, but I -- I guess I was confused by going to this 3.2 and -- which is talking about collecting data.
Q Right. So -- so do you agree that the impacts associated with the mine development on the groundwater are predicated on the SRK numerical model developed using site data? And put more -- and put more explicitly, this is derived from only 19 monitoring wells, some of them dry?
A So I'm going to ask Ms. Grainger to respond to your question.
A MS. GRAINGER: Mr. Secord, the groundwater assessment was based on site data in part; but as is

listed immediately above Section 3.2 and Section 3.1, there's a lengthy list of information that was used to inform and undertake the groundwater assessment.

Q Sure. But in terms of the SRK modelling, I take it the dataset that it had consisted of 19 monitoring wells, some of them dry. That's the dataset that was given to SRK for the model.

A That's a portion of the dataset, but that's not the complete dataset.

Q But in terms of the dataset that consists of monitoring wells, the entire dataset consisted of only 19 monitoring wells, some of them dry. Do I have that right?

A Monitoring wells, that would be correct. There's other information, but just monitoring wells, there were only 19, correct.

Q So given the size of the project area, over 1,500 hectares or 3,706 acres, and given the complexity of the hydrogeology, can you tell me how this can possibly capture the variability to produce adequate model projections? And maybe that's a question for SRK.

A Mr. Secord, I will speak to the groundwater numerical modelling portion as it's attached to the Millennium groundwater assessment.

Sorry. Your question was whether a -- 19 monitoring wells alone would be enough to

characterize -- sorry. Can you repeat your question, then?

Q Given the size of the project area and the complexity of the hydrogeology, how can this possibly capture the variability to produce adequate model projections?

A Well, I believe when you take the entirety of the data that was utilized to prepare the groundwater numerical model, then it does provide us with an understanding of the hydrogeology at the site and that we have suitably tested uncertainties associated with that model in the numerical model report.

Q So you're saying you can -- you could capture the variability to produce adequate model projections with only 19 monitoring wells, some of them dry? That's what you're saying under oath?

A MR. HOUSTON: Mr. Chair, I believe what the witness, Ms. Grainger, said, was that the 19 monitoring wells are part of the dataset. There are other data points that are used to -- to create the model.

Q Okay.

MR. SECORD: If we could turn up CR Number 3 and CIAR 42 at page -- PDF page 233. And I'm looking for -- yeah, significance of the results.

Q MR. SECORD: So it states here: (as read)

> The British Columbia groundwater monitoring guidelines define three levels of modelling

complexity, based on the potential impacts, modelling objectives, hydrogeological framework, and data availability. The model developed to undertake this assessment may be classified as of moderate complexity defined as follows.

"These are conceptual or numerical models based on a reasonable, though limited, dataset and having limited calibration. These models may be used to determine the potential range of change or to bracket potential effects that may occur due to a given stress."

Hence, while specific results are calculated during the modelling process, there always remains a degree of uncertainty associated with these estimates. Quantification of the uncertainty may be a laborious and expensive process. SRK has attempted to quantify the uncertainty by providing a range of estimates; however, these ranges should not be viewed as definitive.

Now, this statement is made by SRK that the groundwater transport model developed for the project is based on reasonable, although limited, dataset and calibration.

Please explain what you mean by "reasonable" given the limited nature of the dataset supporting this model. And I'm assuming that would be a question for Mr. Jensen or Mr. Day.

A MR. HOUSTON: Although -- Mr. Secord, although Mr. Jensen and Mr. Day both work for SRK, this question you're asking relates to hydrogeology, and so we'll have Ms. Grainger respond.

Q So, Ms. Grainger, do you work for SRK?

A MS. GRAINGER: I do not. I work for Millennium.

Q Okay. And did you write this section of SRK's report?

A I did not.

Q Okay. But you're going to speak to it?

A Correct. It was --

Q Okay.

A -- completed to support the -- the groundwater assessment, and therefore I can speak to it to a degree, yes.

Q Okay. Okay. So the question, then, was: This statement is made by SRK that the groundwater transport model developed for the project is based on a reasonable, although limited, dataset and calibration. Can you please explain what you mean by "reasonable" given the limited nature of the dataset supporting the model?

A My understanding of that would be that, yes, although the dataset is limited, as you pointed out, for a large area, it does -- it's internally consistent. It does provide us an overall understanding of the hydrogeology of the site. It's consistent with our observations. And on that basis, we can use it to predict the potential effects of the project on the hydrogeology at the site.

And I note that in the first paragraph that you quoted, it states that the assessment is classified as moderate complexity, not simplistic. But it is of an intermediate complexity, so it's not -- anyway. Deemed sufficient for the purpose of -- that was utilized for this assessment.

Q And who made the assessment that the British Columbia groundwater modelling -- modelling guidelines Level 2 classification applied in this case? Was that you?

A That would have been completed by the authors of this report.

Q Okay.

MR. SECORD: So please turn up PDF page 226 of CR Number 3, Figures 3-12. So just six pages back. If you can ... 226. There we go. Thank you.

Q MR. SECORD: So if we look at Figure 3-12, which is entitled "Transient Calibration, Monthly Hydraulic Heads, Linear Calibration", you can see that

the blue line is what was measured between 2014 and 2017; correct? I'm assuming you're going to speak to this, Ms. Grainger?

A Yes, that's correct. I'm just confirming the legend.

Q Do you want to scroll down a little bit so we can see the legend at the bottom?

A I guess perhaps it would help if I just confirm that one line represents the modelled output or the head for that period, whereas the other line represents the observed measurements.

Q Sure. And if you see -- if you looked at this before, you'll see underneath that the -- the photograph or the print -- the picture of the mine area, you'll see the blue line showing observed response, and then the -- the red dot is the modelled response; correct?

A Correct.

Q Okay. So the blue line is what was measured between 2014 and 2017 and represents the steady state or observed response; correct?

A That's correct.

Q And the red dotted line is what the SRK model simulated over that period of time?

A Yes --

Q Is that --

A -- that's also correct.

Q And do you agree that the calibration of the

groundwater level fluctuations for the transient calibration are not very good in some parts of the model domain, specifically the northeast quadrant, RGSC-0009C and MW14-06-105, containing Gold Creek?

A I think the model report identifies that there are specific locations that are -- are not well-captured by the model. However, on the whole, the calibration did meet the requirements.

Q Okay. Yeah. But, of course, that wasn't what I asked you.

Let's just take a look at RGSC-0009C in the top right-hand corner. You'll notice the observed response is essentially a fairly flat blue line, whereas the model doesn't come close to duplicating the observed response between 2014 and 2017; correct?

A Correct. The model's overpredicting.

Q And then -- over or under; correct? Why do you say "over", when you have the red line going underneath the observed response? Why did you go to -- why did you go to "over", Ms. Grainger?

A MR. HOUSTON: So -- so I think what --

Q I'm asking -- I'm not -- I'm not -- I'm not asking you questions, Mr. Houston.

A Yeah, I just feel the need to explain. That -- that's all.

Q I don't -- I don't have the need for you to explain.

Are you a hydrologist, Mr. --
A No. I -- I --
Q Are you a hydrogeologist?
MR. IGNASIAK: Mr. Chair, the witness can answer. To the extent it's -- he doesn't think the answer is good, he can make that point in argument.
MR. SECORD: Yeah. Well, I haven't got an argument yet.
A MR. HOUSTON: So --
Q MR. SECORD: How can you answer for Ms. Grainger?
A So what -- what "over" means is -- is that the model is exaggerating the response both in the positive and negative direction to what is actually experienced on the graph.
Q Okay. So you wouldn't accept Ms. Grainger's evidence that it was overpredicting?
A No, I -- I was just confirming her evidence, that it's overpredicting both the positive and negative directions that are -- are --
Q Okay. All right. Ms. Grainger, if we look at the second graph, MW14-06-105, you would agree that the model there comes nowhere close to predicting -- or matching the observed response; correct?
A MS. GRAINGER: Correct. There's also a significant -- well, a notable difference between the

model prediction and the observed measurements at that location.

Q That's in Gold Creek?

A This is in a monitoring well.

Q Right. That monitoring well, MW14 -- I guess, MW14-06-105, that would be sort of in the centre of the mine projection area?

A Yes. It --

Q (INDISCERNIBLE - OVERLAPPING SPEAKERS)

A That's consistent with the figure.

Q Yes. Essentially that black line going to that -- so the red dot area, that -- that would be where that monitoring well is located?

A Correct.

Q Okay. And then we have RGSC. That would be in one of the reaches of Gold Creek?

A That's also in a -- in a vibrating wire piezometer.

Q Okay.

A So a different -- one is a monitoring well, and one's a vibrating wire piezometer.

Q So do you agree, Ms. Grainger, that the red dotted line is way more variable than the blue line, which means that SRK have not constrained the model; or put another way, SRK haven't matched it very well to the observed conditions around Gold Creek?

A These are not -- these are in -- at depth in

groundwater, so this is not in Gold Creek --
Q This is an area --
A -- to be clear.
Q Just to be clear, this is in an area around and near to Gold Creek, RGSC-0009C?
A MR. HOUSTON: Mr. Chair, that point is on the west side of the project footprint. I -- I don't think we can say that it's in Gold Creek. And the other point --
Q I see.
A The other point is certainly in the centre of the mine and probably closer to Blairmore Creek.
Q I think you can -- I think you can say, Mr. Houston, that RGSC-0009C is near to Gold Creek.
A It's on the west side of the project, that's right.
Q Right.
A Or east side of the project. I'm sorry.
Q Okay. Do you agree that -- Ms. Grainger, that this casts doubt on the accuracy of the model to address predicted changes in certain parts of the domain assessed?
A MS. GRAINGER: As I said earlier, it's acknowledged that in specific locations we may not have accurate predictions; however, the intent of the model is provide overall understanding and a good understanding of the system. So there may be specific

locations where there are inconsistencies. That's been acknowledged, yes.

Q How can the Joint Review Panel and my clients, like Fran Gilmar, have faith that the model is giving us results that are anything close to what will actually happen during and after mine development?

A Well, we -- Mr. Secord, there's a significant component of the model which includes the sensitivity test, a series of them, in which we look at and test various scenarios to understand how the model predictions would be different from the ones that were used in the assessment based on those changes. So some of those include variations and recharge, changes in our understanding of the conceptual site model. So we've tested those through the -- the sensitivity analysis to give us confidence in our predictions.

Q Yeah. We're going to look at some of those sensitivity analysis tomorrow.

But, Ms. Grainger, you would agree one of the assumptions in the groundwater model is that the geological strata are homogenous and anisotropic with greater k-values in a north-south versus west-east direction; correct?

A It's a layered system, so the -- each layer is homogenous and anisotropic, so different k-values in each orientation. But each layer has a set different

of properties, so it's not just one mass with the same three properties.

Q How will this affect the model output regarding spatial extent of the drawdown?

A Well, we can start reviewing the sensitivity analysis now if you'd like to look at some of those specific assumptions. But, for example, the anisotropy without the X-Y plan, so parallel to bedding, was tested in the sensitivity analysis, and it was found to make no significant difference in the predictions, whether they were the same or whether they were using the values that were reported in the calibrated version of the model.

Q On this -- on this Figure 3-12, why did you decide to put these monitoring wells where you did?

A Monitoring wells, oftentimes we were combining them with the core-hole program, so we were utilizing locations that were already being drilled as part of the core-hole program. We tried to spatially distribute them across the site and obtain information from different zones.

So that's essentially the driver for why they're located where they are.

Q Okay. I take it you would agree, Ms. Grainger, that sensitivity tests on a bad model are still bad?

A MR. HOUSTON: So, Mr. Secord, we haven't

said that we have a bad model. We've said that our model correlates well with the observations that we -- that we have. So I'm not sure that -- I'm not sure the nature of your question.

Sensitivity analysis around uncertainties in a model are a normal and prudent practice to understand the possible variability.

Q Ms. Houston [sic], did you conduct any investigations to substantiate the more limited hydraulic conductivity in the west-east direction like pumping tests to determine connectivity between discrete monitoring well locations or impacts at springs?

A MS. GRAINGER: So if I understand you, Mr. Secord, you're asking how we specifically identify that anisotropy within the -- the units? Is that what you're asking?

Q Yes.

A So that was an assumption. The physical tests test the conductivity in the planer direction, so in the horizontal direction. So there's no way to tell from the results whether that's reflective of the 'X' direction or the 'Y' direction, whether it's north-south or east-west. It just reflects generally the more permeable direction.

Because of our understanding of the geology and the understanding that there are thrust faults that are

mapped with displacement that's been determined on those features and that they're orientated in a north-south direction, combined with the folding, there was an interpretation that there was a -- a lower conductivity in the east-west direction. And so that's why that was incorporated into the model to account for that feature in the geology.

Q Did Millennium conduct any pumping tests to determine connectivity between discrete monitoring well locations or impacts at springs?

A So I think there was two questions there. There -- the first was, yes, there was one pumping test that was completed in a flowing core-hole which gave us some limited information, but there's no observation wells that were included in that pumping test. So it gives us some data, but it's limited in its value because of the lack of observation wells.

I'm sorry. The second part of your question -- can you remind me?

Q Were there any pumping tests to determine conductivity [sic] between discrete monitoring well locations or impacts at springs?

You probably heard, for instance, that my clients have a number of springs that provide water to their properties, both inside the mine permit boundary and outside, just outside.

A So with regards to springs, we did complete a review of all the information of recorded springs in the area. We also completed a field survey which included collecting information from those springs. And, in fact, some of the old mine portals were monitored on a very frequent basis. I'm not sure if that answers your question.

Q Did that include looking at the springs on Ms. Gilmar's property?

A I don't believe it does.

Q Okay.

A Because it was private property, we didn't access that.

Q Please turn up Bullet Point 3 on this -- CR 3, so basically PDF 202 of this same document. So PDF 207 under the heading "Model Assumptions". So this is -- so Bullet Number 3. So we're now dealing with the SRK model and its assumptions, and the third bullet reads: (as read)

> On the scale of the assessment, groundwater system flow, which is expected to occur dominantly via fracture flow, can be approximated by an equivalent porous media (EPM) model.

What is "EPM"?

A The numerical models use equations which essentially are valid for porous media. So they don't model

specifically the fractures or faults or features like that. So the approach is to take -- essentially to correlate, to say that because we're doing a large model that we can use values on a larger scale that allow us to use equations applicable to equivalent porous media that are essentially representative and reflect the groundwater flow even though there -- there is the influence of fractures or -- or jointing.

Q You would agree with me that EPM is like a sand and --

A Or a sandstone.

Q And everything is flowing equally in the model; correct?

A I -- I think "equally" implies it's isotropic, which isn't necessarily the case.

Q But that's -- that's what happens with an EPM model, isn't it?

A EPM model would mean that it's -- its flow within the porous spaces of the rock, so around grains and that kind of flow, as opposed to a fracture flow, which is through a -- a planar surface.

Q Do you agree that Grassy Mountain is a fracture-dominated groundwater system flow so that groundwater could go left or right?

A I agree. Our interpret -- in the sense that our interpretation is that it is likely a fracture-dominated flow system. But we believe that it

can be represented in order that we can -- by an equivalent porous media approach, and then -- in order that we can use a numerical model to estimate effects.

Q So: (as read)

On the scale of the assessment, groundwater system flow, which is expected to occur dominantly by a fracture flow, can be approximated by an equivalent porous media model.

In which essentially everything is flowing equally, whereas you've just said the Grassy Mountain is a fracture-dominated groundwater system.

So it is nothing like -- it is nothing like an EPM; correct?

A No. This is a -- a common approach that is used for numerical modelling and -- and has been shown to be useful and provide accurate predictions for a fractured system.

Q Please explain how the groundwater system can act as an EPM when conditions are dominated by flow in discrete fracture networks in Grassy Mountain.

A So the equivalent porous media framework assumes that the behaviour of the fractured rock system can be represented by a porous media with properties that approximate the larger scale of conductivity of the fracture network. So flow within the discrete

fractures is not directly accounted for, but represented by the equivalent porous media.

Q If we could look at Bullet Point Number 4 on PDF page 207, so the same page, it says: (as read)

> K is largely anisotropic, with the highest K parallel to bedding planes/coal seams, and to the thrust fault strike with lowest K perpendicular to bedding.

What is "anisotropic"?

A "Anisotropic" basically means that the conductivity, which is the ability of a -- of a -- a unit or a material to transmit water, is different in different directions.

Q So basically anisotropic has a direction to it; correct?

A Correct.

Q And "isotropic" means in all directions?

A "Isotropic" means that it's the same in all directions.

Q And let's look at Bullet Point Number 5 next: (as read)

> Apart from preferential flow parallel to fault strike, there is no major fault acting as a significant conduit and no major regional deep flow influences.

Could we please turn up Bullet Number 2 on PDF page 209 of this same document. And this is under the heading

"Model Properties", and the second bullet is as follows -- it -- it reads in part: (as read)

> The north-south thrust fault systems are modelled to impede flows in the east-west direction.

Do you see that?

A Yes.

Q Do you agree that this configuration will have a profound effect on how much drawdown will propagate outward to the west and east of the proposed Benga mine pit?

A I -- I don't agree. And the reason is because the sensitivity tests -- the sensitivity analysis specifically looked at this condition and tested a scenario where we made the conductivity K1 equal to K2, and there was no significant change in the output of the model with respect to hydraulic heads and baseflow predictions.

Q Please explain why the model has been configured this way when we know that there is evidence of active west-east faults based on the trellis-style drainage pattern.

A Well, I -- I would disagree, Mr. Chair, that there is no evidence for east-west faults.

A MR. HOUSTON: Mr. Secord, if -- if you could give us a reference where you found that information,

that would be helpful, perhaps.
Q Are you saying, Ms. Grainger, that there is no evidence of active east-west faults in the project area?
A MS. GRAINGER: That's correct. The model -- or the site was investigated by -- in Section B, it reports over 400 boreholes, and subsequently there's been more than another hundred, so more than 500 boreholes advanced on the site. The geology has been mapped in detail. As I indicated, there's thrust faults that have been mapped with displacements of, I believe, 10 to 200 metres. All of -- any east-west structure would impact -- if there was displacement on it, would impact the distribution of coal on the project and, therefore, would have been mapped. And these features are not described in the geology section in Section B.
Q So do you agree that the trellis-style drainage system -- or the trellis-style drainage pattern is a fault drainage system and that it is typical in the mountains?
A I -- my understanding of a trellis-style drainage system is that it can occur when there's a -- a ridge and drainage is perpendicular away from that ridge. And that is what we see at the site, but that doesn't necessitate the existence of east-west faults in order to create that drainage pattern.

Q If we could go back to PDF page 207, Bullet Point 6, it states as follows: (as read)

> Recharge follows the same spatial trend with elevation as precipitation. The precipitation, evaporation, and evapotranspiration mechanisms are not explicitly modelled but assumed to be integrated as net recharge. It is assumed that this is approach will not unduly bias the model.

How can this assumption be substantiated in the absence of any documented or field-based evidence?

A Well, the information that we have is recharge at different elevations at the project, which clearly show increasing elevation -- or increasing recharge with elevation. So there is a positive correlation between the two.

Q If too much recharge is added to certain parts of the model domain, how will that affect the extent of drawdown in those portions of the model domain?

A So if I understand you, yes, applying too much recharge would -- it has multiple effects, and -- and that's part of understanding a numerical model, is all of these features are interlinked. So if we apply too much recharge, we also get water levels that are too high in the groundwater system. So there would be

multiple changes that we would see. I think it's important to understand that recharge was calibrated in the process of building the model.

Q So let's -- let's look --

A So, in other words, it's -- yeah.

Q Sorry.

A No. Go ahead.

Q So let's look, just to finish off this afternoon, at PDF 183 in the same document, CR Number 3. And at the bottom -- at the bottom of the page -- bottom of this page, it states that the MAP -- so the maximum annual precipitation for the entire Blairmore catchment is estimated at 719 millimetres and Gold Creek as 777 millimetres.

Correct?

A Correct, that's what it states there. But it's mean annual precipitation, sorry --

Q Mean annual.

A -- not maximum. Yes.

Q Mean annual.

And SRK used the average number of 28 percent for recharge in its model; correct?

A It's not that simplistic. They actually used two calculations of -- of a proportion of mean annual precipitation based on elevation. So there's what's referred to in the model as a linear recharge scenario

and then an exponential recharge scenario. So there are two different functions that were applied to apply recharge across the model.

Q Okay. My understanding is, though, that Benga used the average of 28 percent recharge in its groundwater numerical model, and in some cases -- in some areas of the model, it is as high as 50 percent?

A So it was increased in some specific areas, such as a -- a clear-cut area, where it was interpreted that groundwater recharge would be higher because of reduced evapotranspiration.

Q So is the model then saying that 28 percent of the Gold Creek MAP will end up as recharge? So that would -- by my math, that would be -- 217 millimetres would go as recharge, and 550 -- 559 millimetres would run off. That's what the model would be doing using the 28 percent figure; correct?

A Sorry. To be clear, the -- the model's only adding recharge onto the top layer. Runoff is -- is not included in the model.

Q No. I'm just doing the math, Ms. Grainger. So if the model is saying that 28 percent of the Gold Creek MAP will end up as recharge, that would be 217 millimetres annually; correct?

A MR. JENSEN: Mr. Secord, perhaps I can step in here. We are moving into the -- into the realm of

water balance. No, that's -- that's not correct.
Q Okay.
A The -- you're leaving out the evaporation proportion of it. So we estimate that the mean annual runoff is equivalent to 323 millimetres.
Q Okay.
A So -- sorry, not runoff. Yield. We think of it as yield when it comes to a water balance.
Q Yes.
A So that means the difference would evaporate.
Q Yes.
A So you're -- you're -- you're not accounting for the evaporation in your math.
Q Sure. Well, the number I'm really mostly interested in, Mr. Jensen, was the recharge number. That would be 217 millimetres would end up in -- as recharge?
A MS. GRAINGER: Sorry. Can you repeat the question?
Q I thought it was just simple math. 28 percent of 777 millimetres is 217 millimetres.
A Sorry. You're asking if that is the correct value? I guess what I was trying to be clear is that's not necessarily the amount of recharge that's applied across the model. So if that's what -- if you're just asking what's 28 percent of 777, I would have to check the -- you know, but that sounds about right.

Q Sure. And my understanding, that was the average number, and in -- and in some cases the model uses -- the model has a recharge as high as 50 percent. So that would be -- basically half of the 777 millimetres would be allocated as recharge in some area -- in some parts of the mine site? Do I have that right?

A I guess as I tried to explain, it's -- it's -- there is a function that's applied, so I would have to confirm. But --

Q You want to -- you want to confirm that and then come back in the morning, and we can pick up on this thread? Because I think the chair would like me to finish at about 4:30, and we're there.

A MR. HOUSTON: So, Mr. Chair, I think it would be a good time for us to come back to this in the morning, and -- and we'll have a clear answer then.

MR. SECORD: Thank you, panel. We'll see you all at 9 AM.

THE CHAIR: All right, Mr. Secord. We will start tomorrow morning at 9 AM, and you will continue with your cross.

MR. SECORD: Thank you.

THE CHAIR: Is there any business we need to take care of before we say goodbye for the evening?

Discussion

MR. IGNASIAK: Mr. Chair, it's

Martin Ignasiak. We did have an opportunity to look at the -- the DFO document that Mr. Drummond provided earlier.

THE CHAIR: Yeah.

MR. IGNASIAK: Look, so that document is essentially another submission by -- by DFO in this proceeding. It's about 23 pages or so. I might be off a few. But it's -- it's basically a -- you know, a number of additional DFO people I understand contributed to it and -- and they're submitting it, and it -- it essentially bootstraps DFO's previous submissions.

So, one, it's -- it's an additional submission in the middle of a proceeding long after the deadlines. Two, it bootstraps previous evidence, which is inappropriate to say the least. But that said, provided it -- you know, it's clear to everyone we're not -- we're not setting a precedent here where this will be allowed going forward, we -- we don't object to it being entered as an exhibit, you know, taking into account the nature of these proceedings in a somewhat more, you know, more -- more -- more lax rules, I would say, about filing of exhibits and accepting evidence on the record so -- so would allow it, but -- but we wanted to make those comments and -- and will address it to the extent we need to further in argument or

during cross-examination of DFO's panel.

THE CHAIR: Okay. Thank you, Mr. Ignasiak.

So I guess on that basis we'll accept it as an exhibit. I guess the Panel's open to -- if there's a feeling that there's a need for any additional process in relationship to this late submission, we would entertain that, and people can make that case if they would like to.

MR. IGNASIAK: Thank you, sir.

THE CHAIR: So do we have a CIAR number for that?

MS. ARRUDA: Elaine Arruda here. It would be CA -- CIAR 847.

THE CHAIR: Okay. Thank you.

EXHIBIT CIAR 847 - FROM THE GOVERNMENT OF CANADA (FISHERIES AND OCEANS CANADA) TO THE JOINT REVIEW PANEL RE: ASSESSMENT OF THE ECOLOGICAL IMPACT OF THE GRASSY MOUNTAIN COAL PROJECT ON WESTSLOPE CUTTHROAT TROUT IN THE BLAIRMORE AND GOLD GREEK WATERSHEDS, ALBERTA

THE CHAIR: Any other business? Okay. Good evening, everyone. We'll resume tomorrow morning at 9 AM.

PROCEEDINGS ADJOURNED UNTIL 9:00 AM, NOVEMBER 17, 2020

CERTIFICATE OF TRANSCRIPT:

I, Claire Forster, certify that the foregoing pages are a complete and accurate transcript of the proceedings, taken down by me in shorthand and transcribed from my shorthand notes to the best of my skill and ability.

Dated at the City of Calgary, Province of Alberta, this 16th day of November 2020.

<Original signed by>

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Claire Forster, CSR(A)
Official Court Reporter

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