Board of Inquiry into the McCrae landslide

Before: The Chairperson,
Ms Renée Enbom KC

Federal Court of Victoria,
305 William Street, Melbourne, Victoria

Tuesday, 5 August 2025 at 10.00am

(Day 12)

Mr M. Costello KC with Mr A. Di Stefano appeared as Counsel Assisting.

Ms K. Evans KC with Ms E. Peppler appeared on behalf of the State of Victoria.

Ms K. Foley SC with Ms E. Bateman appeared on behalf of the Mornington Peninsula Shire Council.

Ms D. Siemensma appeared on behalf of South East Water Corporation.

CHAIRPERSON: Mr Costello.

MR COSTELLO: Good morning, Madam Chair.

CHAIRPERSON: We have the same appearances as yesterday?

MR COSTELLO: Yes.

CHAIRPERSON: We do. Just before you start, thank you, experts, for returning this morning. Can I remind you of what I said yesterday, which is that you're here to provide your honest opinions on very important issues. You are not here to advance a position that suits those who engaged you. You're here to provide your honest opinion. You may have noticed that there are many residents from McCrae in the gallery watching this hearing, and they're here because these issues are very important to them and they're here to hear your expert opinions, only your expert opinions, not your client's.

Mr Costello.

MR COSTELLO: Thank you, Madam Chair.

<HONG VU, CONTINUING:

<CHRISTOPHER MARTIN JEWELL, CONTINUING:

<HUGO DOUGLAS BOLTON, CONTINUING:

<DAVID MATTHEW HARTLEY, CONTINUING:

<DARREN ROSS PAUL, CONTINUING:

<STEPHEN LEONARD MAKIN, CONTINUING:

<DANE RICHARD POPE, CONTINUING:

<PHILLIP WILLIAM HITCHCOCK, CONTINUING:

<EXAMINATION BY MR COSTELLO:

MR COSTELLO: Mr Pope, can I start with you. I just want to deal relatively briefly with two remaining preparatory factors that are points of contention. The first is old fill.

MR POPE: Yes.

MR COSTELLO: And the second is the retaining wall, and then others will wish to ask you questions on this topic. But let me just orientate us all. Old fill, which is 17 in the joint report concerning the 5 January landslide and 29 in the joint report concerning the 14 November - sorry, 14 January landslide - and 29 for the 14 January landslide and 17 for the 5 January landslide, this was a topic that you didn't consider in your causation report, is that correct, old fill?

MR POPE: No, that's incorrect. It's very much a unit identified in the report.

MR COSTELLO: Sorry, Mr Paul didn't consider it in his causation report but you did; is that your recollection --

MR POPE: That's my recollection of it, yes.

MR COSTELLO: Yes. Okay.

MR POPE: But I think Darren might want to - I think he's considered fill but not much.

MR COSTELLO: He has.

MR POPE: Yeah, yeah.

MR COSTELLO: He has.

MR POPE: Yep, sorry. Yep.

MR COSTELLO: He says in the joint report that he hasn't dealt with it in his causation report but has subsequently considered it and made some comment about it in the course of the notes to the joint report.

MR POPE: Correct; yeah.

MR COSTELLO: Does that assist? Now, on this factor, it's a preparatory factor, so there's no suggestion by you that fill is a trigger for the landslide occurring; that's correct?

MR POPE: That's correct, yes.

MR COSTELLO: It's just a factor that leads to - is it fair to say to potential for greater slope instability? How would you phrase it?

MR POPE: No, that's correct. I mean, I - side cast fills or fills over steeper existing ground are quite a common hazard. Like, my team's routinely fixing them on roads. So, yeah.

MR COSTELLO: I see. And would it be even more common in built-up residential areas?

MR POPE: In big quantums, no, but in small volumes it's pretty common, yep.

MR COSTELLO: It was established yesterday in the course of the evidence that fill generally - I'm not speaking of the particular fill at the site of the slide here, but fill generally can have been in place for significant periods of time?

MR POPE: Yes.

MR COSTELLO: And still meets the definition of fill?

MR POPE: Yep, absolutely.

MR COSTELLO: And do you have any view about the fill here? Is it of varying ages; that is, has some been there probably for quite a number of years and other of it might be more recent?

MR POPE: Yes. So I identify in my report essentially two fill types, so fill associated with construction of the retaining wall on 10-12 View Point, and then everything else is old fill beneath that layer, and so - I touched on it yesterday - there's - a registered surveyor went I think through there in 2014 and did levels in that area. So we have survey records from a surveyor. We have got a series of LiDAR files that predate the retaining wall, and then we have the evacuated land form from - as in post-landslide. So they're essentially the key surveyed surfaces I rely on to bound where the fill is.

MR COSTELLO: All right.

MR POPE: Yep. The significance to me of the old fill is

if it wasn't there I don't think we're having a landslide. So that's why I've put it as major.

MR COSTELLO: When you say old fill, do you have a view as to the age?

MR POPE: Look, I - in the conclave report we discussed it. It's not convincing that - from aerial photos alone that it was the mid-70s. But I feel it's older than the 70s.

MR COSTELLO: I see.

MR POPE: Yep. It's got VC pipe, or vitrified clay pipe, the old sewer pipe, in it. It's got galvanised pipe in it. Those materials have been around for a long time. So it's not unusual for that to be there that long ago.

MR COSTELLO: Right. And so the fill from the 70s alone, even absent any newer fill than that, would to your mind be a preparatory factor of some significance?

MR POPE: Yes.

MR COSTELLO: And could you just explain briefly what it is about the fill being at that location that creates the problem that means it is a preparatory factor?

MR POPE: Essentially the fill has been deposited over a steep existing - the escarpment is quite steep, I think as everyone understands. So that fill has been placed over steep slopes. So, if you apply loading to that fill, fundamentally the load has a lot of difficulty getting into the underlying granites and it must go sideways. In engineering we call it a strain incompatibility, but essentially you load the fill up, it will move a lot more than the granite will by comparison. So you place a load on that fill, it wants to translate down the hill. That's the significance of it. It can translate without load as well, though. So if you had water in there it can move. Yeah. That can be the change in load, is the change in water. Trying not to get too technical levels, but if water levels change the stresses so there's a change in load then it can move from that as well.

MR COSTELLO: Yes, all right. So, just to be clear, you've viewed this in relation to the 5 January landslide

as a major contributing factor, and with that you had a high degree of confidence?

MR POPE: Yes.

MR COSTELLO: And in respect of the 14 January landslide you also viewed it as a major factor with a high degree of confidence?

MR POPE: Yep, yes.

MR COSTELLO: All right. Thank you. I'm going to ask Mr Paul to comment on this issue now, but before I do is there anything else you wanted to mention in connection with fill?

MR POPE: Just with the old fill model, I mean, PSM has been subjected to independent peer review of that model, and I don't believe it was flagged as a problem during peer review. Yep.

MR COSTELLO: Mr Paul, you at least at the time of the conclave had a different view on the question of old fill. You thought that it - well, sorry, not - yes, of old fill. You thought that it was a minor factor and you had a moderate degree of certainty in that opinion. Is that still your view as you sit there now?

MR PAUL: It is.

MR COSTELLO: All right. Could you explain why?

MR PAUL: I looked hard at finding physical evidence for the old fill and couldn't find it, is the simple answer. So it might be worth talking to what things we would look for to identify that something is fill compared to natural. We would look for things like does it contain materials that are non-natural, and I can perhaps show an image, actually, to illustrate that.

MR COSTELLO: Yes, of course.

MR PAUL: MSC.5087.0001.0405, which is just some photo of the headscarp.

MR COSTELLO: Is that from your report?

MR PAUL: No, that is from the PSM causation report.

MR COSTELLO: So I think it's 5087.0001.0157, and it's at page 0405. What we're looking for here are two pictures side by side?

MR PAUL: There's two images on that page, and one of them is of the - yes, it's the one on the left there.

MR COSTELLO: Yes. Perhaps the picture on the left could be --

MR PAUL: One of the - the picture on the left would be the headscarp. Okay. Great. So that's an image looking towards 6 View Point Road, and you can see the landslide headscarp. And we can see at the top of the headscarp a darker coloured material. We see there's some fabric sort of within the first few metres below the top of the scarp.

MR COSTELLO: The fabric. That's the mesh that can go into the ground; is that what that --

MR PAUL: Yes. That's right. So where the red dot is that is on that material. Now that is certainly fill. I have no doubt that's fill because that contains plastic and rubbish and, you know, fills that don't belong. Below that what's exposed in the headscarp does not contain those materials. So that's one of the things we look for.

We also look for does the soil type that the fill is comprised of, is it natural to that area or not. That's an indicator it's been brought in. The soils below that interface to me are natural to that area.

We also can look for, you know, historical evidence, things like aerial photos. So - and old survey. So, for example, I took the 1950s survey, contour survey, which was shown yesterday, compared that to the current surface and couldn't find evidence there that that surface had changed significantly. But it's a 1950s survey. It has the accuracy of a 1950 survey. So couldn't see evidence of that. When I look at that escarpment I can see there must be some fill involved in the landslide because I can see fill at the top. But what I don't have evidence for is that that fill essentially filled that entire hole that we can see in that image. I don't have physical evidence for that.

Now, if that evidence were to appear, of course that would change my view. But at this point I don't have physical evidence for that entire thing containing fill. So that's the difference.

MR COSTELLO: Does that mean, Mr Paul, that you and Mr Pope are in disagreement about the contour of the headscarp, how it would - the natural contour of the headscarp as opposed to the contour created by the addition of fill?

MR PAUL: No, we have a survey from 2017, and that survey from 2017 shows the ground surface. Disagreement is in what's below that surface.

MR COSTELLO: I see. Mr Pope - Mr Hartley, I will come to you. Mr Pope, there has been mention made by Mr Paul about the absence of materials that one might expect to see in fill. I think in your initial answer you pointed to some materials that you had observed or somebody had observed that were in the soil that helped - led you to the belief that it was fill; is that right?

MR POPE: I mean, high confidence of what Darren talked about is fill. It's 2 metres deep there. When we - when I - not we. When I took the water sample on the water flow rate - sorry, clear that up, didn't take a sample - flow rate on 16 June, briefly put the shovel into the flank of that bottom left-hand side of the material to the - it's to the left of that shrub that's in the photo, and on two or three - I wasn't in there for a long time, so this is something we need to have a better look at when it's more appropriate to go in there. But a couple of digs with the shovel, I'm in a sand matrix and hit a big chunk of clay that is of alluvial origin, and in that area there's gardening gloves and things. So I'm not convinced it isn't fill.

MR COSTELLO: So you're not convinced it isn't fill?

MR POPE: I'm confident it's fill. Sorry, I'll be clearer. Yeah.

MR COSTELLO: Mr Hartley, you seem to bridge the gap somewhat between the opinion of Mr Paul, who thought it was a minor factor, and Mr Pope, who thought it was a major

factor. You thought it was a medium factor. But, like Mr Paul, you had a moderate degree of confidence. Is there anything that you would like to add to the discussion that's already occurred on this topic?

MR HARTLEY: My conclusions have come from reading the evidence from the other two experts and from the photographic evidence and the maps, you know, supplied by Mr Pope. The asymmetric nature of the geology looking on the plan of the gully would seem to explain the asymmetric nature of 5 January. So that would be where my conclusions basically rest.

MR COSTELLO: Right. And, Mr Pope, you're in the position that Mr Hartley and Mr Paul are not in of having attended at the site?

MR POPE: Yes.

MR COSTELLO: And you've just given some evidence about observations you made. Are your observations made at that time of a strong significance to the conclusions that you've come to on this topic?

MR POPE: The main fill on the flank there is not so significant as the amount that's up the top, and what I talked about yesterday how - it's very difficult to get that fill over the escarpment and not have it translate down the hill. If I can show you - there's two images - or one image in particular in my report.

MR COSTELLO: Is this from your report?

MR POPE: Yeah, appendix C.

MR COSTELLO: It should be the same document. If you just give the last four digits it will --

MR POPE: 0388.

MR COSTELLO: This is an aerial shot of some description?

MR POPE: Yeah, an oblique view. Yep, you just went past it. So --

MR COSTELLO: Let's understand what this is first --

MR POPE: Sure.

MR COSTELLO: -- because it's sort of clearly distorted in the image. But what type of image is this?

MR POPE: This is a screenshot from Nearmap's 3D models. So, as I said, they're a rough 3D model, but it gives you, as you can see, a rough view of what's going on. If you look to the trees that I've highlighted in the centre of frame, there's a red line with the triangles on it. That is the mark-up for a break in slope. So if you move up the page from that line you can see what looks like brown grass to me. That zone there - and this is validated by the feature survey from 2014 - it's not particularly or it's not as steep as the other slopes around there. So to me - sorry, the red line is metres north of where we identified the fill in the headscarp photo. So to me I can't see how the facts support that you don't have a tip head pushed out off the escarpment there. That break in slope is metres north of where the headscarp is, and it's not a significant distance down the hill. So it's been pushed out and then the fill has to reel down at repose. Like, you can't cutely tie it in neat to a cute flat escarpment.

MR COSTELLO: Is there another image you wanted to go to?

MR POPE: To what David was talking about is 255.

MR COSTELLO: This is a cross-section?

MR POPE: Yes, correct. So Mr Hartley touched on this. This is looking up the gully towards, like I said, if you were standing down at - if it was possible - somewhere down near 3 Penny Lane and looking towards - so 6 View Point would be on the left-hand side and 10-12 View Point would be on the right-hand side. The dark line is the - is what has been evacuated by the landslide. The blue is what I've called old fill. There is uncertainty about how much colluvium is underneath all that. We're not sure.

MR COSTELLO: When you say "all that", do you mean underneath the old fill?

MR POPE: Yeah, correct. Sorry. So when you look at that the gully itself is what we've described in the conclave report. It's out of balance. So if you were to draw a line vertically on the 15-metre X axis there you can't fold

it over and - there's no symmetry there. And from the mapping I've done around McCrae a lot of the gullies are quite symmetrical, especially the ones that have recently had water and recent - and take water as we speak, like Coburn Creek in The Eyrie. They're symmetrical - roughly symmetrical on axis, and it's quite unusual, and I'd challenge any of the experts to take me to somewhere in McCrae where you have a gully like this that's this out of balance. I can't place that from windblown deposits. Like, I can't believe the wind blows in one direction for 5,000 years, and I can't believe that you've got preferential landslides in that direction and not the other flank. It just doesn't make sense, and I don't think the facts support it.

MR COSTELLO: So that leads you to conclude that fill is the only plausible explanation?

MR POPE: Yes.

MR COSTELLO: Mr Paul, did you want to make any - you don't have to, but did you want to make any comment on either of the pictures that you've just been shown?

MR PAUL: The one up there, the difference in my model is you can see the yellow on that model, which is colluvium, and it shows it in sort of a uniform thickness layer extending right the way across where - remember we spoke about yesterday the colluvium in my model was channelised. The volume of fill there - I'm not disputing in any way fill has been pushed over the edge. That's fairly normal. I'm disputing the volume. I would say only there's fill just at the top there. The reason for the asymmetry in the gully is the orientation of the gully. It doesn't come - the paleochannel, sort of my model, doesn't come directly out of the slope. It's comes out of the escarpment at an angle. That's what explains the - you know, like, the problems with the geometry --

MR COSTELLO: I see.

MR PAUL: -- (indistinct) exits the slope.

MR COSTELLO: Mr Hartley, did you want to make any comment?

MR HARTLEY: Only so much as the - I'm not too sure if -

well, I think Mr Paul is alluding to the idea that - you can correct me when I'm wrong - the gully turns at an angle. So basically it approaches the escarpment from a south-easterly - a more south-easterly direction, and therefore the turn is almost like a racing car. It swings around on the outside of the bend.

MR COSTELLO: Mr Paul, is that accurate enough? It's better that the two of you have this conversation for us all to hear rather than Mr Hartley's evidence preceding on a false assumption, that's all.

MR PAUL: We've probably got to be clear when we talk about channels, there's the paleochannel, which is the channel that's - if you look at that image we see there would be the channel that's defined sort of almost by the dark black line. It's the one that's got the colluvium in it. And then we're talking about the surface channel, which is the - you know, the more recent one rode into it. So we've got to be careful we're not crossed with terms there. So I'm talking about the colluvial channel. It's the one which we consider the water was conveyed along to the landslide site. That channel seems to come out of the escarpment at an angle, and there's multiple pieces of evidence to do with where the seepage was observed that tell us that's the case.

MR COSTELLO: I see. Does that assist, Mr Hartley?

MR HARTLEY: It does, although the initial - the situation at the present time, which would be - you know, as we can see from the cross-section is pretty central. I believe that there are - the drone footage points from 15 January would indicate spots of seepage. Basically if you're looking up the gully from about 1 o'clock through to about 10 o'clock, something like that, if you're looking at the centre point of the gully, you're looking there, there's seepage points there. It doesn't quite sit comfortably with me that the 5 January failure, which is so viciously on the right-hand side of this gully, would have failed at the point of which it failed, I mean, just this kind of - this angle of approach from the water.

MR COSTELLO: And what does that tell you about the question of fill, then?

MR HARTLEY: It strikes me that on the western side of

the gully or the right-hand side of the cross-section, you know, change 18 through to 20, that type of thing, is that there is a difference in soil make-up - you know, consistency, compaction, deposition method - compared to the remainder of the channel.

MR COSTELLO: I see. Thank you. Mr Pope, Mr Paul, Mr Hartley, a general invitation before I move to the question of the retaining wall. Is there anything else on this topic that you felt it was necessary to mention to assist the chair to properly understand the issue?

MR PAUL: We looked at aerial photos, tried to find evidence the fill was placed in the 70s. I sort of make the comment that 260 cubic metres of fill, which I think is what the estimate is, is something like, you know, 26 dump trucks coming up over the edge, and I make the point that at that time you had the house at 3 Penny Lane there, which was built in the 50s down the bottom, and I just find it improbable that that volume of material - even in the 70s, under the standards in the 70s, that volume of material would be tipped off the edge above a house I'd find quite improbable.

MR COSTELLO: Mr Pope, I should just give you an opportunity to respond to that. Have you seen any evidence that indicates when or how this fill would have been placed?

MR POPE: There's - as I said earlier, aerial photos in the 70s have got disturbance to the vegetation and there's exposed slopes at that time. It's not as blatantly clear as the other landslide that I identified in the 70s from those photos. So in the conclave report I basically accept that the photos don't support it that well as being from the mid-70s, but there's no reason it can't be earlier. Yes.

MR COSTELLO: I see. Thank you.

MR POPE: The community as in - not the community. The council, the State, there's a lot of legacy of a lot of fill going into deep gullies in the community. So obviously --

MR COSTELLO: Generally, not this gully --

MR POPE: Generalising, yes. But the Mornington freeway, the Margaret Street gully, The Eyrie gully. There is a history of significant backfill in gullies around the town, yep.

MR COSTELLO: Thank you. There might be other questions on that, but I'm just going to move to retaining wall, and others can ask questions on both topics together. On retaining wall I think you each line up with the same degree of contribution and the same degree of confidence as in respect of old fill; that is, Mr Pope, you're major with a high degrees of confidence; Mr Hartley, you're medium, and I think you've got a low degree of confidence on this one, slightly lower than you did with respect to fill; and, Mr Paul, you view it as a minor factor with a medium degree of confidence.

So I should probably start with you, Mr Pope, and I might just put something on the screen. Could you just take that - I can't remember which document's up. 5087.0001. Could we please go to 0210 of that document. Thank you. Mr Pope, I'm just putting this up in case it assists you. You might have something else you want to go to, but I thought this might be a useful way to start. Once again, just to make it plain, this isn't suggested as a trigger; it's suggested as a preparatory factor?

MR POPE: Correct, yes.

MR COSTELLO: Something that to your mind destabilises the slope, it's not causative of slide?

MR POPE: No, it's not a trigger. It is causative of a slide.

MR COSTELLO: Sorry, yes, you're quite right. It's not the trigger for the slide that occurred, but it's a preparatory factor?

MR POPE: Correct, yeah.

MR COSTELLO: And I won't go back to the semantical debate about --

MR POPE: Yeah, yep.

MR COSTELLO: Now, why don't we start by you - this is a

retaining wall that was built after the 2022 landslide and obviously before the 2025 landslides?

MR POPE: The front part of it, yes. Yep.

MR COSTELLO: And why don't you start by explaining why it is that you're of the opinion that this retaining wall is a preparatory factor here?

MR POPE: The simplest way to start is with the piers. So they're highlighted in grey, centre frame basically, near the --

MR COSTELLO: Would it help if I had that blown up? There we are.

MR POPE: Yep. So basically where the leader is saying - that's fine. Where I've got "tension crack at base of retaining wall", where that's pointing, that's pointing - that's over the - in line with the pier. So in that pier is concrete and a steel upright, and what we found post landslide with the Pointerra Reality Model is you can measure the length of these piles, especially the ones that went down the slope, and what we found is the piles were not long enough to go down into the residual granite, or the XW granite, whichever view you take on that material.

The effect that that has where the piles aren't long enough to go into what I would call a competent material is any stress applied with the fill above does not have an effective mechanism - there isn't an effective mechanism to transfer that stress into the rock below. So what that - simplest terms is, instead of being a piled retaining wall, then you're looking at a gravity retaining wall. What that means is that the zone of influence of all the fill that's been put there is much wider. So if you had 3- to 4-metre long socket in those piles and they were well down into the granite, the stresses can't distribute down the hill the same as if you just have it all sitting up high.

So basically what this then becomes is an increase in stress on a series of steep planes. So it's complicated enough putting a wide loaded area near an escarpment. But if you put it over buried steep planes the stability is worse or it's more susceptible to landslide, basically.

MR COSTELLO: So on that thesis the retaining wall becomes

a destabilising force?

MR POPE: Yes, yep. So that orange zone, if you do the equivalent horizontal stresses down in the green and the yellow layers, it's a roughly 40 per cent increase in horizontal stress there, and it has no means to be retained there. The stress must distribute down the hill.

MR COSTELLO: The means by which the stress could have been better distributed, on your thesis, is by the retaining wall being sunk lower into the granite?

MR POPE: Correct.

MR COSTELLO: With a socket joint, did you say?

MR POPE: With a socket well into the granite. The extent of the retaining wall would have had to gone into 6 View Point to deal with the mass that moved. So it's the socket and it's the extent of the wall as well.

MR COSTELLO: I see. Can I perhaps bring up another photograph, MSC.5056.0001.0003, and if we could go to 0057. Now, this is an image from the 5 January landslide?

MR POPE: Yes.

MR COSTELLO: From the headscarp looking back to the retaining wall, which can be seen up on the left; is that right?

MR POPE: Yep. Yes.

MR COSTELLO: So at this point in time there's - it's hard to ascertain how much, but there's an amount of ground between the retaining wall and where the headscarp has fallen to?

MR POPE: Correct. But the original image you showed me will show you what that distance is in section. Like, 210, 0210, will give you proximity to the wall.

MR COSTELLO: 0210 is the image I just showed you.

MR POPE: The first image you opened with, 0210, yeah.

MR COSTELLO: Would you like me to go back to that?

That's 5087 - it's the immediate past image, 5087.0001. Yes, thanks.

MR POPE: So the red hatching on the right-hand side of the retaining wall, it represents that evacuated mass that I viewed on 6 January, and the distance between the wall - so this image, to explain it, it's two cross-sections 3 metres apart from each other superimposed on each other. The reason I did that is so you can see where the 6 Jan is relative to where the larger volume in the landslide was back to the north. It's only a couple of metres down from the wall. The loaded area in orange from the retaining wall is metres wide. It's first principles engineering that that is well within the zone of influence of that load. There is - the 3D element for me - to me that's the toe of the fill that's dilated. It's what dilated. The stress changes have been in the toe of the slope and, when it dilates, cracks open up, and you've clearly got all of us - I think all of us agreeing that there's plenty of water coming through there. You open up the soil with cracks, the permeability change, and you have a preferential flow path through that area. So, looking at it in a 3D, it's not a surprise to me that it's failed there.

MR COSTELLO: Can I have on the screen, please, MSC.5087.0001.0157 at 0394. I think it's this document. This is another image of the wall in question; is that right?

MR POPE: No, it's not. That's a retaining wall that was built in 2022, and that sits in behind the wall built in 2024.

MR COSTELLO: This is the state of it as at 2022?

MR POPE: No. There's two walls. So, if you go back to my section, that is a wall built in 2022.

MR COSTELLO: Yes.

MR POPE: And then the wall that we see there today was built in 2024.

MR COSTELLO: That's right.

MR POPE: Yeah.

MR COSTELLO: Sorry, I just said to you this is a picture of the state of it at 2022.

MR POPE: You consider them the same wall. It cracked, yes. Yeah, yeah. This photo is in 23 --

MR COSTELLO: Sorry, don't worry about the other wall. I just want to know this --

MR POPE: This is in 23, 2023, yeah, yep.

MR COSTELLO: Thank you. And then there was further work done?

MR POPE: Yes.

MR COSTELLO: And either a new wall built or some extension to this wall. How do you classify it?

MR POPE: I would need to see detailed drawings to know how the - if they were connected to each other or whether they're independent of each other, so --

MR COSTELLO: Have you seen detailed drawings in respect of the addition - not this, but the addition or work that was done?

MR POPE: I've seen drawings for a retaining wall, but I don't believe it was built. So Rexicon produced some drawings, but I can't - so, yes, sort of. And then for the wall that was built, no.

MR COSTELLO: So you haven't seen any plans or any architectural - sorry, any engineering work associated with the wall that's in question now; is that right?

MR POPE: So in my report I've got - it's page 19, which is 0175.

MR COSTELLO: This one?

MR POPE: Correct, yep.

MR COSTELLO: This is what you've seen in connection with the wall as built?

MR POPE: Yes.

MR COSTELLO: I see. Thank you. Could we just go back to the prior picture. The one thing that really I wanted to establish from this picture is that tree that can be seen close to the middle but towards the left-hand side perhaps of the image, which from the wall as at its 2023 state looked some distance away. Of course things then change. And if we go to - try 0056. I'm not sure if that will work. 5087.0001.0003, sorry, and then at 56. 0056. No, that's not it. Sorry, Mr Pope, I just want to find a picture, but I've given the wrong document reference. Let me just pull it up. Actually, I think that's right, and I think it's actually from your risk to life report, and I think that that might be 5056. Try that. In fact, if you try this, 5056.0001.0003, I can do two things at once because I need to tender this document as well.

CHAIRPERSON: I think that report, Mr Costello, is subject to a non-publication order.

MR COSTELLO: This one?

CHAIRPERSON: Yes. Is there a particular drawing in that document you want to go to?

MR COSTELLO: One photograph. I'll find it somewhere else. I'll come back to it. It's fine. I won't tender that now.

MR POPE: I thought we did yesterday.

MR COSTELLO: Yes, we tendered an earlier version yesterday, and this is the revised version. So I do need to tender that --

CHAIRPERSON: Yes, and we can tender it. It just won't go on the website.

MR COSTELLO: Yes, I understand. I should just tender that now for the sake of --

CHAIRPERSON: Yes.

MR COSTELLO: The version I just pulled up, Mr Pope, to be clear to you, is not the version I tendered yesterday.

MR POPE: Okay.

MR COSTELLO: It's a version that you might recall you made some amendments?

MR POPE: Yeah, rev 1.

MR COSTELLO: I think mainly mathematical calculations.

MR POPE: Yep.

MR COSTELLO: So I should tender that.

CHAIRPERSON: Yes. PSM's landslide risk assessment dated - what is the date of that document? Is it 28 May?

MR COSTELLO: May. 28 May.

CHAIRPERSON: Dated 28 May 2025 is exhibit CA77.

EXHIBIT #CA77 PSM's LANDSLIDE RISK ASSESSMENT DATED 28 MAY 2025

MR COSTELLO: The only - that was a long diversion for a small point, Mr Pope. The only point that I was hoping to raise with you from the photograph that I didn't end up putting on the screen was that that tree is still standing?

MR POPE: It was on the 6th. Yes.

MR COSTELLO: On the 6th?

MR POPE: Yes, correct.

MR COSTELLO: And that tells you something about both the distance between that tree --

MR POPE: Correct, yeah.

MR COSTELLO: -- and the wall?

MR POPE: Yeah.

MR COSTELLO: And it tells you something, potentially at least, about what's going on with the headscarp?

MR POPE: Yeah, and you've got to consider that to build

the new wall I think the piers are 450 diameter roughly and you've got to have an offset downhill from that wall in the photo, and the headscarp of the 6th, as I viewed it on the 6th, was uphill from the gum tree. So the gum tree was what I used for reference, but also --

MR COSTELLO: Go on, Mr Pope.

MR POPE: The gum tree has been used for reference. No-one did a survey on the 6th. So I accept that this is - like, there's a limit to what you can measure by hand out there on the 6th. So there is going to be some scope for - do you mind, Gerry? There is scope for error in the measurements.

MR COSTELLO: All right.

MR POPE: But, I mean, the new wall is half a metre down the hill. The headscarp is - you can see those photos. The tree is not at the upper limit of the landslide. And even if I'm out by a metre you're still within the zone of influence of the wall.

MR COSTELLO: I just want to understand this zone of influence concept before I hand over to others to have something to say about this. There has been evidence in the commission prior hearing blocks that in between the two landslides the headscarp was moving up the hill, that is that it was eroding upwards? Do you understand what I mean by --

MR POPE: Yeah, I know what you mean. I think there's few people aren't across that there was a tension crack at the retaining wall.

MR COSTELLO: Yes. Underneath?

MR POPE: Yes.

MR COSTELLO: That is the headscarp seemed to be moving up and --

MR POPE: No, no. No, when I was there on the 6th the tension crack was there when I was on site. It didn't come later.

MR COSTELLO: Two things were happening at once. Just let

me finish and you can tell me if I'm wrong. One thing that was occurring was that the headscarp was moving up. That was something that happened over a succession of days?

MR POPE: You'll naturally get regression that way, yes.

MR COSTELLO: And another thing you say that you observed on the 6th was a tension crack at the location of the retaining wall?

MR POPE: Yes.

MR COSTELLO: All right.

MR POPE: The base of the retaining wall, yeah.

MR COSTELLO: And are those two things related, to your mind?

MR POPE: Yes.

MR COSTELLO: That the headscarp moving up is related to the tension crack?

MR POPE: No, sorry. No. The - misunderstood what you meant.

MR COSTELLO: No, that's all right.

MR POPE: The tension crack at the base of the wall is a product of the stresses from the loaded area above distributing below the wall. It is literally where there's - as I was saying before, horizontal stresses have increased there and the displacement is observed there.

MR COSTELLO: So that's going on, and that's going on separately and independently to what's going on with the headscarp moving up?

MR POPE: No. So on the - stresses from the retaining wall have failed the downhill side of the retaining wall. The reason why there's no tension cracks behind the retaining wall I believe is because there's tensile capacity with a series of tieback anchors from the original retaining wall. So it was clear to everyone that there wasn't much evidence of tension in the vegetable garden area when I was on site on the 6th. There was tension

cracking immediately below the wall. There is tiebacks there with the capacity to keep the upper parts of the retaining wall intact.

MR COSTELLO: The zone of influence that you've spoken about a number of times, is that a concept that's capable of being measured in terms of distance?

MR POPE: There's a whole bunch of stress distribution charts that you can look at for that, yeah, or we just model it in finite element software most commonly now.

MR COSTELLO: I see. And do you have a view about how large, if large is the right word, the zone of influence was in this case?

MR POPE: My view is that that's the toe of the passive wedge failing. So it's moved at the base of the wall. So the displacement is at the base of the wall. It's well within the zone of influence of the wall. It's literally under the wall.

MR COSTELLO: I see.

MR POPE: Yeah.

MR COSTELLO: All right. I'll give you an opportunity to respond, Mr Pope, but I should let others have a go on this topic. Mr Paul, perhaps I'll start with you. You have considered these matters I suspect principally by reference to Mr Pope's work; is that right?

MR PAUL: When the landslide first happened it was on the news and you could see retaining wall at the top. That was what I focused in on. That's the first sort of hypothesis, is has retaining wall fill been put at the top of the slope and is that involved in the slide --

MR COSTELLO: I see.

MR PAUL: -- and that was one of the first things we looked at very early on.

MR COSTELLO: That would be an unsurprising conclusion?

MR PAUL: Yeah, it's an obvious hypothesis and thing to explore. But I just found as the evidence came in it just

didn't fit that hypothesis and I had to sort of, no, that's not the - that's not the main causation, was not the wall.

MR COSTELLO: I see. So let me just understand this. When you speak about main causation are you speaking here in terms of preparatory factor or are you speaking in terms of a trigger?

MR PAUL: Preparatory factor.

MR COSTELLO: All right. So it is still your view that this is not a significant preparatory factor?

MR PAUL: Correct.

MR COSTELLO: Or - I shouldn't use "significant" because the language gets important. A minor preparatory factor is your view. You have considered, no doubt, what Mr Pope has said about it in his report, and what Mr Pope said about it in the course of the conclave as reflected in the conclave joint report. And separately from all of that did you give independent consideration to the question of the role of the retaining wall as a preparatory factor?

MR PAUL: Yes, I did.

MR COSTELLO: All right. And could you then perhaps explain as simply as you're able to why it is that you've come to a conclusion different to that of Mr Pope?

MR PAUL: May I use a whiteboard?

MR COSTELLO: Yes. Please.

MR PAUL: To illustrate the zone of influence we're talking about, we've got our slope, and what's been constructed is a retaining wall, these piers, something like that, and we've got fill in behind that. The way the retaining wall works, we saw in one of the images active side, passive side. So this would be what we call a passive wedge. This is the force, this soil is pushing force onto that retaining wall, trying to push it that way. The passive wedge we're talking about is a zone here, and that's approximately - that angle would approximately be 45 degrees to 60 degrees, depending on the type of soil. If it's firmer, stiffer soil, that angle's steeper. So that is the zone that's mobilising. There's two pieces of

evidence for the 5 January landslide that tells me that the landslide could not have been influenced by the passive wedge. So the 5 January landslide was somewhere down here. It was outside the zone of that passive wedge. So it could not have been loaded.

The other piece of evidence is that if this is applying a surcharge load down here there's a law in physics called Hooke's law, you can't get stress without strain. So if this had indeed applied a force to the slope here you must see displacement here. You must. That's a simple law of physics. If you didn't, if you don't see displacement there, and we didn't, it tells me it couldn't have applied that load there. So that's for the 5th. So in simple terms this was too far away from the wall for it to be loaded.

Then when we come to the tension crack - so a tension crack was observed in this area in front of the wall. Now, what that means is that the load from here can't mobilise the passive wedge, and that's what we're hearing from Mr Pope there. This has opened up here, and so this no longer has a resistance. Now, for that tension crack to be there you can't have force coming down here and pushing out there, and a crack open up. It's entirely incompatible. This is a compression force in here.

The only way to get a tension crack there is if the soil here is moving away from the wall, otherwise you can't - I can't see or conjure up a mechanism that will put a crack in front of it. Soil must be moving away from the wall and the wall is staying there. Now, if that happens, this is now - has lost its passive support. It probably got some stress into this post. It's moving out because it's now lost its resistance here. Then as we went through the 14 January it's just, as we heard, migrated up the slope and it's just undermined the whole lot. But in all of that the retaining wall role is insignificant.

One more thing to mention. On 5 January - 16 January this was undermined. We had soil - it's a bit messy now, sorry. We had soil drop out from behind the wall. That volume of soil - we can measure by comparing the LiDAR images - was less than 10 cubic metres. So if that is indeed applying a surcharge on 14 January you've got an incompatibility with 10 cubic metres driving 300 cubic metres of soil. It's a very, very small surcharge.

Remember the soil that applies the surcharge can only be the soil that's displaced, and that's about 10 cubic metres. So 10 cubic metres pushing 300 cubic metres is a big incompatibility. This would have to be so on the point of equilibrium and so close to failing for this to have any significance.

So that's why I call it minor. It's not zero surcharge, it's some, but it's very, very small in relation to this. Overwhelmingly the water is the effect, not the retaining wall. So that's the conclusion I get to on the evidence available.

MR COSTELLO: I see. Thank you, Mr Paul.

MR PAUL: All right, I'll sit back down.

MR COSTELLO: Mr Hartley, you're not the tiebreaker, but you're entitled to express an opinion about all of this.

MR HARTLEY: Would Mr Pope like to respond to that or?

MR POPE: I'll respond when he asks me.

MR HARTLEY: Okay. Right. Okay.

MR COSTELLO: When I say you're entitled to --

MR HARTLEY: No, no, no, I did have a number of --

MR COSTELLO: -- I want to make this clear to all of you, none of you are obliged to, but if you have something that you wish to say then you can say it.

MR HARTLEY: In terms of the - the depth to the passive wedge is dependent on the understood depth of the pile, and I'm not too sure anybody's too convinced about how deep that is. To reinforce Mr Pope's concerns about not seeing any as-builts or construction built constructions, I've had a look at the calculations, the Rexicon calculations --

MR COSTELLO: Mr Hartley, can I just stop you there for a moment. Mr Bolton, I'm sorry, I should have explained this to you. You can't be on your phone while you're in the witness box, I'm sorry. The material that you can have regard to is material --

MR BOLTON: Sorry, (indistinct) a groundwater formula.

MR COSTELLO: That's all right. If that needs to happen later, you can mention why and we'll sort it out. Mr Hartley, sorry, go on.

MR HARTLEY: Sorry, gosh, where was I? Oh, yeah, the depth of the pile. I'm not too sure whether we are confident that we know how deep the second retaining wall pile went. Calculations give - that have been supplied give a various range of options. The onsite photographs of the displaced pile - you know, pile foundations, not too sure whether they actually correlate with anything. So I'm very unsure about the depth of that pile, and I've got to - I would side with Mr Pope's assessment that it is unlikely that it's been socketed into the extreme weathered granite. So therefore my suspicion is that it is sat probably, possibly on the refusal, and therefore the tendency for lateral load through the superficial or surficial material is probably greater than what would be the case if it had been socketed into the extra weathered granite.

The second one is that within Mr Pope's causal report there's a photograph. I think it's on PDF page 307. I put this up during conclave and, apologies, I don't have the --

MR COSTELLO: Would you like me to bring that up?

MR HARTLEY: Yeah, as long as Mr Pope's okay.

MR POPE: It's not got anything to do with me, mate.

MR COSTELLO: PDF page number what?

MR HARTLEY: 307, I think it is.

MR COSTELLO: 307?

MR HARTLEY: Yep.

MR COSTELLO: Okay. In Mr Pope's causation report?

MR HARTLEY: Yes.

MR COSTELLO: Okay. So that's MSC.5087.0001.0157. I think the actual pagination doesn't go as far as you've said, but you've probably looks at it in PDF form.

MR HARTLEY: Oh, gosh.

MR COSTELLO: No, no, no, we'll find it. Is that what you're --

MR HARTLEY: No, it's not. It's a photograph which was taken somewhere in 2023. It's on the right-hand side of the landscape PDF.

MR COSTELLO: What was the PDF page number again?

MR HARTLEY: I thought it was 307. I beg your pardon.

MR POPE: The photo we had up before?

MR HARTLEY: Yes. It was related to that.

MR COSTELLO: Is it that?

MR HARTLEY: No, it's an oblique photo taken by a chap next to the stonewall.

MR POPE: You had it up earlier, Mr Costello.

MR COSTELLO: Did I?

MR POPE: It was when you were asking me about the wall in 23.

MR COSTELLO: Yes, I see. Right. Try 0394. 0394, try that one.

MR HARTLEY: You're getting close. Maybe one more on. Maybe. No, let's keep with that, the one that was previously. So this photograph shows a slight distortion of the original wall that was built in 2022. You can see to the right of the green hedgerow that there is a kind of - a moving out of the wall. So, you know, towards us from the green hedgerow which is sat above the retaining wall you can see that there is a - if this was a true line, you know, centre line, of the wall then that particular post is out of true.

Now, there is another photograph which is probably taken from the same time, definitely during 2023, which shows there is a trench that has been created from the

movement of the scoria drainage blanket immediately behind this wall, exposing the tie beams to an extent. Now, my suggestion, which wasn't taken up during conclave, was that that was a sign of movement during that time. It was suggested that it could be the scoria settling. But my feeling is, is that the time difference between the construction of the wall and the time that photograph was taken is too long for that settlement to be the answer. My feeling is that there may have been movement during that time.

My second or final aspect of this is that the witness statement of - I'm going to screw up the name, but it's the municipal building surveyor who was employed from February onwards by the shire, and his witness statement at paragraph 32 talks about having - talking to the landowner during - between the 5th and the 14th, and that statement includes cracking both in front of and behind that retaining wall, which suggests to me there is movement going on, which, you know, backs up Mr Pope's view that the fact that there is a retaining wall and the fact that there is fill above that retaining wall is having an effect on the general global stability of the slope.

MR COSTELLO: The types of matters that you have just drawn attention to, Mr Hartley, are really matters from which you've drawn inferences; is that fair?

MR HARTLEY: I beg your pardon?

MR COSTELLO: The matters that you've pointed to are indicative of the fact that you've drawn inferences from material?

MR HARTLEY: Oh, certainly, yeah, yeah.

MR COSTELLO: And, that being so, can you really have a high degree of confidence on this question?

MR HARTLEY: In so much as I trust that people are making true statements, yes, and the photographs that have been taken and the dates have, yeah, any - no less or no more than anyone else would take from a desktop study exercise.

MR COSTELLO: You feel that you've got sufficiency of information as to this topic?

MR HARTLEY: Well, to back up Mr Pope's view, we don't have the as-builts of the second retaining wall. It's a really big question. The calculations indicate one thing. The photographs of the - since 14 January indicate another. It's really confusing.

MR COSTELLO: You accept that some of the physical evidence is inconsistent with the calculations?

MR HARTLEY: It doesn't match up, so yes.

MR COSTELLO: Thank you. Mr Pope - sorry, Mr Pope, I'll come to you in one moment. Mr Paul, before I give Mr Pope an opportunity to respond to all of this before you're all asked another range of questions on the same topic by another person, I didn't ask you while you were at the whiteboard about the question of how far the retaining wall had been driven into the ground and whether or not that bears upon the matters that you spoke to. Mr Pope obviously thinks it's quite significant that it wasn't driven into the granite and that that had an effect of - on the amount of load that it was capable of bearing. Is that a matter that you have thought about? Do you have any reflection on that question?

MR PAUL: We know the length of some of the piles because they were exposed by the landslide and they've been measured. The piles up above the 5 January landslide have not been exposed. So, no, we don't know how long they are. We also don't really know what they're in. But if we can assume they're the similar length to the ones that were exposed - I think it's slightly over 1 metre long; there's an image in Mr Pope's report with a measurement on it - then it can't be - it's too short. If it's a similar length to those other ones, it's too short for a passive wedge to impact or influence the 5 January landslide.

MR COSTELLO: I think at this point I should hand over to counsel for the shire.

<EXAMINATION BY MS FOLEY:

MS FOLEY: Mr Paul, I have some questions for you. I'd like to start with your WSP report of 21 July 2025. So if we could have that brought up, please, Bates number DPA .0004.0001.0001. Thank you. And if we could go to PDF page 65. Thank you. Mr Paul, this is a section in your

report dealing with planning controls, and I'd like to ask you some questions about the opinion that you express at paragraph 125. So I'll read it out. After discussing the objectives of various planning controls you say in 125, "With moderate confidence I consider the absence of planning controls has led to an increase in the susceptibility of the McCrae escarpment to landslide"; you can see that?

MR PAUL: Yes.

MS FOLEY: Do you still hold that view today?

MR PAUL: Yes.

MS FOLEY: Now, you're an engineering geologist?

MR PAUL: Correct.

MS FOLEY: And you certainly don't hold yourself out to have any expertise in planning?

MR PAUL: Only to the extent I work a lot with planners and so I have picked up something along the way.

MS FOLEY: Yes. And, just like I pick up some things along the way, you certainly wouldn't profess to be an expert in that field?

MR PAUL: I'm not an expert in planning.

MS FOLEY: All right. To express an opinion about whether planning controls impacted susceptibility to landslide you would accept that one thing would you want to know about, for example, is how planning controls might influence behaviour?

MR PAUL: Planning controls don't influence susceptibility to landslide. I say because we have susceptibility to landslide we have planning controls.

MS FOLEY: All right. Well, you've said in 125 the absence of planning controls led to an increase in the susceptibility of the escarpment to landslide?

MR PAUL: Can do.

MS FOLEY: Can do. Is your opinion there better then expressed as "can lead to an increase"?

MR PAUL: Yeah, I'd say "can", yes.

MS FOLEY: All right. So you're not giving an opinion there about whether or not in the facts of this case the absence of planning controls or otherwise in fact led to an increase?

MR PAUL: No, I'm not saying that. I'm saying that as a general statement. So, as an example, if there were no planning controls to prevent fills being placed on the slope or vegetation being removed or that type of thing, then the susceptibility could increase. But, no, I'm not trying to be specific here.

MS FOLEY: And that really identifies some of the questions I was going to ask, which now I won't because clearly what you haven't done here is look at what was or wasn't in place, whether things, actions that were taken complied with existing controls or not and so on?

MR PAUL: No, no. No, all I'm simply saying is this is a susceptible slope, you know, it would warrant planning controls for landslide because it's landslide susceptible, and we know they've not been there. And in a general sense, you know, were there planning controls there, that might mean things like we don't have the vegetation clearance or we don't have the fill placed, we don't have the retaining wall or whatever it is, or maybe we don't even have houses built where they are. So that could happen, but I don't want to say that specific to the extent you're implying.

MS FOLEY: No, because one thing we know, for example, is that there was no building permit that was applied for in relation to the retaining wall. You understand that?

MR PAUL: Yes, I understand that.

MS FOLEY: All right. So you're not making a comment about what was or wasn't in place in these circumstances?

MR PAUL: No. I would say that if there were, say, an erosion management overlay in place, something like a retaining wall of the height, with the planning - the

erosion management overlays I've worked on and drafted, that would not be exempt. A retaining wall of that height would require a permit under an erosion management overlay --

MS FOLEY: But what we know here is that a permit was not applied for?

MR PAUL: Not required, no.

MS FOLEY: All right. So there's an issue there about whether or not people on the ground complying or not complying with planning controls would need to be taken into account if you were going to give an opinion about whether that would impact the circumstances here? You'd accept that?

MR PAUL: I'm not sure I understand the question, sorry.

MS FOLEY: That was very unclear on my part. I'll say it again. Because we have a situation here where the retaining wall, for example, was built without a permit, for you to give an opinion about whether the planning controls or absence of them led to an increase in susceptibility you'd need to take that into account if you were going to give an opinion about what actually happened here?

MR PAUL: Yeah, it sort of goes back to what I was saying there previously. You know, had there been planning controls in place, a permit might have required - I understand one wasn't required in this case.

MS FOLEY: The permit was in fact required in this case, and that will be one of the issues that the board will --

MR PAUL: A planning permit or a building permit?

MS FOLEY: A building permit.

MR PAUL: Yeah, I'm referring to planning permit, sorry.

MS FOLEY: And there's an issue, of course, about a planning permit as well. So you haven't assessed that matter? You haven't looked into whether or not permits were or weren't required?

MR PAUL: No, no, I'm simply saying that, for example, that retaining wall, were there an erosion management overlay in place, that construction would require a planning permit usually. A planning permit I'm talking about --

MS FOLEY: And the point I'm making to you is you have not considered whether or not permits were in fact required already and therefore whether what was done was done without the building permit or the planning permit that was required? You haven't considered that?

MR PAUL: I haven't considered whether that construction's lawful, no.

MS FOLEY: All right. And similarly you haven't considered informal practices that the shire had in place which might have done the same work as an erosion management overlay in the circumstances of this case?

MR PAUL: Yeah, I'm aware of the informal practices in place. I don't know how they were applied or if they were applied --

MS FOLEY: All right. You haven't undertaken that kind of analysis, which is why I think, as you have now said, the opinion that you've expressed in paragraph 125 should now really be read as "the absence of planning controls can"?

MR PAUL: Yeah, I'm happy for it to say "can". Yeah, that's fine.

MS FOLEY: All right. And would the same then apply to paragraph 127 of your report? If we can go to the next page, please. You say there, "In addition to increasing landslide susceptibility, the absence of planning controls is also likely to have increased the landslide risk"?

MR PAUL: Yeah.

MS FOLEY: In the same way we should qualify that with "can"?

MR PAUL: Yeah, so what that's talking about is let's say there were planning controls in place for subdivision. Now, if there was an erosion management overlay in place on that escarpment, you know, by today's standards it would

not be subdivided to the extent it has been. That I could say, yeah, that's factual, that would not have been subdivided to the extent it had been. But how long would the planning controls have had to have been in place? They would've had to have been there right back to the early 50s or 60s.

MS FOLEY: Or even earlier for some of these properties perhaps?

MR PAUL: Even earlier, yeah. Yeah.

MS FOLEY: Okay.

MR PAUL: So what I'm saying there is, were there planning controls in place to the standard we have now, then we might not have the risk and susceptibility that we do. But I understand the planning controls were not in place, haven't been in place prior to this.

MS FOLEY: Understand. And that's how we should understand your evidence at paragraph 127?

MR PAUL: Yes.

MS FOLEY: All right. No further questions for Mr Paul.

<EXAMINATION BY MR COSTELLO:

MR COSTELLO: Mr Pope, two things that I want to ask you about - well, one really and I want to give you an opportunity to say anything else on this topic that you feel needs to be said by reason of everything that's happened already.

MR POPE: Yeah.

MR COSTELLO: But on this question of - is piers the right word?

MR POPE: When you've got a steel upright in concrete, yeah, we call them piers rather than piles, which will have a cage in it.

MR COSTELLO: That's why I ask because there seems to be reference to piers and piles.

MR POPE: It might be a bit loose if it crosses across. But piers, yeah.

MR COSTELLO: All right. We'll use piers. Do you know how deep the piers would need to have been sunk to have hit the granite, where the wall was placed?

MR POPE: Do I know how deep they needed --

MR COSTELLO: Yes.

MR POPE: If you go back to that - off the top of my head, no. But if you go to that section you had up for me before --

MR COSTELLO: Your report?

MR POPE: Page 56 of my report which is 0212.

MR COSTELLO: Sorry, which page did you say?

MR POPE: That one will do. I'll shoot myself for not having a scale in it. Give me a sec. I think they're 5 metre - so the horizontal lines are 5 metres there. I would expect - for similar walls 2 metres high that we design you'd need to be into the pink layer there and - 2 metre retained height, like, crudely to size it, and this is just at concept, you've got one height out of 2 metres. And then you would want at least two in, so that's 4 metres below ground, and then there would be a minimum socket into the granite which I think would be in the order of 2 to 3 metres.

MR COSTELLO: So you think unless the piers were of that length then this - no, let me put it in a different way. If the piers were of that length your conclusion as to whether or not this wall was a preparatory factor might be different?

MR POPE: Yes, correct. Yeah.

MR COSTELLO: And the figure you've just come up with there, that's obviously rough and ready? You've just done --

MR POPE: Yeah, rough as. Like, for a retained height of 2 metres, a minimum we would start with when we're doing

our analysis is a 4-metre long pile. But you'd want to check pier - you'd want to check you've got enough socket to transfers the load into the granite.

MR COSTELLO: Is that the rule of thumb, double in the ground as you have above?

MR POPE: That's where we start from, yeah. It's different if you've got tiebacks and stuff, though. If you've got anchors - yeah. But for a cantilevered wall, 2 metres out, 4 metres in, and then check you've got enough socket in the granite.

MR COSTELLO: Wouldn't need to be as far down if you had tiebacks because you're distributing the load in a different way?

MR POPE: Depends on the bending in the pile, yeah.

MR COSTELLO: I see. You accept that if there were tiebacks --

MR POPE: You generally don't need as long a socket with a tieback wall, yeah.

MR COSTELLO: Thank you. All right. I just wanted to give you a general opportunity, Mr Pope, if there was anything else you wanted to say on this topic. It's obviously one you've given a lot of consideration to and there's been evidence given by others. Is there anything that you wanted to address to the chair?

MR POPE: I'm looking at it from a fair old angle, the sketch on the whiteboard.

MR COSTELLO: You're able to stand up if you want to.

MR POPE: No, it's simple. The use of that Rankine earth pressure wedge in front of the wall doesn't hold particularly well on steep slopes. It's a fast and - like, a quick and ready check on with flat ground in front of the wall. But you do need to consider how the stress is transferred down the slope. Earth pressures - Rankine earth pressures for retaining walls are a very simple way of looking at retaining walls. If I go put that to my clients they'd be challenging whether we would be pre-qualified. Like, if I put that to my clients, I

wouldn't - it's not getting up with State Government at all.

MR COSTELLO: Madam Chair, I'm going to move on to a radically different topic now. That might be a convenient time.

CHAIRPERSON: Now is a good time for a break, yes. We'll return at 20 to 12.

SHORT ADJOURNMENT

MR COSTELLO: Thank you, Madam Chair. I want to move now to the trigger - maybe I should - sorry, I didn't notice.

MS SIEMENSMA: Madam Chair, if my instructor just goes out to find them (indistinct).

CHAIRPERSON: Yes.

MR COSTELLO: It would have made for a more efficient examination.

I want to move now to the trigger for the 2025 landslide. It is agreed I think as amongst you, Mr Pope, you, Mr Paul, and you, Mr Hartley, that the trigger for the slide was a decrease in suction from increased pore pressure caused by water infiltration; is that a fair description?

MR POPE: No.

MR COSTELLO: All right. Mr Pope, you tell me what I've got wrong.

MR POPE: It might save you time. In the conclave report I outline why I don't agree with the suction based model on its own.

MR COSTELLO: I see.

MR POPE: But we agree on water being a trigger. I don't agree on that suction was dominating the landslide; yep.

MR COSTELLO: I see. You agree on an increasing pore pressure?

MR POPE: I agree on an increasing groundwater level; yeah. But I don't see evidence that there's excess pore pressure in that hill.

MR COSTELLO: I see.

MR POPE: Yep.

MR COSTELLO: Thank you. I might come back to that. Perhaps I put it too precisely in my search for agreement. There's at least agreement that the trigger was water?

MR POPE: Yes.

MR PAUL: Yes.

MR COSTELLO: There is not agreement as to the source of the water? Is that as you understand it from the conclave process, Mr Pope?

MR POPE: Correct. There is no agreement.

MR COSTELLO: Yes, thank you. And then there are more technical matters as to the role the water played in causing the landslide to occur which are matters of the type that you just mentioned, Mr Pope?

MR POPE: Yeah.

MR COSTELLO: Yes, thank you. And then there are questions that have to do with possible source of water infiltration which mainly centre around the Bayview Road burst and that has a number of topics, most of which overlap but at a reasonably high level of abstraction. One topical area is paths of water flow from burst site to scarp, are there any and, if so, are they such that water could have travelled within the time required; and, secondly, questions of water chemistry from samples taken in the area and what, if anything, can be inferred from those questions. So I want to deal with all of that now in the course of the day.

We'll come to chemistry I think in the afternoon, and Mr Di Stefano will ask you some questions regarding available pathways. But before that there's a few matters that I want to raise with you that are relevant to some of these matters. I should get some of the language here

correct. There might be further questions about some of this later on. But yesterday I asked some questions about aquifers and shallow aquifers. For the purpose of this discussion is there any relevant distinction that any of you wish to make as between an aquifer and a shallow aquifer? Mr Hitchcock, you I think most carefully, if I might say, in your report make some comment about this topic. Did you want to say something about it now?

MR HITCHCOCK: Yeah. So initially, you know, I looked at shallow or perched water and also water that's deep in the granite to see if - because sometimes the pressures from underneath in the - like, lower aquifer, they can come up and be the source of the water or the pressure to cause the impacts. So my initial look at it was separating it into like a regional granite aquifer, and then anything basically above the granite aquifer was a shallow or perched aquifer which is not a permanent feature over the whole catchment, and certainly not in the upper reaches of it. So I think - we think we've all agreed that the deeper granite aquifer has nothing to do with it. The water's too deep. There's no pathway to get and there's no pressure - there's not enough pressure in that to force water up to cause this. So we're only talking about the water sort of above the granite interface and in the colluvium and sandy soils.

MR COSTELLO: I might just go to a passage of your report while we're here, Mr Hitchcock. That report is MSC.5087.0001.0001. And if we could go to page 0012. I hadn't intended to do this now, but it might just be useful to see if there's a measure of agreement at least on questions of terminology. If paragraphs 32 and 33 could be expanded. Here, Mr Hitchcock, you're making some comment about what you mean when in your report you refer to groundwater and perched groundwater?

MR HITCHCOCK: Yes.

MR COSTELLO: And you say groundwater is defined as water that resides in an aquifer beneath the ground surface. You then define an aquifer as water-bearing strata that provides a constant supply of water. So an aquifer then is different from perched groundwater in that it's constant and perched groundwater is not; is that right?

MR HITCHCOCK: Yeah. By definition I would say perched

water is something that's not permanent. It's sort of water on a pathway, become real groundwater, if you like.

MR COSTELLO: I see. So there is within those two paragraphs a definition of groundwater, a definition of aquifer being a constant supply of water, and then a definition of perched groundwater being an inconstant subterranean water; is that fair?

MR HITCHCOCK: Yeah. I can see that that's confusing because I've said an aquifer needs to be permanent and then below have said it doesn't have to be. But it's not the intent of it.

MR COSTELLO: Well, just to make sure everyone's clear why don't you just state the intent?

MR HITCHCOCK: Well, the intent of - the shallow aquifer isn't a permanent aquifer that always has water in it, whereas the regional groundwater does.

MR COSTELLO: I just want to understand from the other witnesses that are in the witness box now is this terminology as described by Mr Hitchcock terminology that you either all use or are content to adopt for the purpose of today's hearing or do you have a disagreement with it? Mr Pope, I might just start with you and move along the table.

MR POPE: Yeah, I don't have any broad disagreements.

MR COSTELLO: Thank you. Mr Makin?

MR MAKIN: Yeah, I agree with those general definitions. I'd just add that the way we're using it here aquifer can also refer to the geological materials with the potential to carry water. So the perched aquifer being inconstant sometimes has water, sometimes doesn't in different areas. So that area that doesn't have water we might still refer to as (indistinct).

MR COSTELLO: I see. Mr Hitchcock, do you agree with that?

MR HITCHCOCK: Yeah, yeah. It's a pathway.

MR COSTELLO: Yes. Thank you. Mr Paul?

MR PAUL: Yes, I'll adopt what Mr Makin said there as the hydrogeologist.

MR COSTELLO: Thank you. Yes?

MR HARTLEY: Defer to Mr Bolton,

MR COSTELLO: Mr Bolton, are you comfortable enough?

MR BOLTON: I think the issue that I would have is that perched - I would probably call it a shallow perched aquifer, and the reason for that is that a perched aquifer does not necessarily need to be transient in nature. So it can be, for all intenses, permanent. So, for example, at Prospect Hill Avenue, in that area that's bordered between Prospect Hill Avenue and Coburn Avenue, which I sometimes refer to as the Prospect Hill island of houses, that has constant water and yet it's a shallow perched aquifer. And one can see from the - what would you call it - foundation, the watering systems that are there, which are agi-drains, that sort of thing, at number 7 Prospect Hill that there's a constant flow of water. Now, I've only been there for a couple of - a few months. But, having talked to residents, I understand that that area is - I think it was referred to sometimes as the swamp, you know, and prior to the houses being built there there was, you know, longstanding water in that area. So I guess the issue I have is this idea that shallow perched or perched groundwater is indicated as transient in nature, and I don't think that that is the case. I think a better description would be a shallow perched aquifer system and a regional aquifer system, regional being deeper.

MR COSTELLO: All right. So you don't accept that there's necessarily something inconstant about perched?

MR BOLTON: Inconstant?

MR COSTELLO: Yes.

MR BOLTON: Correct.

MR COSTELLO: Yes. Okay. I understand that.

MR HITCHCOCK: Can I just add that --

MR COSTELLO: Yes, please.

MR HITCHCOCK: -- when I wrote this I didn't have the causation reports, which had two bores that have perched water sitting in them. There was no evidence of any water at all in the perched water.

MR COSTELLO: I see.

MR HITCHCOCK: I have no issue with what was just said.

MR COSTELLO: Okay. Thank you. That's very useful. All right. In terms of potential water sources here there are a number identified in the joint report that I think we can just put aside quite quickly. In respect of both of these slides, the two slides that is in 2025, numbers 18 and 30 concern rainfall and everybody accepts that to be a minor factor here.

There is then 20 and 32. This is groundwater from an aquifer as a triggering source. This is either viewed as minor or insignificant to minor by each of you. So I don't intend to ask any questions concerning that. And when you have each addressed those questions, that is 20 and 32 in the joint report, I think it's right to say that you've been considering groundwater from a deep aquifer, not a shallow aquifer; is that a correct understanding of the work that's been done?

MR POPE: Could you bring it up on the screen?

MR COSTELLO: Yes, of course. I'll bring the joint report up. That's very prompt. I'll show you a few pages, Mr Pope. If we first go to I think it's page 4. So this is 5 January. And can you see number 20, "Water source groundwater from aquifer - triggering". It's number 20 there. And then if we go over the page, number 32, this is the 14 January slide, "Water source groundwater from aquifer - triggering." And then I'll take you down to the notes. If we just click through, please, and if we could go down to 18. Sorry, not page 18, sorry. If you go back up to the table. Go down. Just stop there. If you see number 20 there. These are the comments that you've each made in connection with number 20.

MR POPE: Yep.

MR COSTELLO: I think I'm right to say, yes, no separate comments made on 32, which is the later slide. So the totality of the comments on this are the comments there. So when considering this as a potential trigger, groundwater from aquifer, are we speaking deep water aquifers, shallow aquifers or aquifers of all kinds, or only deep?

MR PAUL: So this is talking about shallow aquifers. I think we agreed to rule out the deep aquifer was not involved. But it's specifically referring to natural water flow through the shallow aquifer.

MR COSTELLO: As opposed to?

MR PAUL: As opposed to, yeah, water that might have flowed through the aquifer and another source.

MR COSTELLO: Is that a consensus view by those at the table that reflects the conclave?

MR POPE: Yes.

MR COSTELLO: Thank you. If we could go back to the fourth page of that document, please. There's then at 22 water source domestic usage irrigation as a triggering factor. Minor, minor, and medium for you, Mr Hartley, with a moderate degree of confidence. That's in many respects - given what medium means in this context, that's peripheral. If we have time I might come back to it, but it's a fair way from the main game.

And then 24, this is another water source but a preparatory factor, stormwater leakage. Minor, medium and medium. So a small amount only of disagreement on that factor, which really directs attention then to the Bayview Road leak, which is 21 on this table and 33 in the next table. And, Mr Paul, you view this as significant with a high degree of confidence; Mr Pope, you view it as major with a high degree of confidence; as do you, Mr Hitchcock. And I take it I'm to attribute the opinion for South East Water - that's the opinion of both you, Mr Hartley, and you, Mr Bolton, or is that just Mr Bolton's opinion?

MR HARTLEY: Both of us.

MR COSTELLO: Both. Thank you. You view it as insignificant to minor. All right. Could I have on screen, please, DPA.0004.0001.0001. Could I have 0084. And could I have that picture at the top, figure 8.19, expanded together with the text just below it just to explain what it is, thank you. Mr Paul, this is a diagram taken from your report. As you see it now you're familiar with it? You recall what this is?

MR PAUL: Yes.

MR COSTELLO: Yes. This is to do in some respects with the mechanics of the burst, and I thought it might be a useful introduction into this topic. Would you explain this picture, please?

MR PAUL: Yes. It's a 3D model. So in order to investigate or just try to really understand how the leak site fits together with the services fits together with geology it's been modelled in three dimensions. So in this model the green are our transported soils, the dark green that's labelled. Residual granite below that. And then based on the services plans available we've put in the locations of the water main and the locations of sewers and stormwater. And the purpose of that is to - you know, how far, for example, was the sewer from the leak location. That's what we're trying to achieve with that.

MR COSTELLO: I'm going to move to another image, but before I do did anyone want to make comment on this image? I take it that this is relatively elementary, unlikely to be causative of dispute. Thank you.

Within the same document could we go to page 92, please. If I could have 92 and 93 on the screen together to begin with, thanks. I might start with the top left-hand corner, figure 8.25. Mr Paul, this is still in your report and this concerns potential flow paths, a topic we'll come to in more detail. But the yellow line there is the colluvial gully that runs from Arthurs Seat to the escarpment; is that right?

MR PAUL: Correct.

MR COSTELLO: All right. And what's the purpose of this image?

MR PAUL: Each of these images, I'll call it a hypothesis of how water may have got from the pipe burst to the landslide site. Each of those are then ones that we can explore with the evidence.

MR COSTELLO: Yes.

MR PAUL: So this one at the top assumes water might flow only through colluvium.

MR COSTELLO: All right. We might blow them up one by one because they're probably a bit hard to see. If the first one in the left-hand top corner could be expanded, please. So this is a potential flow path that is through a colluvial gully; is that correct?

MR PAUL: Through what I mentioned yesterday, the thalweg, you know, down at the bottom of an infilled gully filled with - containing colluvium.

MR COSTELLO: That's just a hypothesis of a path?

MR PAUL: Correct.

MR COSTELLO: All right. If that one could come down and the next one below it, 8.26.

MR PAUL: This is another hypothesis which we know water went down - from the burst went down the stormwater. So this is looking at whether it could have got out of the stormwater pipe and then flowed down towards the landslides. So that's what that hypothesis is.

MR COSTELLO: Could we then move to - thank you; perfect - 8.27. This I think shows the sewer lines that run from the burst site to Coburn Avenue and then they pick up again at around Prospect Hill Road; is that right?

MR PAUL: That's right. So this is a third hypothesis showing how groundwater may have migrated through sewer trenches.

MR COSTELLO: That can come down, please. Just so the witnesses understand what I'm doing here, I'm really just adducing a generalised explanation of the subject matter area. We will come in detail to paths and the area of debate. Could I have on the screen, please,

SEW.0001.0002.4187. Could I have page 61, please, 0061. Thank you. And if that figure 34 could be expanded.

Mr Hartley, I'm not sure if you or Mr Bolton are best placed to explain this, but as I understand it this is a diagram showing flow paths to stormwater drains from the burst site; is that a fair description?

MR HARTLEY: Yeah, based on the visual evidence of the sand fan, you know, the deposition of sand that emanates from the point of upwelling over an area which, you know, basically culminates in the stormwater going.

MR COSTELLO: Yes. And the general relevance of this, although it's relevant in more than one sense, but at least at the most obvious level is whether and how much water that came from the burst site travelled promptly to the stormwater drain and then along the stormwater drain?

MR HARTLEY: That's a - yeah, that's it. Yeah.

MR COSTELLO: Thank you. Could I have on screen, please, DPA.0004.0001.0001. And could we go to page 0059, please. If that could be blown up. Mr Paul, I think this is a localised map of stormwater and sewerage infrastructure; is that right?

MR PAUL: That's correct.

MR COSTELLO: And this of course is along View Point Road?

MR PAUL: That's right.

MR COSTELLO: What's the green?

MR PAUL: The green of a sewer.

MR COSTELLO: And blue.

MR PAUL: Blue is stormwater.

MR COSTELLO: If we could move across to --

MR PAUL: I should correct that the blue with the - the blue and white, sorry, is the stormwater. The solid blue is the water main.

MR COSTELLO: Yes, quite right. Solid blue is the water main.

MR PAUL: Yes.

MR COSTELLO: Blue and white is stormwater.

MR PAUL: Correct.

MR COSTELLO: Green is sewer.

MR PAUL: Correct.

MR COSTELLO: There's also pink lines there. They're just the boundaries of the properties.

MR PAUL: Property boundaries, correct.

MR COSTELLO: Thank you. Could we move two pages forward in the same document, please. If that could be expanded. Again, Mr Paul, we're in your report here. This shows a sewer invert on View Point Road, I think; is that what this is?

MR PAUL: That's right. This is - again, it's a slice through our 3D model which we put together to try to understand the spatial relationship between the services and the landslide. There are two sewer levels labelled there. The one sort of bottom right label that says "sewer from SEW plans figure 7.13", that is put in at the elevation as shown on the plans. But then the PSM investigation which involved excavating over the sewer trench found that sewer to be high. So we put both in. That's why it's shown there twice as two sewers. There's only one in reality, but we've got two pieces of information communicating them to be at different levels.

MR COSTELLO: And just so I can make sure that I've got the right information, Mr Pope, in your report - I think you've got your report in front of you, don't you?

MR POPE: Yes, correct. One of them, yep.

MR COSTELLO: I can bring it up if you want. You mention at paragraph 171 of your report that - I'll just read it out - "The SEW trunk sewer on View Point Road is approximately 6 metres upstream of the proven flow path."

MR POPE: Yes, correct. Yes.

MR COSTELLO: And you then mention it's got gravel at the invert of the trench, which you take from a borehole log, and evidence of a tree root system. But what you're speaking of there, that South East Water trunk sewer on View Point Road, is that what's depicted in this image in front of you?

MR POPE: One of them, yes.

MR COSTELLO: There's more than one?

MR POPE: No, like, as Darren said apparently - I didn't realise there was that much of a difference between the South East Water's drawings but yes, that's what it's --

MR COSTELLO: Yes, thank you. Could that come down and could we move one page back to page 60, please. Yes, just one page back. That's okay. Thank you. This is also in your report here, Mr Paul, and it's identifying the sewer there close to the bottom right-hand side.

MR PAUL: Correct.

MR COSTELLO: That's the same as we've just seen but from a different perspective? Yes, thank you. Also there's a prominent blue arrow in the centre there. That's the dye testing, is it?

MR PAUL: That's right. We don't know the dyes would have travelled exactly along the arrow, but we do know the dye put into NDT01 emerged at around that location --

MR COSTELLO: That's the black dot. Yes. So when dye testing was done it was put in at NDT01, which is a bit hard to read, but is the black dot closest to the start of the blue arrow?

MR PAUL: Correct.

MR COSTELLO: And the dye emerged - as you say may not have travelled in a perfectly straight line, it may have travelled in all sorts of lines, but in any event emerged at or about the end of that blue arrow?

MR PAUL: That's right.

MR COSTELLO: All right. There might be some more questions about dye testing a little later. Could we go to page 84 of that report, please. No, could I have the table below, sorry. This is table 8.1. Mr Paul, this is a table within your report, table 8.1, which sets out water observations. Could you just describe how you put this table together?

MR PAUL: What we're seeking to do there is to develop a chronology - you see that table is ordered - based on the times at which various observations were made. So the source of this information includes observations from witness statements, includes records from South East Water of when water was observed emerging at the surface, and that's what you see most of those columns. And then the right-hand column based on the chart of inferred leakage out of the Bayview Road leak, which is put together by - I can't remember his name now, but the chart of leakage out of Bayview Road --

MR COSTELLO: Do you mean Professor van Zyl?

MR PAUL: No, no, the South East Water leakage estimate.

MR COSTELLO: Dr Crook.

MR PAUL: Crook, sorry, that's the one. So using his evidence as to how the leak progressed over time we've tried to, in that column there, match what was leaking out of the pipe with the observation, try to get a chronology there.

MR COSTELLO: If that could just be brought down and if we could go over the page just to make it clear. That table - what you've just been shown is not the limit; it goes over a number of pages.

MR PAUL: It does, and it's also shown graphically in the appendix as well.

MR COSTELLO: Yes, thank you. Could we go to the next page, please. And again. Thank you. Can I have MSC.5087.0001.0157, and could I have point 0245. Mr Pope, this is from your report, and I think it is somewhat related to what I've just been discussing with Mr Paul. It

always takes a while to come up. This is the map of I think walks that you did around the area; at least somebody did. I don't know if it was - I thought it was you but, if it wasn't, you'll tell me.

MR POPE: Yep. That is me.

MR COSTELLO: This is you connected --

MR POPE: Darren and I, fortunately or unfortunately, have got the same initials. But it's definitely me.

MR COSTELLO: Yes, it's proved a real irritation, I can tell you. This is a map where you've been hooked up to a GPS or something --

MR POPE: Yes.

MR COSTELLO: -- and it's tracked your movement?

MR POPE: Yep.

MR COSTELLO: And you haven't done that for fitness purposes; you've done it for purposes connected with your work here?

MR POPE: Yes.

MR COSTELLO: And what was the purpose of the explorations that you were doing and tracking?

MR POPE: I mean, obviously there's a lot that are acute to the EO, the emergency order, area. So there's a lot of work done there for the landslide risk assessment. The stuff that goes further to the north-east is the same. Bayview Road area was a series of visits, so mapping the extent of the sand plume; returning with the community to have a meeting with them up there one of those days. And then so, for example, the black one that runs to the bottom of frame, I was going upstream of the failure area just to look at - essentially I could find where the sewers were, with not much help from the mapping system. So there was more water - moister soils is what the simplest conclusion I came to. It didn't mean there was water flowing or anything, but certainly there's a lot of green grass around sewer trenches and things in upstream of where the failure was. That was where I was starting to put together flow

paths and mechanisms for the water to come down the hill.

And then just other stuff, like, clearly I've stopped at Browne Street on 27 February. There was a CCTV operator there at that time, and I looked over his shoulder and that's where we initially identified the Browne Street defect. This is the sort of walks I do when I'm trying to assess something of this scale, is the rest of the walks around, trying to have a look at the gullies.

The eastern limit is looking at the water main coming across the gully, the big 900 diameter water main, but having trouble getting down there. And then the western limit is coming up near the McCrae Homestead, where the community and the old maps talk to springs in that area. And then having a walk down Coburn Creek up near the motorway just to have a look at how much water was flowing in that creek. But that's pretty much it, I think.

MR COSTELLO: One of the purposes of these walks, by no mean the only purpose, was to make observations of where you identified significant amount of moisture?

MR POPE: Yeah, true. Yep.

MR COSTELLO: If we go over the page, I think on this map you identify where you have observed moisture or saturation?

MR POPE: Yes. There is some - in the legend on the right you'll see "MPSC observations in January". So early days some of their team had done some mapping. So the orange and brown is exclusively from them, but the remainder of it is me.

MR COSTELLO: Thank you.

MR POPE: The CCTV stuff is, yeah, indirectly me as well. But the mapping is me. Yep.

MR COSTELLO: Now, Mr Hartley, in your report there's also some evidence of site walks. Were they done by you?

MR HARTLEY: Yes, myself and Mr Bolton.

MR COSTELLO: You and Mr Bolton. I'll just see if I can have one brought up. I think it's SEW.0001.0002.4187, and

if we could go to 0052, please. Here in 6.1 you make some observations about site walkovers?

MR HARTLEY: Yes.

MR COSTELLO: And you did those walkovers on at least 13 March and 13 June, 17 June and 20 June. Were there any other times?

MR HARTLEY: There was 3 March rather than 13 March, but --

MR COSTELLO: Sorry, 3 March.

MR HARTLEY: Mr Bolton has done some other impromptu walkovers as well.

MR COSTELLO: I see. That's why the word "including" is used, is it?

MR HARTLEY: Yes.

MR COSTELLO: Yes. Okay. I understand. Thank you. And were you and Mr Bolton looking for the same things during these walks?

MR HARTLEY: The objective of them varied slightly, but the 13 June was a walkover to familiarise ourselves with the parts of the region that we hadn't done so on 3 March. But we were also looking at feasible areas to put borehole locations down. The 17th and 20th were opportunistic walkovers which - following on from the landowners' kind acceptance that we could visit the sites of the landslide at those dates, we took the opportunity of, you know, basically really getting as much confidence as we could of the site as possible.

MR COSTELLO: I see. And in the course of your observations did you make any notes of when and where you identified water in a quantity that you wouldn't expect it to be present? That is saturated ground, for example?

MR HARTLEY: Oh, gosh. Well, it was in June and the - appendix C of our report - appendix C is basically the views that I - the observations I made of number 6 and number 10-12 View Point Road. The main body of the umbrella report talks about observations in general.

We didn't actually find much in the way of saturation as I would've thought, but we did notice constant flowing of the stormwater drains.

MR COSTELLO: In the course of preparing your report or at least for the purpose of participating in the conclave, did you consider Mr Pope and Mr Paul's evidence of surface water in the general area?

MR HARTLEY: Mr Pope's, you know, mud map - I don't want to be disrespectful - was certainly considered between the submission of the expert reports and conclave, and, yeah, along with, you know, sketches supplied by the parties, yeah.

MR COSTELLO: All right. Thank you. Mr Bolton, you don't have to add anything but, if there's anything you'd like to add, by all means do.

MR BOLTON: Yeah, I'd just add that I was at the site during the time of drilling. So I spent a fair bit of time out there, and drove, walked the streets, you know, all that sort of stuff, spoke to residents, you know, just to get a general sense of the history of (indistinct) in the area, that type of stuff, which did prove important in my assessment.

MR COSTELLO: I just want to briefly touch on dye testing. Could I have MSC.5087.0001.0157. Could I have it at .0248. Mr Pope, I'll direct this to you since we're in your report. The page that's about to come up will hopefully show the results of dye tests. So you can see there the previously mentioned NDT01, which is where the dye was placed into the ground.

MR POPE: Yes.

MR COSTELLO: And then where the dye emerged is evident from the two arrows on the scarp there. This was testing that you performed?

MR POPE: Yeah, I was there with our senior --

MR COSTELLO: Sorry, when I say you performed it, you caused it to be performed and --

MR POPE: I was on site when it happened, yeah, when we

put more water than we wanted to into the hole, yep.

MR COSTELLO: Thank you. Can you explain how NDT01 was chosen as a location?

MR POPE: Yep. So initially, like I said before, I was looking around sewer trenches that were greener than other parts of the world, and on 6 View Point the private sewer trench - that borehole was in the private sewer trench, and the sewer trench itself runs - literally follows the property boundary at that offset. So if you go straight up the page and follow the property boundary and you come around to a few metres from the headscarp basically in the - yeah, pretty close to where the change in direction there is with the property - to your right. To your right. So, yep. And then if you go up a little bit along the property boundary - that's a grid, sorry. Yep, there. Stop. So it comes roughly up to there, and then all the pipes go into the - come out of the kitchen and - so my early theory was that we were getting water coming down that private trench. So that's hence why I was testing there in particular.

MR COSTELLO: I see.

MR POPE: Yep.

MR COSTELLO: And I might just ask you to comment on what it is that you draw - what conclusions you draw from these dye tests, but I'll just put another photo up first.

MR POPE: Yes.

MR COSTELLO: It's in the same report. Actually, if that could be reduced - it might be on the same page. No, sorry, it's not. It's at 0408. This is a photo you'll be well familiar with, Mr Pope. It's the one where you can see the dye coming out of the scarp.

MR POPE: Yeah, correct.

MR COSTELLO: So both of those photos are photos of the dye coming out; is that right?

MR POPE: Yes, correct.

MR COSTELLO: An untrained eye might just think that was

some algae or moss growing or something, but it's green dye out of the --

MR POPE: Yeah, correct. I think I've discussed that somewhere before. So that was my initial concerns, was it just moss. And we still had supply of water and then the green faded. So I didn't - like, if it's going to grow in water, why's it going to die in water? So for me it's pretty high confidence that it's dye.

MR COSTELLO: Okay. And where that green dye is emerging that's emerging from the colluvium?

MR POPE: Yep.

MR COSTELLO: And so apart from - well, I shouldn't assume anything is obvious. What is it that you took from the results of this dye testing? What did it tell you as --

MR POPE: So I should clarify NDT01 went well - it was in the sewer trench but we punched way below it. So we were actually into the colluvium below the trench.

MR COSTELLO: When you put the dye in?

MR POPE: Yeah, correct.

MR COSTELLO: So the dye into below the trench?

MR POPE: Yeah, absolutely. Sorry. There wasn't any - at that point we didn't have standing water in the - because it's quite a big hole. So we put GoPros down it to film it and see what was going on down the bottom, and not much water. So we added plenty, and it took a while to - it didn't drop really quickly in the borehole, but it certainly - 90 minutes later was the start of the evidence of it at the headscarp. And then I came back the next day, I think there's photos to that, or not the next day, within the week, and the borehole's dry sort of thing. So to me it meant that whatever the water source was was a little bit below our borehole. I think at that time it was roughly 4 metres deep, and we came back and extended it to I think 5 or 6. I don't have the exact numbers in my head. But at the time to me the water - the flowing water was below where we placed the dye. The dye's gone down into whatever water was there, rather than being in flow - like, in groundwater, if that makes sense. Yep.

MR COSTELLO: Let me just see if I can accurately state the position before we move to the question of particular flow paths and their viability. In respect of this issue, the Bayview Road leak as a water source, everybody agrees that it was either - if it was a source, it was a source for both 14 January and - it was a trigger, rather, for both 14 January and 5 January; is that correct? Mr Hartley, you don't accept it was a trigger?

MR HARTLEY: An insignificant to minor trigger.

MR COSTELLO: That's right. And to the extent that it was a trigger at all, whether insignificant or minor, you accept that the position is relevantly the same for the two landslides; is that right?

MR HARTLEY: Oh, gosh. In - I beg your pardon. No, it's --

MR COSTELLO: It's all right. I had rather hoped it was a simple question, so I was just as surprised by the response.

MR HARTLEY: My position is, is that the 5 January destabilised the situation so much that the 14 January was going to happen, and therefore insomuch as if one accepts the premise that Bayview Road leak is happening at the time of the 5th it would be happening at the time of the 14th, or water coming down at the same time. But the fact it was there or not, my opinion is, is that it has even less of an impact because the 5 January has happened, destabilising the situation.

MR COSTELLO: Another way of saying that is the 5 January slide meant that the 14 January slide was inevitable?

MR HARTLEY: That's a way of saying, yes.

MR COSTELLO: You accept that?

MR HARTLEY: "Inevitable" is a strong word, but yes.

MR COSTELLO: I see. What word would you choose? I don't want to put words in your mouth, Mr Hartley.

MR HARTLEY: "Even more likely".

MR COSTELLO: I see. Thank you. Mr Paul, you conclude - I'm only doing this at a high level before we get to the specifics. You conclude that there are plausible flow paths to the site of the - perhaps I'll just call it the scarp.

MR PAUL: Yes.

MR COSTELLO: Plausible paths from the burst site to the scarp?

MR PAUL: Correct.

MR COSTELLO: You don't have a concluded view on which of the plausible paths is the more likely?

MR PAUL: That's right. I'm unable to get to a point to say one - what proportion either of those paths might have contributed.

MR COSTELLO: Thank you. You consider that the only water source within the vicinity of the 2025 landslides of sufficient volume to cause the landslides was the burst?

MR PAUL: That's right. My model is that the soil, you know, for the weeks probably in December, prior to January, just got wetter and wetter and wetter and wetter, and more of it got wet until it slid. So the only source that was available at the time to do that was the Bayview Road leak.

MR COSTELLO: Thank you. Mr Pope, I think it's right to say, but you'll no doubt correct me if I'm wrong, that you agree with Mr Paul on each of the matters that I've just put to him?

MR POPE: Yes.

MR COSTELLO: Thank you. Mr Hitchcock, you have a particular view about the most probable flow path. You consider that a shallow aquifer was the most likely pathway; is that correct?

MR HITCHCOCK: Having had the benefit of the causation reports, I think it's more likely a combination of flowing along some of the stormwater and sewerage bedding materials, as well as going down to the colluvium and then

following the groundwater path.

MR COSTELLO: You make reference in your report to embedment material?

MR HITCHCOCK: Yeah.

MR COSTELLO: You think the likely combination then is shallow aquifer but also travelling along the path of embedment material?

MR HITCHCOCK: Yeah. So flowing along embedment material, that being saturated, going into natural soils, going laterally and also down, down to the aquifer and then down to the escarpment. But a combination of those things rather than one or the other. I would think it's unlikely just to follow a trench the whole way down there.

MR COSTELLO: Thank you. Mr Hartley, I think the starting point for your analysis is that the majority of the water went into the stormwater drain?

MR HARTLEY: Yes, correct.

MR COSTELLO: Thank you. You accept the theoretical possibility of a, I think what you call, direct flow path from the burst site to the scarp? Theoretical possibility?

MR HARTLEY: Theoretical, and that's what we've been trying to establish.

MR COSTELLO: You think that it's unlikely in large part, I think, because of the question of velocity, that is you don't think the water could have got to the scarp in sufficient time; is that right?

MR HARTLEY: That's bang on, yes.

MR COSTELLO: Thank you. Do you accept that there are subsurface trenches that could form a flow path that would be a theoretically possible way of water travelling?

MR HARTLEY: (Indistinct), yes.

MR COSTELLO: I think I'm right to say that you are not convinced by the viability of the subsurface trenches as a flow path by reason of the chemical testing. Perhaps when

I say "you" I'm perhaps aggregating to you a view that's held by the joint authors of your report. So, if you want to pass to Mr Bolton, of course you can.

MR BOLTON: Yes, we've looked at geochemical testing and used that as one of our lines of evidence.

MR COSTELLO: Thank you. And I think, Mr Hartley, at least so far as I understand your joint report, the last critical integer in this question is that you consider the trigger volume to be so low, that is the amount of water that would have been required to be in the scarp to be so low, that you can't rule out other potential water sources as being the water, that is water other than the burst - from the burst site?

MR HARTLEY: That's correct. Based on working on the 5 January failure the volume is very low.

MR COSTELLO: Thank you. All right.

MR HITCHCOCK: Can I make a comment there?

MR COSTELLO: Yes, please.

MR HITCHCOCK: There's a difference I think between the amount of water to saturate the soil and cause a slip, and the amount of water coming out. That can be a lot greater.

MR COSTELLO: The amount of water coming out of?

MR HITCHCOCK: Out of the escarpment.

MR COSTELLO: Thank you.

MR HITCHCOCK: So Dane measured 17,000 litres a day at - I think the day after or close to?

MR POPE: 6th.

MR HITCHCOCK: And then the only other time access was allowed, 50 litres a day, which is a massive difference. It's 340 times difference. It shows there's some sort of a surge rather than just little bits pushing out.

MR COSTELLO: Thank you. I appreciate that, Mr Hitchcock. You can be assured that we'll be returning to that. My

colleague, Mr Di Stefano, is now going to ask each of you some questions concerning viable water paths.

<EXAMINATION BY MR DI STEFANO:

MR DI STEFANO: Madam Chair, before I start I just note that a photograph of the diagram - of Mr Paul's diagram has been taken. We would seek to tender that photograph.

CHAIRPERSON: The photograph of Mr Paul's whiteboard drawing is exhibit CA78.

EXHIBIT #CA78 PHOTOGRAPH OF MR PAUL'S WHITEBOARD DRAWING

MR DI STEFANO: Thank you. I'd like to begin by touching on the first topic that Mr Costello addressed in your analysis, Mr Hartley and Mr Bolton, which is the volume of water that entered the stormwater system at the burst site.

MR HARTLEY: That was Professor van Zyl, but we can talk about it.

MR DI STEFANO: Yes, yes. So Mr van Zyl is - do you know what his background is or his expertise?

MR HARTLEY: Professor van Zyl was engaged by South East Water direct, and we had no communication with him, so.

MR DI STEFANO: But you've read his report, I assume?

MR HARTLEY: Correct.

MR DI STEFANO: And do you have any professional experience with him, aside from this?

MR HARTLEY: No.

MR DI STEFANO: And is it the same for you, Mr Bolton?

MR BOLTON: Yes, that's true.

MR DI STEFANO: So you're not aware of whether he's a hydrogeologist or has expertise in measuring - aside from measuring flow rates from burst pipes, as he appears to do in the report, are you aware of whether he has expertise in measuring absorption rates through soils or through other materials?

MR HARTLEY: Not from my own research, no.

MR DI STEFANO: Yes. And the same for you, Mr Bolton?

MR BOLTON: Yes.

MR DI STEFANO: Mr van Zyl's report includes the most up-to-date, I infer, analysis of the total leak volume from the burst site, and he provides an estimate of 40,300,000 litres. Is that consistent with both of your understandings of the volume of water that leaked from the Bayview Road burst?

MR HARTLEY: 40, 4-0?

MR DI STEFANO: Yes, 40.3.

MR HARTLEY: Cumulative.

MR DI STEFANO: Cumulative, yes.

MR HARTLEY: That's our understanding.

MR DI STEFANO: Yes. The same for you, Mr Bolton, I assume?

MR BOLTON: I tend to deal with litres per second, but total volume, yes.

MR DI STEFANO: If we could have Professor van Zyl's report put on the screen, please. It's SEW.0001.0002.4191. Thank you. Can I have page 12 of that report on screen. So this graph, one we've all seen many times, figure 2 at the bottom shows the flow rate over time, and it shows the cumulative - the bottom graph shows the cumulative leak and the top graph shows the daily leakage rate, and you can see there that it peaks at 1.4 to the 6, which is 1.4 million litres per day. That's correct?

MR HARTLEY: Yes.

MR DI STEFANO: And if we go further on in Mr van Zyl's report to page 31, here he's produced a chart which estimates or, rather, summarises his estimates of the modelled leakage volume per day, which is the second column, over time, and then deducts from that the estimated

flow within pipe and sewer bedding materials per day, leading to his conclusion of the leakage volume reaching the surface per day?

MR HARTLEY: That's my understanding, yeah.

MR DI STEFANO: Yes. So in his view as at 6 October - I mean, of course accepting that these are approximate - 3,800 litres are reaching the surface per day of a total leakage of 14,800, so 14,000 minus 11,000, and then by the end he estimates that 1.38 million litres are reaching the surface each day?

MR HARTLEY: That's my understanding too, yeah.

MR DI STEFANO: And in your analysis of the volume of water that entered the sewer trenches for the purposes of considering the flow path through the sewer trenches, is that 11,000 litres per day the number that you used to estimate the total volume that was in the sewer trenches, or was it some other number or is it not related?

MR HARTLEY: When we were doing the analysis of the volume of water that was needed to create a failure, it was independent. It was a fairly straightforward geotechnical slope stability analysis where you said, "Okay, how much volume of water is needed to get the initial slope," and that was that. So the flow path, the volume of water that was available wasn't part of that analysis.

MR DI STEFANO: Yes. So in your analysis, though, of the plausibility of the sewer trench's flow path or the service trench's flow path did you compute an amount of water that you estimated to be flowing into those service trenches from the burst?

MR HARTLEY: I don't think we did, no.

MR DI STEFANO: No. So you would accept, though, that it would be not less than 11,000 litres per day flowing into that pipe and sewer bedding materials based on Professor van Zyl's analysis?

MR HARTLEY: That's reasonable, yeah.

MR DI STEFANO: Yes. I don't think much of Professor van Zyl's report is contested. But for the benefit of

the chair I might explain his conclusions and you can correct me if I'm wrong. If we turn back to page 26 of the report and we zoom in on the diagram at the bottom, this diagram, as I understand it, depicts the water main, the burst in the main and the relation of that to the sewer?

MR HARTLEY: Yeah.

MR DI STEFANO: And you can see there that the surface - the ground level, the green line at the top, is approximately 1.4 metres above the water main, and the sewer - the edge of the trench material around the sewer pipe is approximately 1.45 metres away from the burst. And Professor van Zyl's estimate - evidence, if we move to the next page and we zoom in on the next diagram, is that over time as the volume of water increased from the burst up until 11,000 litres per day effectively a channel was formed of turbulent water to the surface, and that that channel - through that channel any water above 11,000 litres per day would flow to the surface and then spread out across the surface?

MR HARTLEY: Yes, effectively the difference between the leak volume and the volume capable of being taken up by the service trenches goes up to the surface.

MR DI STEFANO: Yes. And so his evidence is, because of the pressure - the amount of pressure in the pipe and the fact that that was being released in - you know, like a high-pressure hose into the soil, it created a turbulent zone of water which then erupted, effectively, out of the surface, forming a kind of low geyser, I guess?

MR HARTLEY: Yes, yes. It wasn't as spectacular as that, but yes.

MR DI STEFANO: I'm trying my best to be neutral, but, yes, however you would describe it.

MR HARTLEY: Yeah, yeah.

MR DI STEFANO: And if we zoom out of that and we look at the bottom of that page, these are Professor van Zyl's calculations that lead to his 11,000 litres figure. They're described as sample calculations. Do you have any explanation for why they would be described that way?

MR HARTLEY: No, I don't, I'm afraid.

MR DI STEFANO: That's okay. Have you separately calculated what you consider to be the permeability of the bedding material flow?

MR HARTLEY: I think we've got some samples from other people's, you know, excavations which we've done some tests on, embedment material, trench backfill. Hugo, please tell me if I'm wrong.

MR BOLTON: Yeah. We've done tracer tests at different locations, and we did a tracer test in the sewer embedment material.

MR DI STEFANO: Yes.

MR BOLTON: (Indistinct).

MR DI STEFANO: And was that this particular sewer embedment material, as in this part of the sewer main that runs closest to the burst location?

MR BOLTON: It's not at this location, but it's on Charlesworth Road, the one that we had, but it's similar material.

MR DI STEFANO: But aside from that you haven't sought to independently verify Professor van Zyl's flow rate there of 10,000 litres per day through that sewer embedment material?

MR HARTLEY: No.

MR DI STEFANO: No. And if we turn to the next page you can see that Professor van Zyl estimates 1,000 litres per day in the top of that chart. He's estimated the flow capacity of the pipe bedding material, and then the sewer bedding material is estimated to be 10,000 litres per day. Then he estimates the capacity of soil between the pipe bedding and the sewer bedding material as being negligible. So in his view a negligible amount of water would be permeating through the soil itself as opposed to travelling to the sewer embedment material or to the pipe embedment material; is that a correct interpretation?

MR HARTLEY: That's a correct interpretation.

MR DI STEFANO: Mr Bolton, do you think that's a plausible analysis, a negligible amount? Sorry, do you think that that negligible figure there for the permeability of soil between the pipe bedding and the sewer bedding, do you think that a negligible amount of water would have leached through that material?

MR BOLTON: The embedment material is much more permeable than the surrounding soil material. So it would be - it would prefer to go down that embedment material until it reached capacity.

MR DI STEFANO: Yes, and once it reaches capacity, though, wouldn't it then leach through less permeable materials, including the soils around it?

MR BOLTON: It would, unless it had a pathway to the surface, in which case it would take the surface because that's an easier route.

MR DI STEFANO: Yes. So, correct me if I'm wrong, but my understanding is that water will of course take the path of least resistance, and where a particular material has a permeability of a particular volume of water over time it will absorb that amount of water, and then the back pressure effectively causes the water that's behind that water to find the next available path?

MR BOLTON: That's right, and that could either be the soil or a pathway to the surface.

MR DI STEFANO: Yes. So wouldn't it only be the case that no water would permeate through the soil if that had an effectively zero permeability, because there would still be water pressurising against that wall even if there is a geyser, to use my colourful expression - there would still be water against the soil along the side of that geyser?

MR BOLTON: Well, if the permeability of the soil was zero, as you say, then it would go to the surface.

MR DI STEFANO: Yes. And what I'm suggesting to you is that --

MR BOLTON: But that's not possible.

MR DI STEFANO: Yes, quite. Thank you. Madam Chair --

MR BOLTON: It's impossible to have a permeability of zero; I guess it's not possible.

MR DI STEFANO: Yes. Noting the time, I might just ask if any of the other experts have anything they wanted to add to that analysis, and otherwise --

MR POPE: Just very briefly, that's quite a high permeability when you look at what we actually found in our boreholes in that below the sewer there, NDT13. We intentionally put the photo of the boulder and the sand in the report for that reason. I think that's orders of magnitude lower than I would expect of what we found in that borehole.

MR DI STEFANO: So, just to be clear, the permeability in respect of the soil bedding?

MR POPE: No, the soil between the two pipes.

MR DI STEFANO: Yes.

MR POPE: Yeah, correct.

MR DI STEFANO: Sorry.

MR POPE: Yeah, yeah. No, no, no, that's good.

MR DI STEFANO: So the tested permeability of the soil, and you're inferring here being effectively the same soil as between the pipe, the burst pipe and the sewer embedment material, in your view those numbers included here in Professor van Zyl's report underestimate the flow rate of what water - the permeability --

MR POPE: They would underestimate it, yes.

MR DI STEFANO: Yes. Thank you. Anyone else? Did you, Mr Hartley, have anything to add there?

MR HARTLEY: The only thing I would suggest about that is that a sewer is underneath the mains, and therefore the sewer to be built would have been built in a trench, and so the material between the mains and the sewer is effectively made ground or fill, and it wouldn't have been in its

natural state, maybe compacted, probably not compacted to a great extent so that the sewer doesn't get damaged, and therefore there will be a difference in the material directly between the mains and the sewer compared to that if you go back to the --

MR DI STEFANO: Yes, the diagram that showed it at --

MR HARTLEY: The kind of point that the crows fly or the worms burrow between the point of the leak and the sewer, that is - that's likely to be a different animal.

MR DI STEFANO: Yes. You are not suggesting that that would make it impermeable or mean that a negligible amount of water would travel between the burst and the - in that soil?

MR HARTLEY: The relative path of least resistance. Once the 1,000 litres per day in the mains, in the mains embedment material, as it chunters along and then falls - it's more likely to fall into the sewer trench below, and then from there it's likely to get up, one would expect it. I'm going outside my area of a great deal of expertise, but, to back you up, then you can't say it's zero in the surrounding trenches, but you can say the amount of water that's being, you know, taken up by the trench surrounds is considerably lower than what's going on in the embedment material.

MR DI STEFANO: Yes. If that's a convenient time?

CHAIRPERSON: Mr Hitchcock may want to respond.

MR HITCHCOCK: You read my face. I just think conceptually broadly you've got your geyser, lots of water is saturating the soils above the pipes, between the pipes and sideways in the sand and gravel. To say there would be negligible losses aside from what's going into the trench doesn't make sense, or I can't agree with it, sorry.

CHAIRPERSON: We'll break now for lunch and return at 2 o'clock.

LUNCHEON ADJOURNMENT

UPON RESUMING

MR DI STEFANO: Thank you, Madam Chair. We left off on the report of Professor van Zyl. I'd like to move on now to a related aspect of the first question which we're dealing with, which is the amount of water that made its way from the burst into the stormwater. So appendix G of the supplementary SMEC report deals with what I understand is the absorption - the spread of water from the leak location along the ground and into the stormwater pipe. And it in effect takes as read Professor van Zyl's number of water that reaches the surface but independently assesses what amount as a proportion of that water that would reach the surface would make its way to the stormwater; is that a fair summation?

MR HARTLEY: We actually carried out - independently carried out before Professor van Zyl's report was written. So it actually took almost as read the majority of the leak volume or the flow rate that came out of the surface.

MR DI STEFANO: So in that sense it doesn't depend on any particular numbers from Professor van Zyl's report, but independently assesses for an amount of water that would reach the surface how much would that reach - how much of that would reach the stormwater.

MR HARTLEY: Yes, it was a pleasing - it was pleasing to read Professor van Zyl's report when it came through that the flow rates and the volumes sat nicely with the independent conclusions of that appendix.

MR DI STEFANO: Yes. So the appendix is prepared by a Mr Tim Rhodes.

MR HARTLEY: Correct.

MR DI STEFANO: And did either of you have any involvement in the preparation of the appendix?

MR HARTLEY: I had a read through. And Hugo had some involvement because he went out on site to do some infiltration tests.

MR DI STEFANO: Yes. Okay. So if I turn - if we can have on screen, please, SEW.0001.0002.4187, yes, thank you, at page 349. Great. And if we could just zoom in on the top portion of that. Perhaps, Mr Bolton, are you able to explain what this image depicts?

MR BOLTON: The red is the sand fan, so to speak, and then the remainder is some outputs of hydraulic testing that was undertaken which I wasn't involved with.

MR DI STEFANO: And so am I right in inferring that the shaded areas superlaid over the top of the photo are outputs from hydraulic modelling that predicts where water would flow from the burst site?

MR BOLTON: I didn't undertake this work; it's Tim Rhodes. But, in essence, that's what I understand it to be, yes.

MR DI STEFANO: Yes. And I assume that's the same for you, Mr Hartley?

MR HARTLEY: Yeah. Basically this is what happens when 20 litres a second comes out of the burst location and where it's likely to flow to.

MR DI STEFANO: Yes. And if we can just look down at the - thank you. The second paragraph there provides, "The surface area of the inundation extent is estimated to be around 400 metres squared. Applying an infiltration rate of 50 millimetres per hour suggests that an infiltration into the subsoil of up to 5 litres per second could have occurred." So that's an explanation of how much water that reaches the surface at the burst site but then travels along the surface towards the stormwater, how much of that could have then infiltrated the soil back through absorption through the soil itself?

MR HARTLEY: Yes, over that area on the assumption that there was so much of water flowing over, 5-litres per second, over that area.

MR DI STEFANO: Yes. And you adopt that number or at least the 5 litres a second across the course of a day. If we can turn back to page 62 of this report and we zoom in on 9.42 at the bottom of that. So you can see there in the top paragraph you adopt Professor van Zyl's number of 11,000 litres per day entering the embedment waters of mains water and sewage. And then in the second paragraph you refer to appendix H, which I infer is a typo, it should be appendix G.

MR HARTLEY: Yeah, my apologies.

MR DI STEFANO: No, not at all. Which estimates that the velocity of flow required to create the sand deposits downstream is between 10 and 20 litres per second, with approximate infiltration of 5 litres per second, which equates to 0.4 megalitres per day.

MR HARTLEY: Correct.

MR DI STEFANO: So I'm right in understanding, aren't I, that that paragraph states that approximately 0.4 megalitres per day will infiltrate the soil between the burst location and the stormwater drain on the assumptions that are in appendix G?

MR HARTLEY: The only thing I would add to that is that's on the worst case. So that's on 31 December.

MR DI STEFANO: Yes. So explain that a little bit further?

MR HARTLEY: So a lot of the calculations which are summarised in this section and, you know, in appendix G is on 31 December, which is modelled as the worst day, the most amount of water during the day that went through. So we've seen the charts from Professor van Zyl's reports. It's a fairly exponential shaped chart which gives you the cumulative volume of water that's been lost and the charter path which gives you the daily rate. So there is a steep incline during the latter half of 2024, let's say. And therefore taking 31 December, which is 1.4 megalitres a day, that didn't happen on the 30th, it didn't happen on the 29th, 28th. They were moderately less.

MR DI STEFANO: So then correct me if I'm misunderstanding this .4 to .5 megalitres per day of infiltration. Is that a function of the amount of water, the depth of the water on the soil, or is it a function of the absorption potential of that soil over that area?

MR HARTLEY: Right. Okay. So they're kind of intertwined because you need a certain head to get that kind of infiltration going. So if you had a metre's worth of water above that the infiltration would be worser. So we take - it would be reasonable to say that it's generally a centimetre, 10 millimetres, of flow of thickness is assumed to have required to have that sand deposit, as it turned

out and, yes, so if you have that over an area, that gives you 5 litres per second. If that area reduces or indeed the head reduces, that 5 litres a second reduces.

MR DI STEFANO: Yes, because there's a smaller area that's being covered by the water?

MR HARTLEY: Absolutely.

MR DI STEFANO: Yes. But it's not that soil becomes more conductive of water the thicker the layer of water is on top of the soil? That might be a question for Mr Bolton, but --

MR HARTLEY: Do you want to say anything? I'm going to end up --

MR BOLTON: Yeah, I mean, it's a relatively shallow depth of water. Yeah, I guess obviously if you had a very deep amount of water, then obviously that would be a bigger driving force in a sense. But it's a shallow depth of water over 400 square metres, to give an estimate of what we consider to be the infiltration.

MR DI STEFANO: So maybe I can ask it this way. If you have a metre squared of a particular soil material and you have 100 millimetres of water sitting on top of it or you have 200 millimetres of water sitting on top of it, does the rate at which that water is absorbed into that soil change?

MR BOLTON: It will be greater for the one that is deeper.

MR DI STEFANO: So the more water on top of the soil, the greater the absorption rate: is that correct?

MR BOLTON: That's right.

MR DI STEFANO: Yes. And the other experts agree with that too? Yes. So if --

MR HITCHCOCK: I think what you're asking is does the soil properties change because you've got more water over it?

MR DI STEFANO: Yes.

MR HITCHCOCK: No.

MR DI STEFANO: No. Okay. So are you able to explain the difference in opinion?

MR BOLTON: Well, it's just the head of water rather than - like, you're right, the soil properties don't change. It's the head of water driving the infiltration.

MR DI STEFANO: So as the area increases there's more infiltration, but not as --

MR HITCHCOCK: And the height of the water pushing it through.

MR DI STEFANO: So the force of the gravity on top of the - increases the mass driving the water into the soil; is that right? Okay. Then if we consider that four to five hundred thousand litres per day absorption rate on the assumed area of 400 metres squared, you would expect then that, as the burst rate increases, water is exiting the burst location and it's spreading along the site, and some portion of that is being absorbed as the area increases and as the depth of that water increases, but once it reaches the stormwater some portion of it goes into the stormwater?

MR HARTLEY: Yeah, absolutely. It's a bit like when you - gosh, you know, you have a bucket full of water in the - you take the bucket - you're at the sand. You're taking a bucket of water from the sea. You take it up to your sandcastle to create a moat. It flows over. It doesn't quite get back to the sea. It kind of absorbs. Eventually, you know, if you had a big enough bucket, the channel would get back to the sea.

MR DI STEFANO: Yes. And in your example the sea is the stormwater drain and the bucket is the burst, and the sand is the distance between the ground between the burst and the stormwater?

MR HARTLEY: Yes.

MR DI STEFANO: Yes.

MR HARTLEY: Now, the point is - apologies, I'm butting in, but the point is that that 5 litres a second is not going to be constant because it depends on the area.

MR DI STEFANO: Yes.

MR HARTLEY: So there's going to be some infiltration, but it's going to be pretty smidgen because the thickness - the depth of the head and the breadth of the channel up until the point where everything's really quite, you know, covering 400 square metres, it's going to be relatively small.

MR DI STEFANO: So have you performed any analysis which determines what the relative infiltration rate is over time?

MR HARTLEY: Hugo's been out on site and doing some in situ infiltration tests to back these numbers up.

MR BOLTON: We haven't done any, say, modelling or something like that of how that might change over time. Is that what the question is?

MR DI STEFANO: Yes. So just so I understand what you've done, so you've performed an analysis which gives you the four to five hundred thousand litres per day at the maximum flow rate from the burst?

MR HARTLEY: Yes, because appendix G was, "Can a flow rate of litres per second that we understand came from the leak, can that create a sand fan?"

MR DI STEFANO: Yes.

MR HARTLEY: And we've done the model to say that if you do a model between 10 litres per second and 20 litres per second the kind of flow from the - you know, those figures is basically consistent with what we found on site, yes.

MR DI STEFANO: Yes. And so from that you infer that at its peak four to five hundred thousand litres of water would not reach the stormwater, it would be absorbed into the ground, but 1.1 or 1 million-odd litres of water would reach the stormwater on effectively the final day of the burst?

MR HARTLEY: It sort of comes from Hugo's in situ testing. The infiltration tests gave us that kind of 5 litres per second.

MR DI STEFANO: Yes.

MR HARTLEY: So the in situ tests which were done effectively separately to the modelling but sit within the scope of appendix G, you know, give us that 5 litres per second.

MR DI STEFANO: Yes, but is my explanation of it to you correct, that at the peak flow rate from the burst on your best estimate between four and five hundred thousand litres would have infiltrated the ground between the burst site and the stormwater drain?

MR HARTLEY: That's right, yeah.

MR DI STEFANO: Yes. So if we were to - if I can have SEW.0001.0002.4191 at page 31, which is the Professor van Zyl report. So we went to this before. Professor van Zyl says 11,000 litres constant reaches the surface per day, and then --

MR HARTLEY: I beg your pardon, in the mains.

MR DI STEFANO: I was - I misstated. Eleven thousand litres per day reaches the pipe and sewer bedding materials, and is transported through that. We had some engagement around whether the assumptions to that were accurate, et cetera, which we don't need to rehearse. But you have never prepared in effect a second column after leakage volume reaching surface per day which estimates the volume of that - that reaches the surface that actually then, instead of infiltrating the ground, reaches the stormwater?

MR HARTLEY: That's correct, because we'd be expected to basically do a model for every day because every day the flow rate would be different.

MR DI STEFANO: Yes. Quite. So that sort of modelling hasn't been done. All we could do is we could add a second column next to "leakage volume reaching surface" and at the bottom of that we could say four to five hundred thousand litres don't reach the stormwater. But, inferring back from that, we don't know how much for each previous volume of water that reached the surface what volume actually reached the stormwater?

MR HARTLEY: No, that's right. But, you know - yeah, I'll just cut myself off, if that's --

MR DI STEFANO: Yes. But what we do know is that, once the water plume reached 400 metres squared and had a depth of approximately 50 mills, at least 400,000 to 500,000 litres of that was being absorbed into the ground?

MR HARTLEY: That's the - that's what our calculations and testing suggests.

MR DI STEFANO: Yes, that's the modelling, and you adopt that number in your report. So can you be confident then when you form the conclusion that the majority of water would have reached the stormwater when you haven't performed an analysis on even the days indicated in Professor van Zyl's report as to what portion would have actually been absorbed into the ground?

MR HARTLEY: I think it's reasonable to say that the ratio between absorption and getting into the stormwater once the flow reaches the stormwater is reasonable. The tendency would be for the water to actually keep on the surface, would be my estimate. Hugo?

MR BOLTON: I mean, this calculation was largely done to try and understand the amount that was coming out of the - you know, the burst. So it was, you know, done in that sort of light, I guess, was trying to understand does everything fit in in terms of the water balance, I suppose, if that's to makes sense - what I'm saying makes sense.

MR DI STEFANO: It does make sense. I can perfectly understand the purpose of Professor van Zyl's analysis, and it appears to me that it's an essential integer in the maths required to work out what volume reached the stormwater. What I don't understand is where the analysis is that sits between the stormwater and the burst, and analyses the absorption rate, which you accept applies at the maximum volume, but in between the maximum volume and the volume of water first starting to breach the surface, and it seems to me there is no such analysis in your evidence of that amount, as a proportion or otherwise.

MR HARTLEY: Only on the worst day.

MR DI STEFANO: Yes.

MR HARTLEY: Yep.

MR DI STEFANO: Thank you. So on the worst day we know that it is approximately a third of the water, on the Professor van Zyl's numbers, that reaches the stormwater; do you accept that? Sorry, I withdraw that. It's two-thirds that reach the stormwater, one-third approximately that is absorbed?

MR HARTLEY: Yeah, yeah.

MR DI STEFANO: Yes. And is that the basis for your majority number, your --

MR HARTLEY: Yeah.

MR DI STEFANO: Yes. So, really, I should understand your evidence has been, or the inquiry should understand your evidence, that on the worst day the majority of the water reached the stormwater, but prior to that, aside from just an inference from the ratio on the worst day, you have not performed separate analysis of how much actually reaches the stormwater?

MR HARTLEY: I'm going to go for yes, but could I just say that on 31 December there was a photograph taken down the - effectively the grate - the chamber below a grate at Waller Place, where there was a still of flow coming out of that water - out of the pipe, and part of the analysis that we used was based on that - on calculations done by others to say that there's between, I don't know, 7 - I do know, I beg your pardon, between 7 and 12 litres per second at that time.

MR DI STEFANO: And that was on which day, sorry? The 31st?

MR HARTLEY: That was 31 December. So our analysis was, "Okay, do these add up? You know, can you get the flow coming out with 400 square metres doing that thing?"

MR DI STEFANO: Yes.

MR HARTLEY: "Do we have the 5 litres a second? Does it correlate roughly with the bow? Yes, it does." So you're right, we didn't do things on 1 November and such like

that. But on the other hand, of course, we'd have another variable, which would have made the modelling really quite, you know, academic.

MR DI STEFANO: Yes. And I accept that that photograph provides practical evidence to verify the model's result that, of the 1.4-odd million that reached - left the pipe, around 1 million of it must have flowed through the stormwater. So I accept that that's practical evidence of that. I'm just trying to understand the basis for the inference drawn as to the majority on the other days.

MR HARTLEY: Yes.

MR DI STEFANO: So can I open it up to the balance of the experts as to whether or not that ratio, i.e. two-thirds reaching the stormwater and one-third being absorbed, is a safe assumption for the days between the water reaching the surface and the peak flow rate day? Mr Paul, I don't know if you have an opinion on this?

MR PAUL: This type of analysis is not really my field of expertise, but there is evidence I've seen talks about when the stormwater flow was observed to have increased.

MR DI STEFANO: Yes.

MR PAUL: I can't remember the name of the witness. But it was around about --

MR DI STEFANO: Brett Cooper perhaps?

MR PAUL: Was it Brett Cooper? Yeah, around about 10, 15 December it's noted that - that sort of mid-week of December is when there was observational evidence of a big increase in the stormwater flowing down the drain. So that would be later than what's implied here by, you know, water leaking to the surface.

MR DI STEFANO: So if Mr Cooper's evidence represented the first date of which a significant amount of water reached the stormwater, which is an inference that is a matter for your expertise, not mine, any suggestion from me, there wouldn't be a significant - a significant amount of water would be being absorbed up until early December?

MR PAUL: Yes, that's right, or absorbed - we've got to

understand with any analysis like this it must be based on a series of assumptions - assumptions about the ground, assumptions about the permeability of the ground, the consistency of the permeability, the connectivity to coarser materials at depth. All of these are variables that are largely unknown. So, you know, I'd be sort of careful - you know, if I was doing an analysis like this I wouldn't be quoting such precise figures. That 3,867 litres per day in my view is far more precise than you could really provide given the uncertainties and the variables involved in the analysis.

MR DI STEFANO: Yes. Mr Makin or Mr Hitchcock, any comment on the ratio, whether it's appropriate to apply the same ratio between the peak volume day and the first day or any of the days in between? Mr Makin first, perhaps?

MR MAKIN: I couldn't say exactly, but I'd expect it to be somewhere in that range. As discussed (indistinct) area flooded as well as the depth. But that is infiltration once the water has come up to the surface, spread out and then gone back down.

MR DI STEFANO: Yes.

MR MAKIN: Could also be infiltration direct from the subsurface.

MR DI STEFANO: Yes, and presumably for a period of time water would reach the surface and then not traverse far enough to reach the drain at all. In the sandcastle, sand on the beach example, unless you had a sufficient volume in the bucket it would just be fully absorbed before it reached the - as it fanned out and thinned out and saturated the pores in the soil. Mr Hitchcock?

MR HITCHCOCK: I think those ratios probably sound sort of ballpark, but I didn't have the report and haven't really looked at it apart from your discussion of it, which has been good, but --

MR DI STEFANO: Sorry, did you say you didn't have that report?

MR HITCHCOCK: No.

MR DI STEFANO: Okay. So can I return to page 62 of

the SMEC supplementary report, which is SEW.0001.0002 - thank you very much. In light of our discussion, Mr Hartley, do you want to revisit your conclusions at the top there where you say, "Total volume of water entering the embedment material and mains water and sewage is 11,000 litres per day"?

MR HARTLEY: Well, the term "volume" probably could do with revising, really, because it's the total - the total volume of water per day is - we've just got to be consistent with the units.

MR DI STEFANO: Yes.

MR HARTLEY: So that first part or that part of the sentence is probably correct, and therefore the volume of leaked water that flowed to the surface, 1.39 megalitres per day, should be caveated to the, you know, 31 December, or worst case scenario.

MR DI STEFANO: Yes.

MR HARTLEY: Yep. And, in fairness, the last sentence, although written to help the reader, doesn't actually say, "Well, yeah, we've just gone for the worst case scenario as opposed to things can get worse from those" --

MR DI STEFANO: Yes. And it's fair to say, isn't it, that the 11,000 litres per day is just the amount of water that is estimated to have travelled directly from the burst into the embedment materials, not the total amount of water that could have travelled to the embedment materials?

MR HARTLEY: Yes, it's the capacity of the surface trenches - of the embedment materials.

MR DI STEFANO: Yes. And it's an estimate of the direct transfer from the burst subterraneanly to the embedment materials as opposed to infiltration from the surface back down to the embedment materials?

MR HARTLEY: That's definitely right.

MR DI STEFANO: Yes. And that's where our .4 to 5 - .5 megalitres per day number comes in?

MR HARTLEY: That's correct. And, again, it should have

been worst case scenario.

MR DI STEFANO: Yes. So can I have DPA.0004.0001.0001 up, which is at page 83. And can I have a zoom-in on the top chart, please. So this is, I assume, a street view photo overlaid with the locations of the burst, the sewer and the stormwater?

MR HARTLEY: That's correct.

MR DI STEFANO: And I infer that Professor van Zyl's opinion relates to the distance between that yellow pipe burst mark and the blue sewer main?

MR HARTLEY: Yes, correct.

MR DI STEFANO: And if one in one's mind can superimpose the fan diagram that we saw before of the sand plume over the top you would see that down to those two nodes in the upper left portion of the image labelled "sewer pits" - "stormwater pits", rather, the water would fan out from the burst location to those locations?

MR HARTLEY: It wouldn't go - there's no evidence on site to suggest it went to the stormwater pit adjacent to the southbound carriageway. There's a bund which basically channelises runoff to the first or the - you know, the one, say, 20 metres or so south-east.

MR DI STEFANO: Yes. So that four to five hundred thousand litres per day absorption at peak we would expect to be absorbed into the ground and to travel to the path of least resistance subterraneanly?

MR HARTLEY: Yes.

MR DI STEFANO: And you'd accept, wouldn't you, that that would either be the sewer embedment materials or any more permeable colluvial channels that might flow in that area?

MR HARTLEY: Yes, yes. I'll pass to Hugo, but does water know where these permeable things are, because everything fans out and so things go down. It doesn't make a beeline for the nearby trench. It doesn't actually know where the trench is. Is that right or am I wrong?

MR BOLTON: Yeah, I mean, it is unsaturated flow, I mean,

because it's - well, unless there is a water table there, but we - well, I think it would likely be unsaturated, so it does make it a bit tricky. But in general I would have thought it's going to travel downhill and, yes, some of it I guess could go into the sewer embedment material. But I understand it's reached capacity, though, at 11,000. So I guess it's not going to want to go into that easily. There's also other pathways, you know, going just through natural soil also. So it's not going to all go to one place in particular. It's going to go in a number of different places.

MR DI STEFANO: Yes. So as the path of least resistance saturates the water flow will then go to the next path of relative least resistance?

MR BOLTON: I guess it has, you know, infiltrated into the ground from the sand fan and it's now going through, I would assume, one material, you know, at that point. It doesn't have choices then. It 's just got the one material that it's going through. Eventually it's going to continue to go down through the ground, and when it's unsaturated it's going to have a tendency - unless it hits layers, it's going to have a tendency to go down until it hits a clay layer or some other impediment, or if it were to come eventually to, let's say, a sewer or something, sewer embedment, if it has capacity to accept that it could go into there also.

MR DI STEFANO: Yes.

MR BOLTON: It's not as simple as I think you're trying to describe it, really.

MR DI STEFANO: Yes, I'm trying to understand your evidence about how the water would flow. So what I understand your evidence is is that it would - the sewer material - the sewer embedment material, once it reaches capacity, would not receive further water?

MR BOLTON: Yeah.

MR DI STEFANO: And then water that would otherwise have gone into that material would flow to the next least resisting preferential pathway, and there might be a variety of those?

MR BOLTON: Yes, if it's in its path.

MR DI STEFANO: Yes. Quite. So water that is, you know, 20 metres away from the - underground seeping vertically 20 metres away from the sewer embedment material is unlikely - it doesn't find out the sewer embedment material and redirect?

MR BOLTON: Yeah, it's not like a magnet where all of a sudden you're drawn to it like a planet and gravity or something like that, you know.

MR DI STEFANO: Yes. But we're aware, aren't we, that under this - and there's a chart of Mr Pope's, which I can bring up if necessary. There's also a kind of historic gully and associated colluvial channel that runs from this location downslope?

MR HARTLEY: Is this the wide one or is this the one that's assumed to be the Kings Creek?

MR DI STEFANO: I infer it's the one that's assumed to be the Kings Creek, but perhaps I'll bring the cart up and we'll --

MR HARTLEY: Yes, that would be --

MR DI STEFANO: It's in Mr Pope's causation report, which is MSC .5087.0001.0157, at Bates number 0204. Thank you. Just that chart there. This is the gully that I'm referring to. So what I'm suggesting to you is that water that didn't make its way into the stormwater - I withdraw that. Water that didn't make its way into the sewer embedment materials would travel along the known gullies in preference to just otherwise seeping through the ground?

MR HARTLEY: If it found that, yes.

MR DI STEFANO: Yes. Quite. Would any of the other experts like to comment on where they consider water that's seeped - the four hundred to five hundred thousand, assuming just at the peak flow day, where they would expect that water to flow with what they understand of the topography? Maybe we'll start with Mr Hitchcock in reverse order.

MR HITCHCOCK: Down.

MR DI STEFANO: Okay. And --

MR HITCHCOCK: Over colluvium, down to the gully, base of the gully, follow the gully.

MR DI STEFANO: Yes. And would you expect any to make its way to a deep aquifer or a groundwater?

MR HITCHCOCK: No. The permeability difference is too much at the interface.

MR DI STEFANO: Yes. So that's at the interface of the extremely weathered granite and the inferred colluvium material?

MR HITCHCOCK: Yep.

MR DI STEFANO: Does anyone have anything contrary to that to say or otherwise agree?

MR POPE: No, not contrary at all. When you're considering where this water - what's infiltrated into just natural ground, you've got to consider that the freeway's fill batter is retarding flow in itself. Like, it's not a dam but it will act as a dam and in - informally, and you've got to consider what's been buried by the motorway. So we don't really know how they treated Henry street and the lots that were resumed and what was on those lots and what trenches were on those lots. You had shoulder drains in Henry street. So it will go into the colluvium definitely, and it can come out at surface below the fill embankment.

MR DI STEFANO: Yes.

MR HITCHCOCK: Wouldn't the freeway itself slightly compact the soil, make it slightly less permeable in that direction underneath the soil or?

MR POPE: Without talking too much about the Country Roads Board, maybe. Yeah, if they did the compaction properly, yep. Yep. I daresay by the - sorry, by the performance of the motorway, there's not a lot of - there is settlement in Coburn Creek which I think is related to a stormwater pipe. But that fill side of the highway doesn't have blatantly obvious settlement issues. So yes to what Mr Hitchcock's

saying regarding if it's compacted it will change how water flows as well.

MR DI STEFANO: Yes. Thank you. Can I turn then to the - sorry, Mr Makin, did you want to say anything? Sorry, I just was looking at my notes.

MR MAKIN: Just to add to, as Mr Bolton says, it's initially unsaturated flow. So the flow would tend to be vertically downwards until it reaches a barrier, which may be the base of the colluvium or, if that's already become saturated, then you can't put more water in beyond a certain capacity. So once that saturated ground beneath the leak fills up then it will tend to head off down the hill.

MR DI STEFANO: Yes. Thank you. Can we turn then to a related topic, which is velocity and the ability of water to move through materials over time. Mr Hartley and Mr Bolton, what I'm particularly interested in understanding is the basis for the 230 day number which is quoted in your conclusions. Perhaps we can go there as the place to start. If we go to the SMEC report, the supplementary report, at page 63, please, and if you look at the top of that, where we are here again in part 9.42, for your benefit, which concerns the Bayview Road leak, and the last sentence there states that a period of 230 days would be required for water from the leak to reach the site, whereas the time estimated between the start of the leak and the 5 January failure, 157 days. So that 230-day period, I assume that doesn't relate to water moving through the sewer embedment materials?

MR HARTLEY: Correct.

MR DI STEFANO: Because we know that water - and you accepted elsewhere that water went through the sewer embedment materials and reached as low as Prospect Hill to trigger the sump pumps; the testing - the water chemistry testing has confirmed that aspect. So what does this 230 days apply to?

MR HARTLEY: 230 days applying to? It's the direct flow from the location of the leak through natural material to the location of the landslide.

MR DI STEFANO: So it assumes that the water would flow

through - direct material, is that a colluvial channel?

MR HARTLEY: It's the material that - you know, that we've been finding throughout the site with the honourable exception of borehole 2, which was a bit of an outlier.

MR DI STEFANO: Yes. So, in terms of the height within the ground that you're performing this assessment at, where in the ground is the - maybe I should break this down into stages. So can you explain to me where in the analysis of the 230 day number comes from? Where is the maths for that number? Have you included that in the report or in the annexures?

MR HARTLEY: Well, it comes from the assessed flow velocity. I keep on getting the term wrong, so Hugo can stamp on my foot when I do.

MR BOLTON: I can explain it if it is easier?

MR DI STEFANO: Yes, please.

MR BOLTON: So it's based on testing that we did on the soils that is - we've done flood testing, which is an aquifer permeability test. We've also done permeameter testing, and the values ranged up to approximately 5 metres per day permeability or hydraulic conductivity. So that value, the upper end of that, the 5 metres per day, towards the upper end, was used, and then using a hydraulic gradient of .1 and I think it was a porosity of .3 you come up to a - the groundwater will travel 2 metres per day, which would take - if you take 460, divide it by 2, gives you the 230.

MR DI STEFANO: Yes. So it's in effect an average permeability --

MR BOLTON: Well, it's the upper - of what we have tested?

MR DI STEFANO: Yes.

MR BOLTON: It's towards the upper end of that.

MR DI STEFANO: And applied as a constant across the 450-odd metres?

MR BOLTON: So assuming that the water goes in a straight

line from the burst to the landslide you get 460 metres. Divide that by 2 and you get --

MR DI STEFANO: The number of days - of the rate. And it assumes, doesn't it, that water doesn't, for example, leave - take a faster route, for example, through a sewer trench and then leave a sewer trench and then enter a colluvial channel? You'd assume the 230 days is from the one particle of water leaving the burst site and arriving at the headscarp?

MR HARTLEY: In this instance, yes, the direct route; absolutely.

MR DI STEFANO: Mr Makin, you performed independent analysis of a similar question; is that fair to say?

MR MAKIN: Correct, yep.

MR DI STEFANO: And that is at 166 and following of Mr Paul's report, or the WSP report. Are you able to explain how your conclusions differ from those of Mr Bolton in respect to the time it would take water to travel from the burst site to the escarpment?

MR MAKIN: Firstly, what was similar. Used the same equation, Darcy's law, and used a range of parameters based on the different observations, both the in situ testing and the observations of the soil type, and then various scenarios for how the water may have moved. For the - it's different terms for flow, the volumetric flow or the speed of that water particle or the time it takes to get from A to B. So if we're talking about that last one, from this point to that point, then the range that we came up with for the purely through the ground encompassed the conclusion. It could be slower than that if it was a finer grain material or faster than that if there was more gravel along the pathway. But then applying a similar calculation to material characteristic of the trench gravel you could get faster rates as well.

MR DI STEFANO: Yes. So on that point can I ask that Mr Paul's report, DPA.0004.0001.0001 at 0095 be brought up, please, and the table at the top of the page zoomed in on. So you said a moment ago, Mr Makin, that depending on the assumptions you made about the material the flow - the time it could take could vary significantly?

MR MAKIN: Yeah.

MR DI STEFANO: And is that reflected in that travel time in days row in this chart?

MR MAKIN: Correct.

MR DI STEFANO: So I'm correct in understanding that if the material was uniformly sand at that hydraulic gradient it would take 1,465 days, whereas if it was gravel it would take 12 days?

MR MAKIN: If it was the same material all along the pathway.

MR DI STEFANO: Yes. And perhaps, Mr Hitchcock, do you agree with the approach that's been taken - the analyses of both of these gentlemen, and do you have any comment?

MR HITCHCOCK: I couldn't find calculations of how SMEC came up with 2 metres a day. So I can't really verify that. I understand it's come from a variety of tests, how they've come up with the permeability number to do it. Usually with these things you report a range, as in this report, because you recognise that it's not a very exact science. Soil can vary by a few per cent and in fine content can change permeability by an order of magnitude. So to report something as one number is not very common, I don't think, because usually you think about a range and you mean in that range sort of thing. So while I don't know how they have calculated their 2 metres a day, I think if that number is correct, still don't think it negates the flow path or, like groundwater, it's within the same ballpark as the time available. It's not 10 times or 100 times out. It's sort of in the order of magnitude of doing the tests and analysis. And - yeah. So, you know, obviously the calculation is the calculation. So that's - that method's fine. I just think it's the accuracy of the - of saying - I think it's more supportive than against it because it didn't quite make it, but it's the range you can think about, not a precise number.

MR DI STEFANO: So supportive in what sense, sorry?

MR HITCHCOCK: Well, I think to say it's only 150 days but it should have taken 230, I think that's sort of the same

ballpark; it's within the axes of the testing.

MR DI STEFANO: So, within the level of accuracy that this test can be relied on for, that's close to a positive result?

MR HITCHCOCK: Yeah.

MR DI STEFANO: Because it should really be a plus or minus range, and in your opinion it would be within that plus or minus range?

MR HITCHCOCK: Yep.

MR DI STEFANO: And, Mr Makin, do you have a similar view to that?

MR MAKIN: Yeah, you have the days within that range that I have calculated.

MR DI STEFANO: Yes. And I note that in your passages of your part of this report, Mr Makin, you rely on physical evidence of observed water in the sense of water breaching ground or water otherwise being in places where you wouldn't expect it to be. Are you able to comment on how that relates to a consideration of the overall number of days it would take?

MR MAKIN: That's more supporting evidence for points along the flow path, and not just the leak started on this date and came out here on the other date. More observations that things were changing along the way in the intervening time.

MR DI STEFANO: Yes. Thank you. Would anyone else like to say anything further on that? Mr Bolton perhaps?

MR BOLTON: I would just like to add that I have gone through some of the calculations that have been done in another part of this report, and I found that they're in error. Therefore I would like to check these calculations with my spreadsheet that I've used to make sure that they're correct because I don't have confidence in them.

MR DI STEFANO: Do you know if that spreadsheet's been produced or was placed into the expert dataroom?

MR BOLTON: No, it's my own personal spreadsheet that I use. This has only just come up because I've seen this and I've, you know - I just don't want to - the question might be, "Do you believe these" - "Hugo Bolton, do you believe that," and I have to say I don't have confidence.

MR DI STEFANO: Yes. So in respect of 230 day number is that what you're referring to?

MR BOLTON: No, no, what I've got in front of me right now.

MR DI STEFANO: Okay. Well, it would be useful if that spreadsheet could be produced to the inquiry and to the other experts so that --

MR BOLTON: It's on my laptop.

MR DI STEFANO: So that the other experts can consider the workings. As Mr Hitchcock noted, he hasn't seen it, and I asked you earlier about it and I hadn't seen the workings either of it. Mr Hartley?

MR HARTLEY: Sorry to interrupt. In our first report of 5 May we created a similar kind of assessment of, you know, flow paths and permeabilities and all that, all that kind of thing. We have done the tests throughout the region. We've done permeability test results, porosity test results. They are provided in the admittedly late submission, late last week. They are available for everybody.

Obviously permeability tests carried out in undisturbed samples tend to be done in impermeable material. If they're permeable material they fall out of the tube. But the vast majority of the material that we were encountering, particularly at the hole that was dug at the Waller Place South East Water, you know, tank, if you will, had a certain amount of impermeability, off the top of my head, 10 to the minus 18 (indistinct).

MR DI STEFANO: Yes. Thank you. On the topic of practical evidence, i.e. evidence of actual occurrences of otherwise unexplained excess water, did you take into account in your 230 days number in any way the fact that water was seen in places that it otherwise wouldn't have been expected to, which you accept came from the burst, in

periods much shorter than the - what you would infer would be required if 230 days was required from the burst to the scarp?

MR HARTLEY: Are you talking about the upwelling?

MR HARTLEY: Yes, the upwelling and the water in Prospect Hill Road, number 7.

MR HARTLEY: We've got to apologise. If that acknowledgment of the potential hasn't been made clear, it really is. The idea that water flows through the sewerage trench down through - underneath the M11, Waller Place, Charlesworth, hits Coburn, is very much something that we think is a high likelihood, and what we've been able to do - and it gets all geochemistry breadcrumby from thereon - is understand that there is a trend of water with similar characteristics that go down the sewerage down to Coburn Avenue, then get into the natural material and find themselves underneath the property in the agi-drain system of 7 Prospect Hill Road.

MR DI STEFANO: Yes. Can I just then return to the sewer diagram, which I will find. It's in the South East Water report, the SMEC report, which is the one ending 4187. It's at page 39. And could we just zoom in on the middle of that. So what we can see there bisecting the image from top right corner to mid-left is Coburn Avenue, and the island, as you referred to it earlier, Mr Bolton, is in the upper middle of the frame, and you can see a T-intersection there, which is the corner of Coburn and Charlesworth Street, where we're discussing the - well, you just explained that you're of the view that it's highly likely water flowed to. Can you see there that the sewer main connects back into - I withdraw that. On the other side of Coburn Avenue, underneath and to the outside of the houses on Coburn Avenue near that corner, you can see there's a sewer main that runs to that point; yes?

MR HARTLEY: Yes. Could the red dot be shown just to --

MR DI STEFANO: Yes. Yes, that's a good idea. So to the right of that, if you go just down and follow that branch. Yes. In there, yes. So the distance we're talking about that would - is non-trench flow, if I can put it that, between that corner of Coburn and Charlesworth, and then re-entering a trench - there's no scale on this - oh, there

is a scale, but it appears to me to be something like 10 metres or less. So if we were focusing on trench flow alone the velocity question would apply only to that 10 metres at the rate - the 230-day rate, wouldn't it?

MR HARTLEY: The 230 days is avoiding all trenches.

MR DI STEFANO: Yes.

MR HARTLEY: Because everything's going to be quicker through trenches.

MR DI STEFANO: Yes.

MR HARTLEY: The expectation will be is that if natural - oh, golly. If water from the Coburn Avenue/Charlesworth T-junction gets into the natural material, for it to get down to 7 Prospect Hill Road is about 30-odd days. For it to get into that kind of spur of the sewerage network, that isn't something that we've calculated, but it's going to be in the region of, say - if it's 10 metres distance, then you're looking at five metres - five --

MR DI STEFANO: Five days.

MR HARTLEY: I beg your pardon - and then shoots through.

MR DI STEFANO: Yes.

MR BOLTON: If it's --

MR DI STEFANO: Sorry?

MR BOLTON: Yeah, no, I'm just doing the math in my head trying to make sure that what he said is correct.

MR DI STEFANO: Yes.

MR BOLTON: That's all.

MR POPE: If I can just quickly jump in there?

MR DI STEFANO: Yes, please.

MR POPE: I would have thought if we've got 230-day time frames that it would have been blatantly obvious the peak surface water observations would have peaked in May and not

in January. There's a blatant disconnect between that number and what we've seen in the community.

MR DI STEFANO: Yes. Well, in fairness to Mr Bolton and Mr Hartley, and I think this is part of the disconnect, is that - the way I understand that figure to be calculated - it is purely through the ground without taking into account any jumping or preferential flow from ground to sewer trench back to ground, but - yes, so it's in effect the absolute worst case. If there were no sewer mains in that area and there were no more permeable pathways, it would be a worst case of 230 days.

MR POPE: Yep, yep.

MR DI STEFANO: I'm planning on moving off this onto leakage from stormwater. So if anyone wants to jump in and ask any questions?

MS SIEMENSMA: Madam Chair, while my friend is making her way to the lectern I should indicate in terms of pathways of water I haven't divvied it up in this way, and my preference would be, rather than to try and work out which (indistinct), if I cross-examine (indistinct).

CHAIRPERSON: Of course. Yes.

<CROSS-EXAMINATION BY MS FOLEY:

MS FOLEY: I have some questions for either Mr Hartley or Mr Bolton, and I just want to test which one of you I should be directing these to. So if you can go to the SMEC report Bates number - we're already there - SEW - yes, we're in the right one. If we could go to page 62 of the PDF, please. I want to ask some questions about section 9.4.2, which we've already been dealing with. Which one of you drafted that section of the report?

MR HARTLEY: It's going to be me, probably.

MS FOLEY: Okay. And, Mr Hartley, at any point if you feel that what you relied upon was based on Mr Bolton's work, feel free to pass over to him, as you've been doing. As we know, in this part of the report the conclusion is expressed that in considering the flow of water from the Bayview Road leak the water could not have travelled the distance between the leak and the site fast enough. That's

the position that's taken in the report?

MR HARTLEY: Through the natural material, correct.

MS FOLEY: Through the natural materials, exactly. And in this section, as we've also heard, it has been put to you there's a statement that the velocity of water through the natural material estimated from in situ infiltration tests and water velocity tests is 2 metres per day?

MR HARTLEY: Correct.

MS FOLEY: All right. And from that you then say that the velocity is too slow to have impacted the landslide?

MR HARTLEY: That's the - that's the --

MS FOLEY: So those are the building blocks; all right. If you can help me out, I'd like to know where in the report do you set out the testing and the calculations that have led you to the 2 metre per day figure, given its importance to this part of the report?

MR HARTLEY: It's actually going to be in appendix E.

MR BOLTON: Only it's - it's based on the permeability values. I don't think --

MS FOLEY: Can you take us to the part of the report --

MR BOLTON: I don't think we have the calculation laid out anywhere.

MS FOLEY: No. So you'd agree it's a really important part of the analysis in this report, this figure, the 2 metres per day? Nowhere in the report have you set out the underlying data, the calculations that led to that figure?

MR BOLTON: No, I'll have to go - let me just look through the --

MR HARTLEY: We may have the factual data because the factual data of the lateral tests whereby dyed water was placed in one span pipe piesometer and timed, and then recorded when and if it was received in the second --

MS FOLEY: I'll just stop you there because what I'm interested in is where is it in the report.

MR HARTLEY: Yep.

MS FOLEY: And I've scoured the report and I can't see it.

MR BOLTON: If that's the case, then the calculations aren't there probably because - that's true then, I guess.

MS FOLEY: I'll just wait for a moment. Okay. All right. So the question I'm asking is where it is in the report, and the reason I'm asking that is if it's not in the report we can't test it here in this forum. And so it's very important for us to be able to see the calculations and be able to see the data so that can test the basis for your conclusion as you've expressed it on this important issue in your report.

MR HARTLEY: We don't seem to have it, I'm afraid.

MS FOLEY: All right. Is there a reason it wasn't included in the report? You've accepted it's a building block of an important conclusion. The 2 metres per day is very important to understanding the opinion you give, which is effectively the water could not have travelled that far. Why was that information not included in your report?

MR HARTLEY: That's purely human error. We have done the calculations, we have done the tests on site, we genuinely have, to the best of our capabilities on site to assess the soils that we were able to get hold of and do the tests.

MS FOLEY: But it wasn't seen necessary to put it in or it was just an oversight?

MR BOLTON: Oversight.

MR HARTLEY: It was an oversight. It should have been in, yep.

MS FOLEY: Right. You'd accept that the kind of testing you would have done to come up with that figure is not a precise science?

MR HARTLEY: That's correct.

MS FOLEY: All right. There are many unknowns and variables that need to be taken into account?

MR HARTLEY: Are the tests representative of the entire colluvium band or the transported soils? No.

MS FOLEY: And because it's not a precise science that's one reason why - I believe it was Mr Makin who gave this evidence - one would ordinarily give a range in providing an estimate of this kind rather than a single figure?

MR BOLTON: Just on that, I mean, we - the 2 metres per day was the upper end of what we had available to us in terms of the data that we collected.

MS FOLEY: Well, you say that. I can't test that. So I guess the proposition I'm putting to you is would you accept that ordinarily with tests of this kind, given the uncertainties and it's not a precise science, a scientist in your position would offer a range?

MR BOLTON: Or a maximum.

MS FOLEY: Right. And you're saying it's the maximum, but we can't test that?

MR BOLTON: Because we've - well, I can show you now, but obviously it's an oversight we didn't put that in the report.

MS FOLEY: All right. Based on the material that is currently available, you'd agree, I expect, that it is possible in your opinion for the water to have reached the site by 5 January? I'm asking about whether it's possible, given the evidence you've now heard?

MR HARTLEY: Well, if possible - if there's only two choices between possible and impossible, then possible is the answer.

MS FOLEY: Right. And you accept that the opinions you've given in paragraph 9.4.2 of your report are based on testing that's not revealed in the report; we agree with that? Yes?

MR HARTLEY: Yes.

MS FOLEY: That the testing is not a precise science; you've agreed with that?

MR HARTLEY: I prefer to say, look, it's incomplete.

MS FOLEY: All right.

MR BOLTON: I mean, it's imprecise, but we've put the higher end of what we had the data for.

MS FOLEY: Well, you say that. Again, I can't test that with you. But hearing what you say --

MR BOLTON: But you were asking about a precise science, and I'm giving you an answer to that specific question that it is an imprecise science and so we are providing what we consider to be the upper end, you know, which I thought was conservative.

MS FOLEY: I might pass to the other experts to see if they have any comments about this particular issue, and I appreciate you've already been asked some questions by my learned friend and it may be you've got nothing more to say, but given what we've just heard I just wanted to ask, Mr Hitchcock, in the first instance, whether you have any comments in relation to the 2 metre per day figure?

MR HITCHCOCK: Well, I agree that I can't check or validate it, and that I usually would give some sort of range, and it's an imprecise science of lots of variables. That's why you have to give a range, and I can't check that, and the first thing I did looking at this report was, "Where did that come from?" Couldn't find it. Also don't know how the tests were undertaken. Were they (indistinct) tests; what the test data looked like. You graph these things up. You look at how - what the graph looks like, "Yeah, that makes sense," or it's a (indistinct) curve. There's all these things you to look at, which you can't do at the moment.

MS FOLEY: Thank you. Mr Makin, any additional comments you'd like to make?

MR MAKIN: Yes. The results of the flood testing reported in the table (indistinct) worked out independently.

MS FOLEY: No further questions on that topic.

CHAIRPERSON: Just on that topic, I can see from the first few pages of your report that seven other experts were involved in this report. Did any of the seven other experts draw this oversight to your attention? Did any of them ask you where the calculation is for the 2 metres per day?

MR HARTLEY: I'm afraid not.

<EXAMINATION BY MR DI STEFANO:

MR DI STEFANO: The last topic that I have questions for before I return you to Mr Costello is about leakages from stormwater and the potential contribution of water that breached the stormwater system to the excess moisture in the headscarp. So we've dealt with direct flow, if we call it that. We've dealt with sewer trench flow. In terms of leakage from stormwater, I just would like to firstly start by confirming the language used in the joint report. So at numbers 24 and 36 of the joint report there are references to stormwater leakage as preparatory, and the same for 36. I take it what the opinion is that's expressed in respect of that factor is just whether pre-burst, if I can put it that way, leakage from the stormwater contributed to the excess moisture in the scarp making it more susceptible to landslide?

MR PAUL: That's what that means. So part of the stormwater drains sort of leaking is in general operation, which provides a high background moisture --

MR DI STEFANO: Yes, thank you. So it's not - it's stormwater drains in a general sense as opposed to in particular the main stormwater - that conduit that the burst water went into at Bayview Road and flowed down towards Margaret Street. Yes. Is that correct? And Mr Pope?

MR POPE: Can we go to the page?

MR DI STEFANO: Yes, yes, of course.

MR POPE: I think it broadly is. We did talk about Browne Street in the conclave.

MR DI STEFANO: Yes. Well, I'm coming to that.

MR POPE: Yep.

MR DI STEFANO: Thank you. Perfect. Page 4 there. I'm talking here about number 24, which is a stormwater leakage preparatory factor, and the same factor in respect of the 14 Jan, which appears to me to have all of the same responses given. So I was correct before in the way I described the consideration of that?

MR POPE: Yes, yes.

MR DI STEFANO: Thank you. In terms of stormwater as a part of - I withdraw that - as a flow path of Bayview Road leak water to the escarpment I understand the analysis centres on a series of breaches in the stormwater drain and, Mr Pope, you performed CCTV analysis, video feed analysis, of the inside of the drain and identified a series of breaches in it?

MR POPE: Yes.

MR DI STEFANO: So if I can have Mr Pope's report brought up, which is MSC.5087.0001.0157, and if we can go to page 0247. Yes, thank you. This is the page I'm referring to, Mr Pope. So, as I understand it, we can see here in the bottom right the - Bayview Road, the location approximately of the leak, and we can see after that the two stormwater inlets where water that would have - that wasn't absorbed that reached the surface would have flowed to, and then further down that branch of the stormwater network we can see a series of numbers which are individual stormwater defects; is that correct?

MR POPE: Correct, yes.

MR DI STEFANO: And there's a red shaded section that says "See detail 1"?

MR POPE: Yep.

MR DI STEFANO: And there you can see numbers 4, 1 and 2, which are stormwater defects, and then you can see a number there, number 5, which is what I understand is being referred to as the Browne Street repair out the front of 25 Coburn Avenue?

MR POPE: So 1, 2 and 4 are the repair - like, so in the middle of the street is 1 and 4, was where the repairs were.

MR DI STEFANO: Okay. So perhaps - so that's what you're referring to when you say the Browne Street repair?

MR POPE: 1 and 4, yeah.

MR DI STEFANO: Is 1 and 4; okay. And, Mr Paul, I understand in your report you refer to repairs to a stormwater pit, which is - do you recognise that as being number 5 on this image?

MR PAUL: It might be between 5 and 6 at the bend.

MR DI STEFANO: Yes. Yes, is it your understanding as well, Mr Pope?

MR POPE: Yeah, at the bend.

MR DI STEFANO: Thank you. If we could go to page 0418 of this same document, please. Where we're going is the screen captures from the CCTV footage of the burst that correspond - I withdraw that - from the breaches in the stormwater that correspond with the previous page that we've just seen, the map. 0418, please. So that's the intersection of Browne Street and Coburn Avenue, and we can see there the description of the breach. The description says "Joint displaced radial displacement void visible through defect". If we can just zoom in on that image, please. That's the image in the top right, yes. So it's a 600-millimetre diameter pipe, concrete pipe? Is that correct? It says it in the table. It's not a memory test.

MR POPE: Yeah, no, it's not something (indistinct). But, yeah, I believe it is. Yep.

MR DI STEFANO: And you can see there what I would suggest is a very obvious defect in that pipe, quite a significant radial displacement between the incoming pipe and the outgoing pipe?

MR POPE: Absolutely, yep.

MR DI STEFANO: And you performed analysis, did you, of the potential for water to leak out of this and the other

similar breaches along the stormwater, Mr Pope?

MR POPE: Only here because it was such a significant defect. So I haven't done the full lines. I have tested flow rates in View Point, but I haven't done a detailed analysis of the whole loss on this line.

MR DI STEFANO: Yes, okay.

MR POPE: Given all this discussion about infiltration rates, it was a very simple and (indistinct) soil science based infiltration number. I just used a very big number, 300mm a day. But it's quite complex in this location in that it's literally over the 900mm diameter water main. So where the water goes from here, it's very complicated to work out where it goes.

MR DI STEFANO: Yes. And if we can just zoom out in this photo and scroll down through the image below, detail of another broken joint with what looks like a slug in it. And the next page, please. You can see there that's the intersection of Browne Street and Coburn Avenue in the bottom right, another quite significant radial displacement between --

MR POPE: 1 and 4, essentially as that pipe transitioned over the steel water main there was a noticeable amount of displacement.

MR DI STEFANO: So it's the second side of the same displacement?

MR POPE: Yes. I can't remember whether it was one or two lengths they pulled out. But, yeah, it's associated with that transition over the large diameter water main.

MR DI STEFANO: Yes. And if we can just go to the next page to number 5. There in the bottom right you can see another void in the side of the pipe, and so - I asked you - you explained this a moment ago, Mr Pope, but you conducted a kind of absorption analysis, if I can put it that way?

MR POPE: Yes.

MR DI STEFANO: But just in respect of one of those breaches?

MR POPE: Correct.

MR DI STEFANO: Yes. And can I have Mr Paul's report back on screen, which is DPA.0004.0001.0001. Paragraph 163(c), which is page 89, please. Mr Paul, this is a different breach to the ones we were just looking at?

MR PAUL: That's right.

MR DI STEFANO: So that's a sewage pit - sorry, I withdraw that - a stormwater pit, and you can see there you've identified what you say is a section of broken pipe?

MR PAUL: Yeah, that's what - so I identify it. That's from the Mornington Peninsula Shire Council maintenance record. (Indistinct) identify it. I'm quoting what's in that report.

MR DI STEFANO: And, Mr Pope, that's consistent with your understanding, that that was a --

MR POPE: Yes, it's an oversight that's not in my drawing. It was certainly brought to my attention earlier in the year. Yeah.

MR DI STEFANO: Yes. And do any of you have any basis to think that any of these breaches in the stormwater system occurred after the landslides in 2025?

MR PAUL: This particular one, the date of this is - it's on there - March 25, so it's after. So we just have to make an assessment on looking at it and looking how old it is, is the best we've got, to identify whether it was before. But when I do look at that you can see water's come out of the pipe on the left. You can see pitting on the pipe where it has the inlet and sort of a little bit of erosion on the inlet, which is consistent with water coming out, bringing sediment with it, bringing gravel with it, you know, hitting with velocity to that side. So not surprising you would see that's where the void is. So, yes, based on the age of that, the pitting, the erosion that's gone on, my view would be it was like that prior to January 25. Most unlikely that occurred before.

MR DI STEFANO: Yes. Mr Pope, do you agree with that assessment?

MR POPE: Yeah, yes.

MR DI STEFANO: And in respect of the other breaches, the ones around Browne Street, do you have any --

MR POPE: I had asked for older CCTV. I believe, given the nature of the backfill, it's more likely that it pre-dates the landslide.

MR DI STEFANO: Yes. Thank you. So I'm right then in understanding that, of the water that flowed through the stormwater system, some portion of that would have exited at these breaches in the stormwater system?

MR POPE: Yes, yep.

MR DI STEFANO: And, Mr Paul, is it your evidence that that some portion of that water may have made its way to the landslide site?

MR PAUL: That's an unknown. We know water came out of the pipe, and it goes back - similar to the evidence we were giving yesterday, there are voids, there are potential pathways, but we haven't been able to trace them. So we can't say with certainty it would've got out of the pipe and got to the landslide, only the potential.

MR DI STEFANO: Yes. Does anyone have a contrary view to that for the water that would have escaped the stormwater system and the Browne Street breaches?

MR POPE: Not contrary at all. Probably important is Browne Street was fixed in May.

MR DI STEFANO: May of this year?

MR POPE: May of this year when - probably in the last hearing, I think it was happening around that time. My observations of groundwater levels at the landslide, they've mapped with time, like, against the Pointerra - the reality model, and the groundwater levels there had decreased significantly well before the repairs were made, which only conclusion is that the base flows that come through that stormwater drain which are coming through today from up at Bayview, the base flows didn't materially contribute. What happened with this water during the

landslide event, I'm not sure.

MR DI STEFANO: Yes, okay. And perhaps I can just bring up one last document, which is SEW - sorry, I should say, Mr Makin, do you have anything to add to that?

MR HARTLEY: Only so much as we had been hoping to do some works along Prospect Hill Road and such. (Indistinct) excavation works, but we found that the services and the verge - the verge angles made it almost impossible to do some excavation works at the location we would have liked.

MR DI STEFANO: Okay. So can I take it from that that you otherwise agree with what Mr Paul and Mr Pope have said about the --

MR HARTLEY: Other than that, based on the information that we have and the summations, based on that, yeah, I agree.

MR DI STEFANO: Thank you. And Mr Makin as well?

MR MAKIN: No, it's all right.

MR DI STEFANO: Thank you. Can I ask for one last document, SEW.0001.0002.4187, which is the SMEC supplementary report, at page 40, please. I bring this up just to illustrate one thing, which is, Mr Pope, you identified a moment ago that there is a water main that runs under the corner of the - under the Browne Street stormwater?

MR POPE: Yeah, correct.

MR DI STEFANO: Yes. And we can see there that there's kind of a network of water mains that appears on that corner of Browne Street and Coburn Avenue?

MR POPE: Yes.

MR DI STEFANO: And that those water mains run down to the location of the November 2022 burst water main and then they bisect, one heading down towards View Point Road and the other continuing down Coburn?

MR POPE: Correct, yep.

MR DI STEFANO: So there's a plausible flow paths through water main trenching from the location of the stormwater breaches on Browne Street, and Browne and Coburn, and 10-12 View Point Road; is that correct?

MR POPE: Through trenches in general, yeah, but those ones, the only complexity is the 900 - it's the Dromana-Portsea water main. It's 900 diameter --

MR DI STEFANO: So it's big.

MR POPE: -- and it's underneath the stormwater pipe. So it's quite deep, and it strikes across the whole community. So it comes from the top right corner, it's in the air across a gully there, along Coburn, comes underneath the stormwater defect and then - it was built well before the stormi, as I understand it, and then comes down towards the bottom left corner of the image and does the same thing across the gully over there. So it's deeper than the other conventional domestic mains, and it's a big cutoff drain. So what happens there, I don't know.

MR DI STEFANO: Yes, I understand.

MR POPE: The drawing I haven't seen. The invert level of the 900 and how it was built, I've got no idea.

MR DI STEFANO: Yes. Thank you. So it's another unknown that --

MR POPE: Yes.

MR DI STEFANO: -- cautions against confidence about that? Mr Paul or Mr Makin or anyone else, Mr Hartley, any further comments? Thank you. No further questions from me. Is it a convenient time, Madam Chair, to have a break? We were going to break at 3.30.

CHAIRPERSON: How long will you be, Ms Foley?

MS FOLEY: Just maybe five minutes. I understand there will be some questions from some others after me on this same topic.

CHAIRPERSON: On pathways? Yes. And how long will you be, Ms Siemensma?

MS SIEMENSMA: Difficult to say. I think on pathways maybe 20 minutes.

CHAIRPERSON: All right. Let's have a break. We'll have a break now. Let's just have a 10-minute break and return at 3.35.

SHORT ADJOURNMENT

<EXAMINATION BY MS FOLEY:

MS FOLEY: Thank you, Chair. I have some questions for either Mr Hartley or Mr Bolton in relation to water exiting service trenches, and again I'll leave it up to you to decide who should be answering the question. You'll recall that in the joint conclave report Mr Paul, Mr Makin, Mr Hitchcock and Mr Pope all agreed that, although it's not possible to know the exact flow path that the water took from the leak site to the landslide, there are credible flow paths, including through sewer trenches? You'll recall that evidence or that opinion expressed in the joint report?

MR HARTLEY: Yes, yeah.

MS FOLEY: All right. And the two of you didn't join in that opinion. Given what we've heard in the course of yesterday and today, you wouldn't dispute, would you, the fact that there are in fact credible flow paths for the water from the leak site to the landslide?

MR HARTLEY: There are credible flow paths from the leak site to the landslide? Yeah, possible, correct.

MS FOLEY: Do you accept that it was possible for water in the service trenches to seep into natural surrounding material?

MR HARTLEY: Correct.

MS FOLEY: And that that could have occurred at different points along the trenches?

MR HARTLEY: Throughout given, you know, infiltration rates, and they'll vary, yes.

MS FOLEY: And the seepage would generally occur where the

flow rates fall; would you agree with that?

MR HARTLEY: Infiltration through the trenches would vary based on the amount of water going through. So the head within the embedment material. Also the gradient of the trench as well as the permeability of the surrounding material.

MS FOLEY: I want to take you to a figure in your report, and this is the SMEC report SEW.0001.0002.4187. Bring that one up, please. And if we could go to page 41 of the PDF, thank you. And I'd like to ask you some questions about figure 19, if you can see that there?

MR HARTLEY: Yep.

MS FOLEY: And this is a figure which shows the sewer invert level?

MR HARTLEY: Yes.

MS FOLEY: So you'd agree that seepage might occur where the invert level is relatively flat? It might occur at other places, but it might occur there?

MR HARTLEY: Yes.

MS FOLEY: All right. And if we - I wonder if we can zoom in and look at Charlesworth Street in particular. Actually, in the figure below; thank you. Now, if you can see there - at Charlesworth Street you can see there are points where the invert level is relatively flat?

MR HARTLEY: Yeah.

MS FOLEY: And so that's one of those points where we might see seepage?

MR HARTLEY: We see infiltration into the trench or - from the trench into surroundings, yes.

MS FOLEY: Yes. And water could also exit the trenches at points where the flow is restricted, for example, by a tight turn in the service trenches?

MR HARTLEY: Tight turn, manhole, chambers, yes.

MS FOLEY: All right. And one example is, looking at this, if we look at Charlesworth - sorry, the Coburn Avenue - at the top there, sorry, in the map - you can see near Coburn Avenue there's a sharp turn in that top map?

MR HARTLEY: The sharp left-hand turn if you're going downhill, yes.

MS FOLEY: And that's one of those places where you might see an upswelling?

MR HARTLEY: Certainly. That tight turn doesn't exist as a tight turn. It's a T junction. But, yes.

MS FOLEY: And in fact we did see upswelling near the sewer trench at that location, didn't we? All right. So if water was pushing up at that location it might have also been infiltrating the natural soils at the bend or at the T junction?

MR HARTLEY: Effectively the velocity in that direction goes to zero and then it needs to translate, it will go either side, but, yes, there's a likelihood - there's a distinct possibility, I beg your pardon, that infiltration occurs there.

MS FOLEY: All right. In your first report - and I'll take you to it. If we could go to SEW.0001.0002.0001, please. This is your report of 5 May 2025, and if we could - I'm sorry, I don't have the PDF page, but I need to go to 8.2.4. Thank you. It's at about page 73. 82, thank you. PDF page 82, thank you. All right. In this section of the report back in May there's a discussion about the upwelling through Coburn Avenue and Waller Place, and you tied it to the Bayview Road leak; do you recall that?

MR HARTLEY: Yes.

MS FOLEY: All right. And you accept, of course, that that was mains water that was upwelling?

MR HARTLEY: Since then there's been further analysis of geochem, but at that time, yes.

MS FOLEY: All right. So at that time you thought if was mains water?

MR HARTLEY: At that time, yeah, the upwelling observed, yes.

MS FOLEY: All right. Have you discussed a change of position on this in your most recent report, because I couldn't see that you had?

MR HARTLEY: Hugo, this is your analysis which has changed the matter a bit. During December and the residents calling up, that's not - and the upwelling as a result of that, that hasn't changed.

MS FOLEY: All right. You don't discuss that issue in your most recent report, though, do you?

MR HARTLEY: No.

MS FOLEY: Is there a reason for that, a reason why you discussed this upwelling and you tied it to the Bayview Road leak in your May report but you haven't discussed it in your latest report?

MR HARTLEY: Only so much as it's a supplementary, not something that supersedes this report.

MS FOLEY: All right. So you remain of the same view that you expressed in that earlier report --

MR HARTLEY: Yes.

MS FOLEY: -- that that upwelling came from the Bayview Road leak?

MR HARTLEY: During December and Jan - and parts of January, yes.

MS FOLEY: All right. No further questions from me. Thank you.

<EXAMINATION BY MS SIEMENSMA:

MS SIEMENSMA: I want to ask some questions about pathways, and I might start with Mr Paul, to see if you accept this proposition. To have confidence that the Bayview burst water contributed to the 2025 landslides you need to clear two hurdles at least. The first is you need evidence of a pathway from the burst site to the landslide

465 metres away; true?

MR PAUL: I agree with that, you need a pathway.

MS SIEMENSMA: And the second is you need evidence that the water seeping from the escarpment immediately after the 2025 landslide is burst water; true?

MR PAUL: I wouldn't necessarily agree with that because water from the burst site can mix with other water. So to say it would just be mains water, I wouldn't agree with that.

MS SIEMENSMA: We might put that to one side pending some questions about water chemistry in any event. Let me ask you about the first point, the route of travel. Now, in your report you say there are potential flow paths, and you say water could have travelled through channels in soil, in stormwater, in sewer trenches, and, as I understand your evidence, what you're saying is the actual path water took on your hypothesis is uncertain and that these are possibilities in your view?

MR PAUL: It could be one or multiple at the same time. I haven't gathered enough evidence to know exactly which way the water went. May never get that evidence.

MS SIEMENSMA: And you would agree then that, as to whether water flowed directly or came in and out, that all depends on certain assumptions - and you're nodding, you agree with that. As to where the water went and whether it was in, whether it was out, there are a lot of variables we don't know?

MR PAUL: Not necessarily assumptions. I'd call them there are unknowns.

MS SIEMENSMA: Unknown variables?

MR PAUL: A lot of water went into the ground and we don't know where it went, but it has to go somewhere, though.

MS SIEMENSMA: And, Mr Pope, you referred in your report to paleochannels, and you've said it's possible that there are several buried paleochannels, and then you go on to give an example of a continuous 10-metre to 20-metre wide buried shallow paleochannel backfilled with colluvium and

alluvium, and at the bottom of it it's 1 metre with colluvium, it's saturated, the channel is 500 metres in length. All of those are assumptions, aren't they?

MR POPE: Yeah, of course they are. Yep. The land form does give you an indication of how frequent these gullies are, though. Like, the slope contour shows you how many gullies there are, and then we know that there's more buried ones. So they are there. But it's fundamentally an assumption, yes. Yep.

MS SIEMENSMA: And it's possible - Mr Paul agreed yesterday to my question whether it's possible to test for these paleochannels and underground channels, and he said it was. And I take it you don't dispute that, that they can be tested for?

MR POPE: Correct, you can. You could do - like, if - cut to the chase. If South East Water is so confident it's not their water and it takes that long to get to the escarpment, then they can do a full-scale aquifer stress test and prove it's not theirs.

MS SIEMENSMA: And my question to you is you haven't undertaken any of those geophysical tests to search for the geo - sorry, to search for the paleochannels?

MR POPE: I wouldn't be going around doing geophysics. You've got to validate it with boreholes -- -

MS SIEMENSMA: It's not a criticism. I just want to understand.

MR POPE: No, no, no, like - so I didn't jump on geophysics bandwagon, so.

MS SIEMENSMA: Okay. So you've raised this as a theoretical possibility, as I understand it?

MR POPE: Yes.

MS SIEMENSMA: Okay. Do you accept that to be a plausible theory that the burst water made its way to the landslide site you would really need to undertake the testing to be able to demonstrate the path of these channels if you were going to rely upon them?

MR POPE: I don't see another credible water source for the landslide water. That's - if there were other credible water sources, then I would go testing.

MS SIEMENSMA: Okay. Let's come back to my question. Do you accept that to be a plausible theory and rely upon these underground channels you need to be able to work out where they are and where they flow to?

MR POPE: Yeah, you can. Yep.

MS SIEMENSMA: And not just you can; to be plausible you need to?

MR POPE: I don't think so. I think the land form's telling us they're there in terms of the drainage lines.

MS SIEMENSMA: Mr Paul, yesterday you said in relation to the 2022 landslide that you've got low certainty on it because you don't know exactly where the channels go. That was in relation to an area of some 125 metres. It's fair to say you don't know exactly where the channels go over the 450, 465 metres either; do you accept that?

MR PAUL: We know where some of the channel is because we have observation of the headscarp of the channel, we have observation from some boreholes. We don't know exactly the path it takes between those observations.

MS SIEMENSMA: You don't have the path from A through to B; is that --

MR PAUL: It would be like going down to a river and saying, "Well, there's the river there and there's the river there," and I would say with any geological models there are unknowns. We haven't got x-ray vision, we can't look behind all the ground. So we have to use our geological sciences and knowledge of geological process to fill in the gap. So for mine it would be not completely, you know, without uncertainty. But if I see a channel here, a channel there, it's a reasonable assumption they're connected.

MS SIEMENSMA: You said yesterday that there can be - or the thrust of your evidence, rather, was that there could be numerous paleochannels in the area. Do you - you maintain that?

MR PAUL: There would definitely be more than one in the area. That's how landscape evolves.

MS SIEMENSMA: And there's nothing special about 10-12 View Point that would lead all of those paleochannels carrying burst water, on your theory, to discharge at that one site; do you accept that?

MR PAUL: Well, there's discharge at that site, and it was my understanding, not of others --

MS SIEMENSMA: Well, there would --

MR PAUL: -- during the time of the January landslide.

MS SIEMENSMA: There would be some paleochannels, for instance, that might go down towards the historic gully, we looked yesterday on the map?

MR PAUL: I would say all the paleochannels need to come out of this gully at some point.

MS SIEMENSMA: You would say they all in effect lead to Rome, do you? They --

MR PAUL: No, they would have to come out at the escarpment, remembering of course the escarpment runs, you know, a few kilometres parallel to the coastline. But if the channel didn't - you know, if it didn't come out at the escarpment or flow to the sea, in effect, you'd have a dam, you'd have a lake.

MS SIEMENSMA: And some of the paleochannels might go out to The Eyrie, do you agree?

MR PAUL: There could be some that go to The Eyrie, sure.

MS SIEMENSMA: And some might go towards Margaret Street?

MR PAUL: Yeah, there could be some at Margaret Street. We don't know.

MS SIEMENSMA: Mr Hartley, you've heard some evidence this afternoon about what has been said to be three potential pathways, in summary the subsurface channels through the natural soil, stormwater, sewerage trenches. Now, you,

SMEC, have undertaken or had undertaken some geophysical testing. Taking, for example, Mr Pope's example of the paleochannel that is 10 to 20 metres wide, that is 500 metres long, is it likely that you would have picked that up, a channel of that nature, with your geophysical testing?

MR HARTLEY: The geophys testing included the entire length - well, the length of Coburn Avenue right up to number 40-odd, which is just the other side of The Eyrie catchment, if you will. And it also included Connell's Lane, I seem to remember, and the entire length of Waller Street up until the pedestrian public footpath. To that extent, that area of the geophys would have gone beyond this broad area. Yeah, the geophys is highly dependent on interpretation. But, you know, we've managed to find quite a bit from that geophys, and, you know, it's quite plausible that a significant change related to that channel could have been identified due to the fact that we go a certain depth.

MS SIEMENSMA: And did you identify such a channel?

MR HARTLEY: No, not that we saw.

MS SIEMENSMA: You were shown a photograph earlier today of some deficiencies or a deficiency in the stormwater at Browne Street. Let me ask you this: if there were a leak or a void, how long - in the stormwater, how long would that have taken the water to get to the landslide site from Bayview?

MR HARTLEY: So the leak from Browne Street to the landslide site?

MS SIEMENSMA: Well, how long would it have taken from the burst site if it had gone through the stormwater --

MR HARTLEY: Oh, yes, the burst site. My expectation is, is that, okay, so on the assumption that it goes - you have to go 30-odd metres from the upwelling, right, and then flow across the water - flow across the surface and then into the stormwater drain and then down a stormwater drain. I'd say it's going to be in the same - couple of hours, I'd expect. Hugo?

MR BOLTON: Once it gets to surface and into the

stormwater it's going to be reasonably quick, I would say.

MS SIEMENSMA: And "reasonably quick", do you ascribe to Mr Hartley's view that it would take hours or days? What are we --

MR BOLTON: Once it goes to the surface and flowing 30 metres downhill and into the stormwater, I would agree with what David has said.

MS SIEMENSMA: I can't remember whether my questioning included voids, but if there were a deficiency or a void is that your view, that it would have taken days from the burst site to the landslide site?

MR HARTLEY: The voids would act a bit like - almost like an open channel, with the exception of the fact there would be some infiltrations, so there may be some volume lost. But the flow through a void would be similar to a pipe.

MS SIEMENSMA: Now, Ms Foley asked you, Mr Hartley, whether you agreed that the pathways were credible - whether these credible pathways were possible. I'm sorry, I don't have the language right, but you said "yes". My question to you is why do you say they aren't likely or plausible in that you haven't joined with the others in that view?

MR HARTLEY: It's mainly on the geochemistry problem, so to speak, that we have. The speed or the permeability of embedment material is such that you don't spend enough - the water doesn't spend enough time in the trenches to actually pick up a certain chemical footprint to basically justify, for want of a better word, the chemical footprint that was found from the sample taken on 6 January.

MS SIEMENSMA: So let me see if this is - this is accurate. Are you saying that if it had gone through the trenches the EC level is too low, although it might have gotten there quickly; had it gone via the ground, it takes too long but it could pick up the chemical composition?

MR HARTLEY: That's a very simple, you know, juxtaposition we're in.

MS SIEMENSMA: I'm sorry, do you agree or disagree?

MR HARTLEY: Yes, you're right.

MS SIEMENSMA: Can I ask Mr Pope now some questions about the dye testing. As I understand it, the dye testing was to test your theories on the pathway of travel; is that correct?

MR POPE: Yes, correct.

MS SIEMENSMA: And we see that from your factual report on 12 February some dye has been poured into a borehole at NDT1. Now, NDT1 is not at the sewer main.

MR POPE: Correct.

MS SIEMENSMA: It's 6 metres away in the front yard of 10-12 View Point; correct?

MR POPE: 6 View Point, yep.

MS SIEMENSMA: Sorry?

MR POPE: 6 View Point.

MS SIEMENSMA: 6 View Point.

MR POPE: Yep.

MS SIEMENSMA: And it was on the owner's pipework, not South East Water's pipework; true?

MR POPE: Correct. Yes.

MS SIEMENSMA: And you poured a lot of water --

MR POPE: Below - sorry, below their pipework. It was well below their trench, yep.

MS SIEMENSMA: But not the South East Water main?

MR POPE: Correct. Yep.

MS SIEMENSMA: And you poured a lot of water into NDT1?

MR POPE: Basically lifted the - the fill is from - was 4 metres deep, and started at 2.8 metres. I can check those. I don't have that factually in my head, but it's -

yeah, I put probably more than I needed to. But, yeah.

MS SIEMENSMA: And that test at NDT1 revealed that dye could get from the front yard to the escarpment? You showed us before the dye?

MR POPE: Yes. Yep.

MS SIEMENSMA: It doesn't test the ability of the water to get from Bayview Road through to NDT1; correct?

MR POPE: That's correct.

MS SIEMENSMA: And of all the dye tests that you undertook NDT1 was the only one that showed dye at the landslide site; true?

MR POPE: That's correct. We run out of time when we had elevated groundwater levels --

MS SIEMENSMA: I'm come back to that. About two weeks later you then undertake a dye test in NDT2, being the hole at the South East Water service trench; correct?

MR POPE: Yeah, correct. I couldn't get that to the bottom of the sewer trench. So it's not very helpful.

MS SIEMENSMA: So the outcome of that, as I understand it, is that no dye went from South East Water sewer trench through to the escarpment; correct?

MR POPE: Correct, yep.

MS SIEMENSMA: And the test result for that supports the fact that the sewer main didn't transport water to the landslide site; do you agree?

MR POPE: Not that one, but certainly NDT04 supports that.

MS SIEMENSMA: Well, let me ask you about NDT2.

MR POPE: Yep.

MS SIEMENSMA: It supports the fact it can't go from the sewer trench NDT2 to the landslide site?

MR POPE: It doesn't say - it's not it can't get there.

With the base flow in - like, there was clearly groundwater below the trenches. I didn't put enough water in to get any connectivity, or there might not have been - there isn't enough water there for connectivity. It doesn't disprove a flow path, but.

MS SIEMENSMA: I'll come back to water elevation then. But, putting water elevation to one side, if there were a path from NDT2 to the escarpment you would expect to see dye at the escarpment?

MR POPE: That time in the test, yes.

MS SIEMENSMA: And from 7 to 10 January you had dye poured into the stormwater pit at 7 Prospect Hill Road; true?

MR POPE: The MBS - various members of the MBS team did that, yep.

MS SIEMENSMA: And again that water didn't reach the headscarp; correct?

MR POPE: Stormi; correct, yes.

MS SIEMENSMA: And, again, water elevation issues aside, do you accept that if there were a path from the stormwater pit from 7 Prospect Hill Road it would have emerged at the landslide site? Do you agree?

MR POPE: There was a path, yes.

MS SIEMENSMA: Now, you've mentioned water elevation, and, as I understand it, what you're saying is the reason NDT2 didn't make it to the escarpment is because of the level of water elevation; is that correct?

MR POPE: A reason. It's not - yeah, it might never get there from there. I don't know.

MS SIEMENSMA: And can I suggest that that's speculative, you're just speculating that that's the reason?

MR POPE: NDT02?

MS SIEMENSMA: Yes.

MR POPE: I'm saying it's not a very useful test. I'm not

speculating on it. We didn't execute the borehole well. So asking me about it, it - we didn't achieve the outcome. We didn't get to the invert. We stopped, contacted South East Water and said, "This is very hard to do. How can we do this properly," and that was the delay between that test and the rest of the testing. It was a failed test. The borehole in itself was not - I didn't get to the invert of the trench.

MS SIEMENSMA: So you don't rely on NDT2's water elevation as a reason why it didn't make it out to the escarpment?

MR POPE: I don't really rely on NDT2 at all. I would prefer to use 4. It's in your gravel - it's in the gravel backfill, and that didn't get to the escarpment.

MS SIEMENSMA: Now, as at March 2025 when you were undertaking the NDT2 test - and I don't have in front of me the date you did NDT4, but do you accept that water was still seeping from the escarpment in March of 2025?

MR POPE: Yes.

MS SIEMENSMA: And in fact Mr Willigenburg had given evidence that he couldn't return to his property in April because water was still flowing from the escarpment, and you accept that as at April it was still seeping, the water from the escarpment?

MR POPE: Yes. Yeah, yeah.

MS SIEMENSMA: And I suggest that there was sufficient water flowing in the area at the time to make water elevation a non-issue?

MR POPE: Yeah, I'm not sure that's true. I put dye into borehole 1A on 10-12 View Point. Didn't make it there. That's - that was literally apart - or a metre away from another borehole that said there was water there, and that dye didn't get there, so

MS SIEMENSMA: Isn't the most likely explanation for that that in fact there is no pathway?

MR POPE: No. My team did a lot of mapping, Tim Nash did a lot of mapping. That's director of our firm. I did a lot of mapping. We only saw large volumes of water coming

out of this gully. There's a flow path. We've just got a gap between - to your point, Browne Street, 7 Prospect Hill, there is a gap. We ran out of time to get gear in to actually measure what was going on.

MS SIEMENSMA: You can't rule out the possibility, though, that the reason why the dye didn't emerge is because there is no pathway; true?

MR POPE: Can you rephrase that?

MS SIEMENSMA: You can't rule out the possibility that one of the reasons or the reason --

MR POPE: Yeah, so the sewers might not be connected on View Point. That's a possibility, yes.

MS SIEMENSMA: And just before I leave this topic tell me, Mr Pope, when you were doing the vibrating wire piesometer tests did you take readings at the site or did you use factory settings?

MR POPE: Very much site readings. One of the first VW piers I put in in my career 20-odd years ago I made that mistake, and I haven't made that mistake since.

MS SIEMENSMA: I want to ask a few questions now about the time period it takes to go from the burst site to various locations, starting perhaps with Mr Hartley and Mr Bolton. Now, Mr Hartley and Mr Bolton, you've said that I think based on the modelling by Professor van Zyl you've calculated water velocity and found that it would take the burst 230 or over 200 days going through the natural velocity, which on your analysis means it wouldn't have reached the landslide site by January. Can I ask you - and forgive me if you answered this earlier, but if it had gone through the trenches how long would the water take, if it had gone entirely through the trenches?

MR HARTLEY: Entirely through the trenches? Oh, gosh. I'm not too sure it can get to the trenches because it needs to jump services, service trenches, and I don't think we've got the linkage to do that. There's the fresh water - beg your pardon, there's the water mains underneath Coburn Avenue, where there's an argument that it could upwell from the sewerage trench into the fresh water trench and - but the trouble with that is that the expected

embedment material of the mains water is a finer sand than the gritty granular stuff in the sewerage. So it doesn't feel likely that it's the case. If it did go through there and then found its way down Prospect Hill Road and such, we're talking a matter of days.

MS SIEMENSMA: Days from the surfacing of the burst?

MR HARTLEY: No, not really. I mean, the days - around about - well, the capacity from Professor van Zyl is 11,000, and from the expected - the anticipated start date of the - is somewhere in August. You'd expect it to be in the service trenches flowing downhill, as per what water does. So from the get-go, albeit probably on a very low volume.

MS SIEMENSMA: Mr Bolton, you were asked about the 2 metres a day calculation?

MR BOLTON: Yes.

MS SIEMENSMA: And, just to be clear, on what basis have you come up with 2 metres a day, the movement of the water?

MR BOLTON: Two metres per day, that's based on the permeability testing that we did at the bore sites and the permeameter testing we did, and the upper range of that permeability results that we got was in the order of 5 metres per day, and, as I mentioned, using a velocity of .3 and a hydraulic grading of .1 you come to this, you know, 2 metres per day travel.

MS SIEMENSMA: And you - sorry, you said that that was the upper - the 2 metres was the upper end of the range for you?

MR BOLTON: Yes, it was, yeah --

MS SIEMENSMA: And had to use --

MR BOLTON: Testing was done, yes.

MS SIEMENSMA: Had you used the lower end of the range, how many days are we talking about?

MR BOLTON: At least half that - no, actually 5, so it's - the 1 was - that's 20 - you'd have to multiply by 5,

I guess, if you're talking about the - you know, let's say 200 - let's say 240 times 5. It's going to be over 1,000 days.

MS SIEMENSMA: You were then asked - I think it was you, Mr Hartley - whether water could reach the landslide site by 5 January, and you were given two options: one, whether it was possible, or whether it was impossible. My question for you is: is it likely, and what's the basis of your response?

MR HARTLEY: Okay. So we're talking about water from the leak going via whatever way we want and getting to the landslide at 5 January?

MS SIEMENSMA: Well, it was put in general terms. So, yes.

MR HARTLEY: If you're going through natural material - if you're going through natural material, based on Hugo's site works and computations, no. If you're going through a combination of - well, if you're going through an entire manmade trenched pathway you're going to get there earlier. And if you're going through what is our preferred - apologies to Hugo if that isn't the word - the preferred line of going through the trenches, getting to Coburn Avenue, sitting there because the velocity goes to zip and going through the natural material underneath the houses, including number 5 Prospect Hill, getting into the agi-drains or the sewer trench situation of 7 Prospect Hill Road, and then going down there, you're looking in the region of about 30 days. And so, yes, it could get there on the 5th, but if it's going to get there on the 5th it's going to get there beforehand.

MS SIEMENSMA: What do you mean beforehand?

MR HARTLEY: Well, if the - if Professor van Zyl's calculations are correct and it's going - and 11,000 litres per day are getting into the service network from about 1 October, something like that, then we're looking at 1 - November - thank you very much, everybody - 1 November for getting to View Point Road, View Point Road and other locations it has to be said. But, yeah.

MS SIEMENSMA: You were asked some questions about permeability and by reference to the van Zyl report. Can

I just ask if you can be shown - if we could pop up a copy of the van Zyl report. Unfortunately I don't have the Bates number on me. Thank you. I'm indebted to my friend. SEW.0001.0002.4191, and if I could ask the operator to turn to page 28. The first thing I might ask is the 10,000 litres, do I understand this to be the biggest value and that in fact the table shows a plausible range between 1,000 and 10,000 litres a day?

MR HARTLEY: From my reading of this report, the 1,000 litres per day is associated with the capacity of the embedment material around the mains. So that's the stuff that leaked. So the water has to go through that before finding its way into the sewerage trench, which has the 10,000, and therefore Professor van Zyl, from my reading of it, has basically created the capacity, which is, you know, just adding 1,000 to 10,000.

MS SIEMENSMA: Mr Bolton, as I understand it, you were on site when there was some excavation of a sewer pipe in Bayview Road; is that correct?

MR BOLTON: Yes, I was there when they excavated the sewer pipe at Bayview Road, yes.

MS SIEMENSMA: And what observations did you make about the soil while that was being excavated?

MR BOLTON: So the sewer - the invert of the sewer had surrounding it quite, I guess, impermeable soils, yeah, to probably about - trying to think - maybe about - to me, it was about one and a-half metres, from a depth of one and a-half metres down - this is going off memory - and then above that it gets a bit less - it was very impermeable where the sewer was embedded, and above that it was more permeable, and then towards the surface where the sand fan and all that sort of is it's about - from the testing I did, it was about one metre per day at that material.

MS SIEMENSMA: While we've got the van Zyl report up there could I take you to 0021, page 0021. Do I understand correctly that here Professor van Zyl is talking about lab-tested results by which he determined grain size? Is that a correct understanding of --

MR HARTLEY: Yes.

MS SIEMENSMA: And you can infer permeability of the natural soil from the grain size?

MR HARTLEY: When it's granular, yes.

MS SIEMENSMA: And is that a basis on which you have - that has also fed into your understanding and analysis of permeability?

MR BOLTON: Well, these - my permeability information that I have used is mainly to do with the aquifer material and the tests that I did. That range of approximately 1 metre per day to, you know, 5 metres per day is largely based on those tests. I mean, these ones there, I mean, on the face of it, they look like they're push tubes, I would say, and they are - I wouldn't - I based mine on my testing that I had done, yeah.

MS SIEMENSMA: Thank you. And just to clarify one issue, Mr Hartley, you had spoken of a photograph I think of water flowing at Waller Place. I just want to ask if this document can be shown to you to ensure that we're talking about the same photograph. So it's SEW.0001.0001.0500. And this is a document that was I think part of a notice to produce. I'm not sure whether it's in evidence as yet. And I'll ask, Mr Hartley, for that to be popped up on the screen for you. It's a photograph of water flowing near Waller Place. SEW.0001.0001.0500. The document that was produced as part of a notice to produce.

CHAIRPERSON: It may not be in the hearing book. It will be only in the hearing book if it was proposed by counsel assisting to go through the document. So if counsel assisting had proposed to go to the document it would be in the hearing book.

MS SIEMENSMA: Yes. So, Mr Hartley, you're talking about a photograph in your 5 May 2025 report and it's the photographs at page 52 and 53 of that first report?

MR HARTLEY: Yes.

MS SIEMENSMA: Thank you.

CHAIRPERSON: Ms Siemensma, that report is in the - that's an exhibit, so you can bring that up if you want it.

MS SIEMENSMA: Well, I think Mr Hartley's confirmed that those are the photographs. So thank you. I want to ask you some questions, Mr Paul, just about flow rate and flow rates from the landslide. You have said that based on the PSM measurements that as at 6 January 2025 as much as 0.2 litres per second, being 17,280 litres a day, was coming from the landslide escarpment; you recall that?

MR PAUL: Yes, based on PSM measurements.

MS SIEMENSMA: And do I understand you've used the highest end of the PSM scale, the range being 0.1 to 0.2 in calculating that figure?

MR PAUL: No, I don't remember if I used the highest end of the range, because I can't remember which end of the range I used.

MS SIEMENSMA: In any event, that flow did not remain steady at that rate, rather it dropped off substantially, do you accept that?

MR PAUL: It decreased from there until, say, now, a few weeks ago it's decreased a lot.

MS SIEMENSMA: Well, from 5 January to 10 January I suggest it dropped to 5 litres a minute; do you --

MR PAUL: I don't have that measurement. Is the 5 litres in a measurement?

MS SIEMENSMA: Well, if I could ask you to go to page 276 of your report, 0276, and we see here just upper centre of the page 5 January to 10 January 2025, reduces to 5 litres a minute on 10 January.

MR PAUL: Yeah, okay. I'll just confirm is that a PSM measurement?

MR POPE: No.

MR PAUL: It's not?

MR POPE: Definitely not.

MS SIEMENSMA: This is part of your report, Mr Paul.

MR PAUL: Yeah, that's right; part of my report. I'm just not too sure what the reference is for that measurement is all. But that's fine; we can take that.

MS SIEMENSMA: Mr Bolton, I wanted to ask you about that. What, if anything, with such a substantial drop in the flow generally indicate?

MR BOLTON: Well, when you have a spring, I guess, that's covered over that sort of a seal has been removed under, I guess, natural conditions you would expect the flow to drop off. You know, if there was a source of water behind that you wouldn't expect it to drop off, i.e. source of water being the substantial amount of water from a leak, you know.

MS SIEMENSMA: So, if I understand what you've just said correctly, do you say that tends towards or tends to suggest another source other than the Bayview leak?

MR BOLTON: No, the drop-off indicates that it does not appear to be a substantial amount of water behind it otherwise it would, you know, continue to be, you know, relatively within four days or five days, it is, between the - five days between those periods that you would - you wouldn't expect it to drop off so rapidly because you've got this, you know, source of water that would be keeping the flows up.

MS SIEMENSMA: Now, you have assessed, Mr Hartley and Mr Bolton, how much water was required in your view to be introduced at the site to induce a landslide event, and I think you gave a range of between 2,000 to 2,300 litres. On what basis was that calculated?

MR HARTLEY: The raw data was from Mr Pope's slope stability analysis from 2022. During the conclave he warned against using that but was kind enough to, you know, do a calculation very quickly to indicate that the impact of using preferred parameters didn't make a great deal of difference. The slope topography was based on LiDAR data which had been marginally manipulated to include the retaining wall construction. And the ground model was based on our interpretations of the raw data from PSM's ground investigation of I think it was February and various interpretations from CivilTest.

MS SIEMENSMA: And so are you still comfortable with the range of 2,000 to 2,300 litres a day?

MR HARTLEY: 2,000 to 2,300 full stop. It was using slope - you know, basically a balance of forces approach which has been disputed quite honourably by Mr Paul. But I think the critical thing is is that the volume of material that we were looking for is for purely the 5 January failure which, from was Victorian Gazette, was 20 cubic metres as opposed to the entire 14 January. So, yes, we are.

MS SIEMENSMA: And I misspoke by saying per day. So 2,000 to 2,300 full stop. What do you say as to Mr Paul's figure of 35,000?

MR HARTLEY: Mr Paul, I think it's in his report, talks about I think 35, maybe 36, I can't remember. It uses the - he uses - as long as I'm not speaking over him - suction theory, so the tendency for suction, the ability of material to reduce suction as moisture content increases. And he has assessed that the moisture change needed to reduce suction is between 0.1 and 0.3, and he needs to have a porosity which is taken at 0.4, and the volume of slide to be 300 cubic metres.

My feeling is that, although initially 36,000 and 2,300 can't be - you know, can't be married together, what I would honourably suggest is that, although the 0.4 is on the upper limits of the permeability tests that we received from our borehole that was taken at Waller Place, if you were to use Mr Paul's calculations purely to work out what the 5 January slide needed you would come up with something in the region of between 800 litres and 2,400 litres. So based on that taking of Mr Paul's calculations we tend to marry up very nicely.

MS SIEMENSMA: You've mentioned suction theory. In the joint report, the conclave report, Mr Pope made a comment that Mr Paul's variations in the suction model are speculative and can't be meaningfully measured. Do you agree with that?

MR HARTLEY: Me?

MS SIEMENSMA: Yes.

MR HARTLEY: Oh, gosh. Mr Paul is - we're all decent engineers. We have different - we have different comfortable ways of trying to interpret what we can see. There is merit in everybody's ways of doing it.

MS SIEMENSMA: Now, on the basis that all this landslide - all the water it needed would be on your calculations between 2,000 to 2,300 or using Mr Pope's equation up to 2,400 - Mr Paul's, I'm sorry - sort of having regard to weather events, private leaks, irrigation, do you have a view as to whether or not this was a landslide waiting to happen?

MR HARTLEY: The grand assumption from this, and it's a reasonable one, is that once the 5 January occurred the 14 January was highly - was much more likely to occur. We've got to think about the fact that 2,300, 2,400 upper limit, you know, litres, the volume is the size of a telephone box. A telephone box seems a very small volume of water or a very small trigger to, you know, create something that would otherwise assume to be stable forever, for a reasonable amount of time. 2,400 litres, 2,300 litres is a volume which we can all imagine. And therefore it's a volume which can be reasonably created from local, inert, inadvert and very regular sources. And therefore I would say you're right. It was - at the time of 5 January at the calculations that we've got it was on a knife edge and it was likely to happen anyway.

MS SIEMENSMA: And, just to clarify, when you say it was likely to happen are you talking about the 5 January or both?

MR HARTLEY: The 5 January was likely to happen. And, if the 5 January was to happen, the 14 January was very likely to happen.

MS SIEMENSMA: Okay. No further questions.

CHAIRPERSON: Do you have any further questions on this topic, Mr Costello?

<EXAMINATION BY MR COSTELLO:

MR COSTELLO: Yes. Before I move to the next topic I think the other witnesses should be given the opportunity to answer some of the questions that have just been put by

counsel for SMEC to SMEC's own witnesses and to no others. So, Mr Paul, would you like to comment on anything that you've just heard?

MR PAUL: My model for the landslide is that water was seeping into this slope over a period of time, probably from within - from December, and as that water was seeping in that soil was getting wetter and wetter and wetter, and therefore getting heavier. The volume of soil that is getting wet is increasing. And this process just keeps continuing until we have a tipping point. And it flows. And the important thing is it flows downhill. For the soil to get that much water in it that it flows as a liquid, we've got images of that, it must absorb a lot of water. You know, 300 cubic metres and 2,000 litres would be like getting a bowl of flour and putting a thimble of water in it and expecting it to turn into batter. You don't have enough water to make it flow. And I think it's a really important thing to convey. It flowed. We know it flowed.

So the suction model, without getting too much into it, when the slope is, you know, in its normal condition, it's facing north, it's about 30 degrees, it's getting maximum sun on it, it's got evapotranspiration drawing water out, it's really only around the springs that it's wet, and that's the normal condition. Something really had to change to get that much water into the slope to take it from that condition to a state where that soil was able to flow, and that's a lot of water. And my calculation is based on how much water you need to get it (indistinct), take out the suction, perhaps increase the pore pressure in it and make it flow.

MR COSTELLO: Mr Pope?

MR POPE: If you remember, Mr Costello, the calcs I did for the 2022 rainfall event. If you apply that rainfall event to this slope setting and just use a small 50 square metre area I get 4,000 litres. So the numbers aren't calibrated against slope performance at all. Like, it hammered rain in November 22. We had a landslide on the site. We did not have a landslide at the retaining wall location. So on that basis I think the numbers are inaccurate.

MR COSTELLO: You saved me a question, Mr Pope, although, Mr Hartley, I should allow you to respond. 2,000 litres is

an almost insignificant amount of water for an area of this magnitude; do you accept that?

MR HARTLEY: For the 300 cubic metres, yes, the --

MR COSTELLO: You know in 2022 there was 80 millimetres of rain that was assessed as being the cause and trigger of the landslide. On your theory why wasn't there a landslide in the landslide site for 2025 at that point in time?

MR HARTLEY: Things have changed on the landslide - at the location of this current landslide. For example - oh, gosh, I will stand corrected about when the original retaining wall was constructed, but the most recent construction - retaining wall constructed was on the - oh, gosh, in 2024. There's - and I would suspect, although I can't think of - can't think off the top of my head, that the horizontal terracing, if you will, there's been some modifications to the slope itself since 2024.

MR COSTELLO: And do you think those modifications are decisive in the sense that by reason of those modifications 2,000 litres of water was sufficient to generate the 2025 slides?

MR HARTLEY: Yes, with the - with the - if the (indistinct) changes in vegetation and the construction of these things can actually reduce things, you know, the factor of safety of this site relatively significantly.

MR COSTELLO: Can or did? Can or did? I'm asking for your opinion as to why it happened. I don't want theories anymore. Is your evidence now that the condition of the slope was so altered by the factors you've just pointed to that 2,000 litres was sufficient but before those changes 2,000 litres would have been insufficient?

MR HARTLEY: I haven't done that analysis. I've done the analysis based on the LiDAR survey to say that there is - you can get a slope failure using 2,000 litres.

MR COSTELLO: By reason of? And that is a function in part of what you consider to be the changes in the dynamics of the slope?

MR HARTLEY: I didn't analyse the stability of the cross-section that is subject to the 2025 landslide to

model 2022.

MR COSTELLO: No.

MR HARTLEY: I just did it. So I'm speculating as to why 80 millimetres of rain did not cause a failure.

MR COSTELLO: Yes.

MR HARTLEY: All I'm saying is that my model for 5 January and for the volume of material, material that slipped, according to briefing notes you can get that to fail with 2,300 litres.

MR COSTELLO: So the only way that you can make your model work in the face of what occurred in 2022 is by pointing to changes between 2022 and the date of the slides, otherwise there must be something fundamentally wrong in your model; is that fair?

MR HARTLEY: I would have to think very hard about what does rainfall do to that cross-section because obviously you've got rainfall, the direct rainfall on the surface and such, infiltration, run-off, it's a very steep slope, and things like that. Then you've got the infiltration of, you know, upstream, the fact it's hardstanding for the most part, the majority of it goes into the stormwater drains. I really am thinking off the top of my head here. But I would have to think very hard about how does 80 millimetres affect the slope that we're looking at in the same way that yesterday morning everybody's thought very hard about where does rainwater flow and get to the failure of 2022.

MR COSTELLO: You accept 80 millimetres is an enormous amount of rain in a short period?

MR HARTLEY: It is a substantial amount of rain.

MR COSTELLO: It's described as a one in 100-year rainfall; you're aware of that?

MR HARTLEY: Yes.

MR COSTELLO: And do you think that there's seriously some differential in the scarp such that where the rain was hitting in 2022 it was hitting the slope in 2025 but

somehow not being absorbed?

MR HARTLEY: I genuinely do not know. I cannot - as someone of a profession I'm not able to be confident in the answer I can give you with that one. All I know is that from the data that I was able to get and from the - and from the topography and from the ground model that I produced for this, 2,300 litres could create a - remember, it's a small failure. The 5 January is a small failure. So, yeah, I cannot answer why it didn't happen in 2022.

MR COSTELLO: As you sit there now and you reflect upon what happened in 2022 and the volume of water, does it cause you to have concern as to the veracity of your model?

MR HARTLEY: On the one hand, yes, because, you know, 80 millimetres is a lot of - is a lot of water to occur and, you're right, it's a rarity. But, on the other hand, I mean, thinking off the top of my head, the worst - if you're going to do a - if you're going to have a failure which is 20 cubic metres, okay, the most that you can get water into is - well, you're going to have an RU of something like 0.5 - you're going to have a third of that basically, off the top of my head, is the maximum amount of water you can actually get in there. So what is that? A third of 20 is - let's say it's 7. So it's 7,000 cubic metres, which is 70 - 70,000 litres. I'm going down a rabbit hole here.

MR COSTELLO: Yes.

MR HARTLEY: So I'll stop. But --

MR COSTELLO: Is the answer that it does cause you to doubt whether or not your model might be correct?

MR HARTLEY: There's plenty of things that cause it to --

MR COSTELLO: I'm just asking whether this particular factor causes you to have concerns that your model might not be correct?

MR HARTLEY: Because we were able to prove that it failed.

MR COSTELLO: Did you take into account 2022 as a test when you prepared your model?

MR HARTLEY: No. No.

MR COSTELLO: Thank you. Mr Hitchcock, I want to give you an opportunity to comment on anything that you have just heard in connection with this matter.

MR HITCHCOCK: I'm not a geotechnical expert, but I'm hearing that two to three thousand is the amount of water that loads it up or reduces the suction, and we're all thinking about that. But Mr Pope measured 17,000 litres coming out, which is a lot more than that, and it's a lot of telephone boxes.

MR COSTELLO: On any view, Mr Hartley, when we're talking about the possibility of 2,000 being sufficient for a trigger, there's no suggestion by you or anyone else that that's all that there was here?

MR HARTLEY: No, no. With the measurement that was done which suggested there was 200 millimetres in a second, 12 hours after the event.

MR COSTELLO: That's right.

MR HARTLEY: Yes. It was just the amount that was needed.

MR COSTELLO: On your model it was the amount that was needed. It wasn't the amount that was there. Far in excess of the amount that was needed was in fact there?

MR HARTLEY: That's correct.

MR COSTELLO: And, depending on flow paths and velocity rates, there may well have been 2,000 litres there a long time before 5 January, depending on velocity rates? And not only velocity rates because other sources of water --

MR HARTLEY: Yes, and that's - yes, and that is something which weighs on my mind. I mean, why is it that 5 January was so special? Because, whatever the volume that we're looking at, the 5 January doesn't seem to be particularly unique other than the fact - well, no, forget that. I can't see why it's unique.

MR COSTELLO: I was going to move on, but I am conscious of the time. This has taken - we're almost on track, but

we're just not quite on track. I can't predict how long this will take because it will depend on others. I can do my start part fairly quickly.

CHAIRPERSON: Let's start and see how we go.

MR COSTELLO: All right. Thank you. If anyone has a problem. Mr Paul, do you have a difficulty? Do you need to be away?

MR PAUL: I just need to get the kids picked up. I just need to make a call.

MR COSTELLO: It's a very legitimate problem.

MS FOLEY: I actually wonder, Chair, I'm in a similar situation, whether we can just have five minutes to make calls?

CHAIRPERSON: Yes, let's do that. We'll return in five minutes.

SHORT ADJOURNMENT

CHAIRPERSON: Mr Costello.

MR COSTELLO: I think we're largely sorted, but if anybody has anything they need to say I'm sure they'll say it --

CHAIRPERSON: The children are sorted?

MR COSTELLO: -- except for Mr Hitchcock, who is trying to change his flight. He's on his phone in the witness box for that reason. I have asked Mr Pope to step out of the witness box, but to remain in court. And Dr Vu has gone in in his place, and Mr Jewell has gone in in the place of Mr Hartley.

I want to turn to some questions concerning water chemistry. Before I do that there's just a couple of preliminary things. Mr Jewell, you're involvement is slightly more mysterious than the involvement of others because you haven't provided a written report; is that correct?

MR JEWELL: That's correct.

MR COSTELLO: And were you involved in the production of the SMEC report?

MR JEWELL: I reviewed the SMEC report; yeah.

MR COSTELLO: You reviewed it, did you say?

MR JEWELL: Yes.

MR COSTELLO: Thank you.

MR JEWELL: (Indistinct) comments on.

MR COSTELLO: I see. And are you employed by SMEC?

MR JEWELL: No.

MR COSTELLO: All right. Who are you employed by?

MR JEWELL: I have my own company, CM Jewell & Associates.

MR COSTELLO: Thank you. And what's your area of expertise?

MR JEWELL: By qualification I'm a hydrogeologist. I've just had an interest in groundwater geochemistry throughout my career.

MR COSTELLO: Thank you. There was some evidence given by Mr Hartley earlier yesterday I think about meetings that he's attended by Zoom with South East Water and South East Water's solicitors. Have you been involved in any of those meetings?

MR JEWELL: No.

MR COSTELLO: All right. Mr Bolton, have you been involved in those meetings?

MR BOLTON: Yes, yeah.

MR COSTELLO: You have. This is the weekly meeting that was spoken of?

MR BOLTON: Yes, it's roughly about then.

MR COSTELLO: Thank you.

MR BOLTON: During our drilling phase and other parts, yes.

MR COSTELLO: And who are the ordinary attendees at those meetings?

MR BOLTON: So it would be myself, David, and across the year staff.

MR COSTELLO: And no doubt people from South East Water.

MR BOLTON: Not on every occasion. I can't say - wouldn't be able to say that on every - certainly not on every occasion someone from South East Water was there, but they were there - they were there - I'm trying to think of it, such a rush of things that we were doing - 50 per cent at least, I would say.

MR COSTELLO: And were these formal meetings? Were minutes kept?

MR BOLTON: (Indistinct).

MR COSTELLO: Did you take notes at these meetings?

MR BOLTON: I didn't take notes.

MR COSTELLO: Okay. Thank you. Mr Jewell, when were you engaged?

MR JEWELL: In late June. 16 June. In the middle of June.

MR COSTELLO: Thank you. And what was the scope of your engagement?

MR JEWELL: It was to provide assistance to SMEC specifically with regard to geochemistry and possibly geochemical modelling.

MR COSTELLO: I see. And you have had regard to the written reports that have been tendered in the course of the last couple of days of hearings?

MR JEWELL: Yes.

MR COSTELLO: And in having regard to those written reports you've paid particular attention to questions concerning geo or hydrochemistry.

MR JEWELL: Yes.

MR COSTELLO: All right. Thank you. I want to try and move through this fairly quickly, but I just want to start with some basic propositions before we move to some conclusions that have been reached in the various reports. There's a lot of technical jargon and phrases here. So let's see if we can at least isolate the key ones. Dr Vu, perhaps if I could start with you. Is it right to say that cations, like sodium, potassium, calcium, contribute to the salinity and electrical conductivity of water?

DR VU: Correct.

MR COSTELLO: Thank you. And, for that reason, chemical analysis of water to reveal the presence of cations is an important step in determining likely sources of water?

DR VU: Correct, but not complete.

MR COSTELLO: Yes.

DR VU: I think when you talk about the source of the water you need to consider other factor or component in the water such as anions. And in this case we can talk about chloride, one of the chemicals we as a geochemist or hydrogeologist could consider a tracer in assessing our work, and chloride is very important as well. So we cannot leave it out.

MR COSTELLO: Yes. I didn't mean to suggest that cations were alone decisive. I just meant that in the course of an analysis that is one factor that you would almost always have regard to.

DR VU: Yes. So cations consider, yeah.

MR COSTELLO: Particularly in seeking to determine, for example, the source of a water and whether it was mains water or another source?

DR VU: Yeah. So, speaking of the sources, among the cations you mentioned sodium and potassium are most

important because again, like I said, they are considered the inert chemical or metals that will not interact with any soil metals. So that will be important to carry the source. Other cations like magnesium calcium are also important because it can tell you that it might be along the pathway. Those cations are picked up by the water along the pathway. So they're also important.

MR COSTELLO: Thank you. I'll come back to them being picked up along the pathway in a moment. Can I come to anions. Perhaps, Mr Jewell, I'll put this to you. In terms of the analysis that's been undertaken here it seems to me at least that the principal anions that have been looked for are chloride, sulphide, carbonite and bicarbonate. Would you consider those the major anions?

MR JEWELL: Yes, those are the major ones that you would normally look at and have been analysed for some of the samples here.

MR COSTELLO: Thank you. And the carbonates, bicarbonate and carbonate, they're relevant in a number of senses including that they have a buffering effect in terms of maintaining alkalinity; is that a fair description?

MR JEWELL: Yes. They can buffer it and to an extent can control it as well.

MR COSTELLO: Thank you. There's been quite a bit of evidence in prior hearing blocks about electroconductivity and electroconductivity testing. Is electroconductivity at least in part a function of salinity?

MR JEWELL: Yeah, the electrical conductivity of a solution reflects the effect of all the ions that are dissolved, both cations and anions, on the ability of the solution to transmit electric current. It's a reasonable indication of the overall salinity of water. But because it's contributed to by all the different ions, and different ions will affect it to a different extent, it's not a good way of comparing waters unless they have a similar ionic composition.

MR COSTELLO: I see. When you say not a good way of comparing do you mean not a good way of comparing at single test; that is, electroconductivity alone is not a good way of comparing, or does it cease to be of any utility?

MR JEWELL: Unless you understand from other means that from other analysis that the waters are both similar overall balance of ions present.

MR COSTELLO: I see. And as water travels along different surfaces and through different geological structures there can be an ion exchanges along the path; is that right?

MR JEWELL: That's right. And also absorption. So, yes, the ions can interact with the rock they travel through.

MR COSTELLO: And so what that means at the simplest level is that the fact of the water travelling through geological structures can be causative of changes in the chemistry of the water as it travels?

MR JEWELL: Yes.

MR COSTELLO: Thank you. Have you had regard in the course of considering the materials that you've been provided with before today the relevance of aeolian soils to the question of changes to chemical composition of water?

MR JEWELL: Yes. The presence of aeolian sands within the transported material has been raised. It was raised at the conclave.

MR COSTELLO: Is one of the common enough features of aeolian sands or soils that there are carbonate minerals within it?

MR JEWELL: Well, it depends on the source of the sand. If the sands have been eroded - and aeolian deposits are normally sands. If they've been eroded from a calcareous rock then they would contain carbonates. If they have been eroded from a granite then they generally wouldn't.

MR COSTELLO: Thank you. I was just coming to granite. Are you able to say at least in general terms - let me take one step back. We know that this is a geology that includes granite --

MR JEWELL: Yes.

MR COSTELLO: -- in the area here. Are you able to say

anything at a general level about the interaction between water and granite and what that can reveal - what could be revealed by those interactions by way of chemical testing?

MR JEWELL: So granite is not very soluble in water. That's why, you know, granites tend to form mountains and hills and be resistant to erosion, or one of the reasons. But everything is soluble to some degree. And so the minerals in granite will dissolve in water in which they're in contact with, you know, water flowing over the surface or water within fractures, until an equilibrium is reached between, so the solid mineral phases and the dissolved components of those minerals in water.

MR COSTELLO: Dr Vu, sticking with granite, is it right to say that as granite weathers it releases or can at least release ions into water, and those ions may be revealed in the form of sodium, potassium, calcium or magnesium?

DR VU: Potentially. Like he explained, the granite is quite insoluble with the water, but over the time, we're talking about geological time record, thousands, billions of years, then it will be dissolved to some extent. And we - geologist or hydrogeologist or geochemist - consider it's like an equilibrium state, and then it would expect some kind of chemical which are the signature (indistinct) interact or exposed to granite.

MR COSTELLO: I see. And, just to finish off on this general topic, we've already established, Dr Vu, that as water travels through different geological structures there can be different chemical reactions. And so that necessarily means, does it, that depending on the path of travel there may be different chemical reactions that will reveal themselves in different water chemistry at the final source?

DR VU: Correct. And Chris Jewell comment about the processes could be happening during the water movement. So it's not only absorption and resorption but it can also be mineral (indistinct) and mineral dissolution. So that all will be considered into the equation then contribute to the water chemistry of the water we see.

MR COSTELLO: Thank you, Dr Vu. I mentioned before that there's been evidence regarding electroconductivity testing at earlier hearings. There's a range of tests that can be

done to test the electroconductivity of water. Some of the tests are at the more simple end. A handheld test can be taken into the field. And, Dr Vu, are you aware that there was a variety of those types of tests done from time to time by South East Water?

DR VU: Yes.

MR COSTELLO: That's something you're aware of?

DR VU: Yes.

MR COSTELLO: I just want to ask you a question generally about that style of testing, the accuracy of testing by taking a sample in the field with the small device rather than sending something off to the lab. Is it right to say that that type - what I might call non-laboratory testing - is unlikely to be able to point to the source of water with any real degree of confidence?

DR VU: I would disagree with that. So what you referred to we consider in the field testing. And we use, like, a probe like a (indistinct) and then measure the water on site. So we are quite confident with the field measurement, normally because before we measure it, the field staff, normally we do the calibration step to make sure that the reading from the sample we have of standard had to be in a range of a standard range of equipment. So that's one of the QAQC steps we do. And then also based on my experience normally the field testing is quite consistent with the lab testing. So I would trust the result provided by the South East Water, if they done the calibration properly.

MR COSTELLO: If they've calibrated the device properly; yes, thank you. In terms of that type of non-laboratory electroconductivity testing it might be sufficiently accurate on the question of electroconductivity, but would you agree that the answer to that question, the state of the electroconductivity of the water itself, will often not be conclusive as to the source of the water?

DR VU: It depending. But then for this particular question we are talking about different type of water. Phil can elaborate on this. But when we're talking about the rainwater, which have very low conductivity or (indistinct).

MR COSTELLO: Yes.

DR VU: And the other one, the deep aquifer groundwater have high TDS. So if we have, like, a variety of different type water then perhaps the EC total will be one of the indicators we can use to differentiate the source of the water.

MR COSTELLO: Thank you. Mr Hitchcock, did you wish to add anything to that?

MR HITCHCOCK: Yeah, I think the EC meter will tell you how salty something is and give you a relative indication around the catchment. The anions and cations, looking at the geochemistry, is telling you the type of water and that dissolution and the equilibrium that's happening in the aquifer, which is different.

MR COSTELLO: Thank you.

MR HITCHCOCK: So it's the type of water and how salty it is.

MR COSTELLO: Yes, thank you. Could we please have on screen DPA.0004.0001.0001_0106. Dr Vu, this is your report - sorry, this is appendix E to the joint report which I'll bring up. And if I could have paragraph 182 up to and including subparagraph (c) made larger, please. This looks familiar to you, Dr Vu?

DR VU: Yeah, that my part; yeah.

MR COSTELLO: You're the person principally responsible for this part of the report?

DR VU: I am.

MR COSTELLO: Thank you. I just wanted to give you an opportunity to comment on a couple of paragraphs in your report that appear to me at least to be of significance. Here you're speaking about laboratory test results, and you start in (a) by speaking about pH values being consistent with field measurements. In (b) you talk about TDS and EC values being consistent with field measurements. And then in (c) you say, "The seepage that issued from the headscarp of the January 2025 landslide is enriched in major cations

and anions, including sodium, potassium, calcium, magnesium" - is HCO3, is that bicarbonate?

DR VU: Bicarbonate.

MR COSTELLO: SO4, that's sulphate, and chlorine? Chloride?

DR VU: Chloride.

MR COSTELLO: Chloride, "compared to rainwater and water from stormwater pits. Sodium and chloride are considered conservative traces." What does that mean?

DR VU: Sodium and chloride normally don't interact with any soil material. It flow through different type soil, but no - sodium and chloride would not be change their composition unless it would mix with other water. But if it's interacting with any soil metal, no change. So that's why we often - if we don't have tracer, then we use sodium and chloride as a tracer to estimate the (indistinct), also the source of the water. And then when we follow the tracer it's different from the tracer. Mr Pope, in his study, I believe that he used the kind of plumbing tracer or dye. But as a hydrogeologist or geochemist we often use different type of chemical as a tracer. But we didn't have a chance to do it here. So then that's why I had to use sodium chloride as a tracer to evaluate the source of the water.

MR COSTELLO: I see. And you go on to say that, "Their enrichment suggests some mixing of mains water, stormwater or rainwater with other water which has higher sodium and chloride concentrations or an accumulation of these ions, for instance, via mineral salt dissolution downstream."

DR VU: Correct.

MR COSTELLO: Now, you're talking there about there being a mixing of different types of water, and you've inferred that fact from in particular the presence of sodium and chloride.

DR VU: Yeah, and also calcium and magnesium, and bicarbonate as well. And that conclusive work based on only geochemical data I have. I don't really use different data here at this stage. This is, like, pure observation

from my water chemistry analysis.

MR COSTELLO: Yes. Yes, I understand. But what that observation means is that you had inferred that the particular water sample was not mains water alone?

DR VU: Yeah.

MR COSTELLO: But nor was it stormwater or rainwater alone?

DR VU: No, because it could be any kind of low salinity or low electrical conductivity water travel along the pathway, along the storm pits system, picking up or mixing up with other waters.

MR COSTELLO: I see. I'm going to move to another subparagraph of this but, before I do, Mr Hitchcock, is there any comment that you would wish to make on that paragraph?

MR HITCHCOCK: No.

MR COSTELLO: You agree with it?

MR HITCHCOCK: Yes.

MR COSTELLO: Thank you. Mr Jewell, do you agree with that paragraph?

MR JEWELL: Yes.

MR COSTELLO: Thank you. Could we move to subparagraph (e), please. Here, Dr Vu, you say, "Most water samples have fluoride concentrations less than or equal to 0.1 milligrams a litre, with the groundwater and seepage reporting concentrations of 0.3 and below 0.5 respectively. The source of the seepage based on fluoride concentrations alone cannot be assessed conclusively. However, if mains water contributed to the observed seepage at the landslide location, fluoride in the mains water was likely retained in soil via absorption on to soil components such as ion hydroxides, oxides and clay minerals." All right. It's a bit of a mouthful so let me break it down.

Fluoride - and I'll come to fluoride in connection with your report, too, Mr Hitchcock, because you have

something to say about fluoride. Fluoride's an important chemical for the purpose of testing. One of the reasons it's an important chemical is because it's commonly added to mains water, and so the presence of fluoride may be suggestive of the fact that it's mains water?

DR VU: Correct. And I would add to that, because we are talking about some of the soil type in here like granite, which is known to have enrich in fluoride as well. So have to be careful with that. But then obviously fluoride is one of the parameters we are looking at or assess.

MR COSTELLO: Yes. So is it right that what you're saying there the fact of fluoride being revealed in the testing is indicative of at least the potential that mains water has been involved but it is not alone conclusive?

DR VU: Yes. But then later on I think I mention that the deep aquifer, which is in the granite, could have high fluoride concentration. But then the deep aquifer is excluded in the equation because its location cannot really contribute to the progress at the headscarp. So that's why fluoride is very important for this guide. And you can see from the SMEC report that they conducted some column testing, and some of the material show that they have capability to retain fluoride in the result there. So that why it back up with my observation here. It reported that fluoride can be absorbed by metal hydroxide or clay minerals.

MR COSTELLO: Thank you. Mr Hitchcock, I can take you to the particular paragraphs of your report if you wish, but perhaps I'll start at the more general level. Could you explain to the chair the significance of fluoride and conclusions that you have drawn from the laboratory testing that you've seen as to the presence of fluoride?

MR HITCHCOCK: Okay. A lot of people think fluoride's a conservative tracer, and it's not.

MR COSTELLO: It is not a conservative tracer?

MR HITCHCOCK: It is not - yeah. It does like to stick to soil. I spent a couple of years in a laboratory working that out. So the fact that it's - yeah, it doesn't need a lot of fine material to stick to and then change. So it's very inconclusive to use fluoride. Initially when I looked

at the results and saw 0.3, 0.4 fluoride hanging around I thought, "That's a little bit unusual. But perhaps that's a background natural rather than for mains being diluted." But the samples from the colluvium and the deeper groundwater at interface also had similar levels of fluoride. So I think it's naturally occurring for a mineral called fluoride which is in the granite and represents an equilibrium with that. So unfortunately it's not a smoking gun.

MR COSTELLO: No. So you agree that the presence of fluoride in the water is certainly not alone suggestive of - sorry, certainly not alone definitive in answering the question, "Is this mains water?"

MR HITCHCOCK: M'hmm.

MR COSTELLO: Do you rule out fluoride? Do you say that it is irrelevant to that question or do you just say it's inconclusive?

MR HITCHCOCK: I think it's irrelevant.

MR COSTELLO: I see. Thank you. Mr Jewell, you agree with all of that I take it?

MR JEWELL: Yes, it's not useful in this context.

MR COSTELLO: It's not useful in this particular context. Thank you.

MR HITCHCOCK: I think you wanted to say something?

DR VU: Yes, to add to your comment that the fluoride from shallow perch water also have some kind of level there. But then we had to consider what the source of the perch water. If it is from the main, then obviously we have fluoride. So we can't really --

MR HITCHCOCK: Okay.

MR COSTELLO: That was (e). Can I have paragraph 183 up, please. It goes over the page. Dr Vu, I think it was you that just mentioned column leach testing?

DR VU: Correct.

MR COSTELLO: And you've clearly got an orderly mind because that's the next paragraph in your report.

DR VU: Yes.

MR COSTELLO: Perhaps can I just start with - Mr Bolton, were you responsible for the column leach testing or is it unfair to put that at your door?

MR BOLTON: No, I organised that to be done, yes.

MR COSTELLO: Could you just give a general explanation of what it is, column leach testing?

MR BOLTON: So it's based on a LEAF - we call it LEAF test, which is done by ALS. And essentially you're taking a column, which is about I think 30 centimetres long, and you're placing in that soil. And then you are feeding through that water, and we chose South East Water water to do that. And then you're letting that percolate through and then taking samples at the other end. And we did a number of samples of that and got those analysed. And we measured the blank, which is the South East Water water, and then we did five samples that were coming out of the other end, the exit point, of that column.

MR COSTELLO: Thank you.

MR BOLTON: That was done to help inform the geochemical modelling that was being undertaken so that we at least had something to go on. That was the purpose, the primary purpose, of it.

MR COSTELLO: Thank you. Mr Hitchcock, Dr Vu states here that the presence of ions - calcium, sodium, chloride and fluoride - are consistent with a sample of water that issued from the headscarp of the January 2025 landslide, which were chemically enriched with similar ions. Do you agree with that?

MR HITCHCOCK: I don't pay any weight to the column tests at all.

MR COSTELLO: Why's that?

MR HITCHCOCK: There's a number of things. A standard leach test you get some sample, shake it up with water, and

see how much goes in the solution. A LEAF test is meant to simulate what happens over time. So what it does is you put your water through a column, and you do that a number of times to simulate a long-term contact not just a one-off shaking or agitation. We don't know - all the report says it's a modified LEAF test. There's no information about how much water's gone, through residence time, how the soil was put in columns. With granular materials you can have preferred float paths and, if the things aren't compacted quite properly or put in correctly, then you get similar results - in is out - and, apart from one of the samples which showed an increase in salinity, I just think the results are too consistent to tell you anything.

MR COSTELLO: I see. Do you disagree with that, Dr Vu?

DR VU: To some extent I agree with it; to some extent I disagree. So, for example, the report mentioned that they conducted by LEAF test and then again, like Phillip said, they didn't mention about the wet of the sample put in the column. I think they mentioned about 600 ml of water was used. Also they didn't mention the timeframe the column test was conducted. And for us, as a geochemist, normally the leaching test is an indicator to see the evolution of the chemistry in the bottle. But we don't expect that could be happen exactly in the field because (a) we don't have exact the ratio of solid over liquid. So the columns have to be the same solid over liquid ratio with the real condition. The (indistinct) used the water. But then the period and readouts might be different from the in situ condition. Same the retention time, doesn't mention in the report. We're talking about maybe a couple of days conducting the test, while in the in situ condition we're talking about maybe 150 days, 60 days.

And then (b) the particle size might be different from the in situ and the one in the column test. And I would like to point out that the study and column material they used were - some of them were like a few metres up gradient from the leakage, and then shallow (indistinct). I don't think it would be representative of the whole soil profile or would consider from the leak location to the scarp. We talk about the complexity of natural soil. We expect, like, different type soil like fill, like aeolian, like transported soil, (indistinct) different types. And even the same type soil but different location you will see the variety changes. So, to me, the column test provides some

indication or some information, but it's not the one you are expecting to see in the in situ condition.

MR COSTELLO: You don't rule out the relevance of the column leach testing in the way Mr Hitchcock does, but you acknowledge that it does have some limits in what you can draw from it?

DR VU: Yeah, yeah.

MR COSTELLO: All right. Mr Jewell?

MR HITCHCOCK: The other thing, if I can just say --

MR COSTELLO: Sorry.

MR HITCHCOCK: So usually when you look at how things are changing you do the major cations and anions, and you chuck them on a plot. There's no bicarbonate in this test done. So we can't - it's one of the main - it's one of the missing things. And so it means you can't do that analysis to see how it plots against the other waters and see if it's changed, has it flowed through the column, has it become more like groundwater or groundwater. We can't do that because that bicarbonate wasn't analysed for in the analysis.

MR COSTELLO: Mr Jewell, do you think this column leach testing to the extent that you've been able to understand the way it was done from the material you've read is sufficiently reliable and robust to draw conclusions from it?

MR JEWELL: I think it has some use and, you know, I agree that it can't represent all the conditions in the natural environment. You know, it's an artificially repacked column. I think what it does show is that after the first step, if you like, all the solution stabilise, all the (indistinct) stabilise fairly well. I think that initial increase is quite possibly due to either fine particulate material that was collodial material or that came through - was washed off and came through in that first step or possibly to desorption in that first step, and then receives relatively consistent results throughout the test, apart from I think one of them. I don't have - yeah. But, yeah, I think it had some utility, but it doesn't tell you everything.

MR COSTELLO: Thank you. We can cut to the chase then and go to 184. Dr Vu, this is in many respects your primary conclusion, I think it's fair to say. You conclude at the start of that paragraph that the chemical profile of the seepage from the headscarp at January 2025 was not consistent with typical mains water, nor was it consistent with natural groundwater, nor was it consistent with rainwater or stormwater, and that's consistent with your earlier statement that I've already taken you to that there had been a mixing of water sources going on.

DR VU: Or could be picking up ion along the pathway.

MR COSTELLO: Thank you. And then in the final sentence that starts "the testing indicates" in the fourth last line, you say, "The testing indicates that a plausible model is that water issuing from the pipe burst travelled along a pathway that included seepage through soil, service trenches or both, mixed with shallow subsurface flow or stormwater and accumulated ions along the pathway."

DR VU: Correct. I have this conclusion because here until considering all the data I have I also considered the assessment from my colleague, the geotechnical assessment, geological assessment, that we have no possible other source of water other than the main have potentially contribute to the increased progress in the headscarp. That's why I put it in when considering the overall lay evidence, because at the time we normally don't - our assessment or conclusion in one live evidence; we try to use multiple evidence.

MR COSTELLO: You've quite properly said in the next paragraph that contribution of other water sources can't be excluded.

DR VU: Yes.

MR COSTELLO: But that doesn't affect the conclusion that you reach in paragraph 184 that there at least is a plausible model that the water that issued from the burst pipe found its way to the scarp?

DR VU: Yes. So considering the volume of water lost through the burst, like, from 37 megalitre to 40 megalitre, and then consider the pathway we examine, like, via the

stormwater drain system or from the colluvium aquifer or soil, then potentially, yes, there is a possibility in all of that it can go from the leak to the landslide; yeah.

MR COSTELLO: Thank you. Now, this might be an unfair question, Dr Vu, but it won't stop me asking it. Are you able to state your degree of confidence in that conclusion?

DR VU: With the geochemical or the chemical data only the confidence will be moderate. But then with the hydrogeological assessment and the geotechnical assessment I think will be high.

MR COSTELLO: I see. Is a fair way of describing that that if this was a conclusion based on chemical analysis alone you would have a moderate degree of confidence.

DR VU: Yes.

MR COSTELLO: But inferring from all of the available data, including the work done by allied disciplines to yours --

DR VU: Yep.

MR COSTELLO: -- that in assessing all of that data you have a high degree of confidence that there is mains water involved in the water leaving the escarpment?

DR VU: And, speaking of that, we talk about this water sample from potholes in the different places like Charlesworth Street and Waller Place. South East Water, we quoted some data. That also support the evidence that the main water travelled from the leak to those potholes, and then could move to the landslide.

MR COSTELLO: Thank you.

DR VU: I'll provide later on when we talk about the differences and agreement between the experts.

MR COSTELLO: If we get to that. Mr Jewell, of course I'm going to give you an opportunity to respond to all of this. But, first, given, Mr Hitchcock, your opinion is at least to a lay person of which I am not dissimilar to that of Dr Vu, you say that groundwater is an unlikely source?

MR HITCHCOCK: I think some of the salt's been picked up from groundwater along the way.

MR COSTELLO: Perhaps rather than verbal you I'll bring your report up. It's MSC.5087.0001.0001. And if we go to page 0036. And if I could have paragraphs 100 and 101 enlarged, please. Now, we can ignore the table for now --

MR HITCHCOCK: Sorry, I thought you said "unlikely source".

MR COSTELLO: Sorry, what did you say?

MR HITCHCOCK: I thought you said groundwater is an unlikely source.

MR COSTELLO: Sorry. It's unlikely that groundwater is a likely source; I was trying to take --

MR HITCHCOCK: Can I reduce it and say that this was before the causation reports, which have about 30 sets of analysis, and I'm basing this on salinity and about three sets of analysis.

MR COSTELLO: I see. Well, then let me give the opportunity for you to - to the extent you have more developed or different views, can you just express what your concluded view is now if you have one?

MR HITCHCOCK: I think there's - as Dr Vu said, the confidence in the chemistry's moderate, perhaps even slightly lower than moderate. But combined with hydrogeological and geotechnical facts and also the fact that there's a lot of water coming out of there gives me a high confidence that this is a result of a mixing of waters. Mains water, shallow groundwater are the main sources.

MR COSTELLO: Before I pass to you, Mr Jewell, on this question of shallow groundwater, perched water, springs, one things that we have learnt in the course of earlier hearings is that springs often have a recharge area. Now, quite how that sits within the scheme of perched water or shallow aquifers I'm not entirely sure anymore. I thought I was, but I'm not now. But is there a chance that to the extent some of this is groundwater it's groundwater that has emerged from a spring that's been recharged by mains

water?

MR HITCHCOCK: Yes.

MR COSTELLO: Thank you.

MR HITCHCOCK: And picking up salts along the way from perhaps overland sands, other sources.

MR COSTELLO: You agree with that, Dr Vu?

DR VU: I just want to add in since we submitted our report and had more chance to read the causation report - because when we prepared our report we didn't have a chance to see other reports from other experts. Can I ask you to bring the SMEC report, either the original one or the revised one, you have on the record?

MR COSTELLO: Not the technical memorandum but the report?

DR VU: The causation report.

MR COSTELLO: Is it appendix C you're after?

DR VU: Appendix E.

MR COSTELLO: Yes, I'll bring it up. It's SEW.0001.0001.0501, and it starts relevantly I think at 0266. That's in the updated version of the report.

DR VU: Madam Chair, can I ask other experts some kind of clarification because when I read their report there's some information that I'm not quite sure. Can I ask them to verify their --

CHAIRPERSON: Yes, you can.

MR COSTELLO: I think it's SME.0001.0001.0501. Thank you. And then it starts at 0266. You go ahead, Dr Vu. You ask the question.

DR VU: So can we go to the PDF number - is it the original one or the --

MR COSTELLO: This is the revised.

DR VU: Revised, okay. So the PDF page number 260,

please.

MR COSTELLO: 260.

DR VU: So that's starting appendix E.

MR COSTELLO: Is it this one?

DR VU: No, I think the SMEC appendix E. Or maybe 286.

MR COSTELLO: 266?

DR VU: Could you move to a few more page where we see the graph when they show the different or the change in electrical conductivity in chloride? Sorry, I don't have that page.

CHAIRPERSON: I think you need to go back to appendix E; is that right?

MR COSTELLO: This is E. This is E.

DR VU: The graph, please.

MR COSTELLO: What paragraph number is it at, Dr Vu? The bar chart?

DR VU: The bar chart, please. Keep going, please.

MR COSTELLO: Just keep cycling through. Dr Vu will tell you --

DR VU: That's the one.

MR COSTELLO: Yes, I know the one. It's a few pages further on. Just go through.

DR VU: Yeah, that paragraph.

MR COSTELLO: It's in part 6, yes, about three more pages on. Keep going. We seem to be going backwards. Just go forward. Yes, it should be there. Go back.

DR VU: The other one, please.

MR COSTELLO: Is this the page?

DR VU: Yes, this is the one.

MR COSTELLO: Sorry, Dr Vu.

DR VU: I ask, Mr Bolton, where was the data for this graph, please?

MR BOLTON: They're from the --

DR VU: Is it from the same appendix, appendix E?

MR BOLTON: So the data is taken from laboratory testing that was done principally by - organised by SEW, and that data is contained in this table that was in the May report. So there's --

DR VU: Maybe perhaps page --

MR BOLTON: It is summarised. Let's just see.

DR VU: (Indistinct) of this appendix?

MR BOLTON: Yes, it is I believe in the appendix to, but it's principally taken from the May report, which I did refer when I explained where the data came from.

MR COSTELLO: Dr Vu, you're asking the source of the data for these two graphs because you were unable to ascertain it when you read the report; is that right?

DR VU: Yeah, and also I will discuss about the mixing and the presence of the perched shallow water. So I think to identify the data source before I elaborate my opinion further.

MR COSTELLO: I see. These are --

MR BOLTON: Yes, a large part of it has come from this May report, which I think most - I think by and large it should be in that back appendix, but it's from this table 12, which is in the May --

DR VU: Can we bring that expert report in May, please?

MR COSTELLO: Are you asking to have that data on the screen, Dr Vu?

DR VU: Yeah, please, can we bring that up?

MR COSTELLO: 5 May report.

DR VU: I think we've seen it earlier this morning.

MR COSTELLO: That's the initial SMEC report.

DR VU: And can I see table 12, please?

MR BOLTON: Page 67.

MR COSTELLO: PDF 67, hopefully.

MR BOLTON: Not PDF. Number 67.

MR COSTELLO: Actual internal page.

MR BOLTON: I don't know if that actually lines up with the PDF number.

MR COSTELLO: This table?

DR VU: Yes.

MR COSTELLO: Is this the table you're referring to, Mr Bolton?

MR BOLTON: Yes.

MR COSTELLO: Thank you.

DR VU: Because we've seen the graph in their report previously which suggested that the data were before and after the repair. But in this table I see that most of the sample are after the repair, which I believe that it is on 1 January 2025. So I'm not quite sure where the data from before repair was, unless only one sample from the location. Here we have some result from 24 and 30 of December, which I consider before. But are the location - I don't see after the repair. I'm bringing it up because it seemed to me that on my understanding - correct me if I'm wrong - SMEC team considered no change in the electrical conductivity in chloride as the result of mixing between the main water and the localised shallow perched water. So to me there's no localised perched water or, if like this, there will be some different story.

Let me tell you what because I base my results, for example - we talk about the mixing between water like perched water and then main water. And if we use the local or perched water chloride concentration of 250 milligram per litre, and then the main water I used 20 milligram per litre chloride, how the mixing ratio between the two, roughly - and if I use the - so the mixing ratio will be, like, 55 and 45. And then if we use the volume of water lost through the burst, which is 35 megalitres, then the perched water had to be from 17 megalitres to 28 megalitres.

MR COSTELLO: I see.

DR VU: And then that's the calculation for 70 per cent of the main burst travel to the pothole. And then in the text here they mention about upwelling. So I don't think the perched water can be uprising. It's mainly the main water core pressuring can bring the water up into the pothole. So I believe the question of possibility of having that huge amount of perched water for hydrogeologist or geotech expert, but for my opinion that amount of water, perched water, cannot be there.

MR COSTELLO: I see. Thank you, Dr Vu. Mr Bolton, do you wish to respond to that?

MR BOLTON: Yeah, so in my explanation, so the embedment material is very permeable. So the water has entered in embedment material for the sewer, has made its way down to what I'm calling A, which is Charlesworth and Waller Place. It's also made it to B, which is Charlesworth and Coburn. And it's come to surface there. And you can see the EC is lower. And I've taken samples that are prior to and shortly after the repair was done. And you can see those samples are at a certain level. So we sort of look at the one that's upwelling at the juncture of Waller Place and Charlesworth. If I can read that correctly it's about 600 there.

And then after the burst, like, some time after the burst has been repaired the level jumps up again. It jumps from 600 up to 1,200. And I take that to indicate that the water from the burst has made it to that place and has caused the EC to drop. And then once the repair has been done in some weeks after that, a week or two after that,

the natural groundwater has come back again. And so you get this change from, let's say, 600 back up to 1,200.

CHAIRPERSON: And I think Mr Vu's looking for the before data.

MR BOLTON: Well, that's - so as the burst is repaired on the 31st it takes some time for that water, which continues on its path through the embedment material, before it dissipates and is then replaced by the natural background water. So I've used data - and I say it here - prior to and shortly after the repairing of the SEW burst. So that concept of because you repair the leak doesn't mean that, you know, there is a delay as it travels through.

DR VU: In my opinion, the increase in electric conductivity in chloride has two options. The later one have higher conductivity in chloride maybe because it has the higher or longer time to travel and interact with the soil. That's why it dilutes and it dissolves more salts. That's why it brings up the electrical conductivity in chloride. And (b) maybe the water we observe at the potholes at later dates travelled from different pathway which is less permeable to the original pathway we see in the first few days, and then in the new pathway it may pick more ion on this way.

Again I say that there's no data for before the repair; only sample from location. And, like I said, I used the data location to estimate the missing volume, and that was the 17 megalitre to 28 megalitre where perched water come from using the chloride concentration.

And then in addition to that the shallow perched water might exist but then is not consistent. So I'm saying that because talking about the PSM borehole 03A there was some time we put (indistinct) and even the PSM. But then during the site visit or site work in July it was reported to have the water. So it is an indicator telling me that the perched water could be there, but likely this is source from the rainfall event, not natural water.

MR COSTELLO: Thank you.

DR VU: And then another question I want to put in is a creek, the Coburn Creek.

MR COSTELLO: Yes.

DR VU: We visit the Coburn Creek in June and it is dry. But then in July when SMEC's crew conducted their site investigation then they reported that there's some water there. So again, like, between June and July there's some rainfall. Then maybe the Coburn Creek now I think at the stormwater drainage is not natural springwater. So that's my observation.

MR COSTELLO: I see. Mr Makin and Mr Hitchcock, I want to give you each an opportunity to speak to this issue if you will. I know that it's arisen in the course and then you might not have any concluded views, but if there's anything you'd like to add please feel free. Mr Makin, I might start with you.

MR MAKIN: No. (Indistinct).

MR COSTELLO: Okay. Mr Hitchcock?

MR HITCHCOCK: Yeah, I couldn't find the before data as well. I don't quite think there would be enough perched water there to mix and cause that - what's observed.

MR COSTELLO: Sorry, it's a little hard to hear you. Did you say there's not enough perched water?

MR HITCHCOCK: Yeah. I don't think there would be enough shallow perched water to cause the mixing that Dr Vu has calculated from the chloride.

CHAIRPERSON: How are we going for time, Mr Costello? How much longer do you think you'll be?

MR COSTELLO: I'm conscious that others are going to want to ask questions.

CHAIRPERSON: Yes. How much longer will you be?

MR COSTELLO: I imagine I'll be another 10 minutes, if I do it in light speed.

CHAIRPERSON: And, Ms Foley, how long do you think you'll need?

MS FOLEY: On the chemistry issues as well as mop-up

I think I have about 20 minutes.

CHAIRPERSON: Ms Siemensma?

MS SIEMENSMA: Maybe 15 minutes.

CHAIRPERSON: That takes us to three-quarters of an hour.

MR COSTELLO: At best, I suspect.

CHAIRPERSON: Yes. So let's say an hour. So it will be just before 7. I'm very conscious it's been a long day. Is your preference to press on or return?

MR COSTELLO: Could we just - perhaps we'll go down the line starting with you, Mr Bolton.

MR BOLTON: I think we have to go on. Like, what are we going to do otherwise?

MR COSTELLO: Otherwise we'd be back tomorrow. That's the alternative.

CHAIRPERSON: Mr Jewell?

MR JEWELL: I'd probably need to change a flight to tomorrow if we're going to go on that long, I think. I don't think I want to get to the airport at half past 8 if we're going on here until 7 o'clock.

CHAIRPERSON: You're flying back tonight?

MR JEWELL: I'm flying back tonight, yes. I'll do that, but I need a couple of minutes to - well, yeah.

CHAIRPERSON: Mr Paul?

MR PAUL: Happy to stay.

CHAIRPERSON: Mr Makin?

MR MAKIN: (Indistinct).

MR HITCHCOCK: Happy to stay.

CHAIRPERSON: Mr Costello, how are you feeling?

MR COSTELLO: Yes, I might just ask Mr Di Stefano to hold me up, but I'll be all right.

CHAIRPERSON: What do you want to do?

MR COSTELLO: I'm here at your convenience, Madam Chair. It's a matter for you. But I'm conscious of the convenience of others at the Bar table as well. If we need to be here tomorrow then it will be - if we need to be here tomorrow and there's a hearing room, which there might not be, then we can do it in an hour or so tomorrow. I'll be leaving it in Mr Di Stefano's hands if that's where we get to. But I'm conscious of the views of others that ought be taken into account.

CHAIRPERSON: Ms Foley, what's your preference?

MS FOLEY: I think for our part pressing on seems desirable.

CHAIRPERSON: Press on?

MS SIEMENSMA: I'm in the board's hands.

CHAIRPERSON: Let's press on. Mr Jewell?

MR JEWELL: We can press on.

CHAIRPERSON: Do you need some time to make arrangements or --

MR JEWELL: Going on past experience, it would take a while. So, no, we'll just leave it. I would need 10 minutes, I think.

MS SIEMENSMA: Madam Chair, I wouldn't mind a comfort break just for a minute or two anyway.

CHAIRPERSON: Yes . Let's take a quick break until 6, and then we'll have a hard finish at 7 o'clock. We finish by 7.

SHORT ADJOURNMENT

CHAIRPERSON: Mr Costello, you're very welcome to sit if you want to.

MR COSTELLO: Thank you. No, I would never do that. Thank you. It's very generous. Apart from anything, I wouldn't be able to see anybody. It's hard enough standing here. Mr Jewell, were you able to make arrangements?

MR JEWELL: I've changed my flight to a bit later.

MR COSTELLO: All right.

CHAIRPERSON: Thank you, Mr Jewell.

MR COSTELLO: I want to close off on this issue that Dr Vu has raised, Mr Bolton, before I get back to the matters that I was seeking to give Mr Jewell an opportunity to respond on. The two bar graphs, I won't bring them back up, you know what I'm talking about, one concerns electroconductivity and the other chloride concentration. They are representative of something that you discerned which was an increase in EC and chloride post-repair of the burst pipe; that's what you draw from the data?

MR BOLTON: Yes. Return back towards the background conditions, yeah.

MR COSTELLO: Yes. And is it right that your evidence is the data that concerns the post-repair period is data that is to be found in the table that's in front of you? On the screen, I mean?

MR BOLTON: Yes, it's that and --

MR COSTELLO: Sorry, your screens are not working. They've gone on strike. The one behind you is, or the one over here. I know you can't see it very clearly.

CHAIRPERSON: Mr Vu, is Mr Makin's screen working? No.

MR COSTELLO: Mr Bolton, we'll try and get the screens repaired, but I just want to understand that is your evidence, that the data is found in that table?

MR BOLTON: The data is found in that table, and then plus 7 Prospect Hill wasn't sampled by SEW, it is sampled by PSM, that's before or during the burst sample was PSM's SW2 value, which I state there. And then the after is the sample that we had taken, you know, of the site.

MR COSTELLO: "After" means post-repair?

MR BOLTON: Correct. Yes, yes. And then I think that's the data I relied upon.

MR COSTELLO: So in respect of the post-repair period it's a single sample; is that right?

MR BOLTON: It's - no, there's - well, looking at the table there is the post-repair. Yes, so for A it's one sample. For --

MR COSTELLO: A's Waller Place and Charlesworth Street; is that right.

MR BOLTON: That's right. And then Coburn, that's one sample, yeah. And then the 7 Prospect Hill is - one sample is shown, but I think there were two that were taken. But the value of the EC is roughly the same.

MR COSTELLO: Have you got the table in front of you?

MR BOLTON: Yes, this one here?

MR COSTELLO: Yes, the one that is still on the screen behind you. When you say Coburn Avenue is one sample is that the sample that in the table is sample D?

MR BOLTON: Yeah, the one at Coburn and Charlesworth is D. So you can see that on 6 January the EC was at 750. And then on the 22nd there's two samples there. One is 1,000 on the 22nd and then another one in the same spot on the same date is 1,400.

MR COSTELLO: Yes.

MR BOLTON: And similarly with Waller and Charlesworth there's a number of samples there. So on 24 December there's a sample - what's that?

MR COSTELLO: That's 670, I think.

MR BOLTON: 670. And then the one after that on the 30th and then on the 6th, and then there's another one on the 16th which jumps up to 1,200. And then with, you know, Prospect Hill there's the SW02, which that one was at

I think 400. And then the sample that we took, i.e. SMEC took, that was around 800.

MR COSTELLO: So if we stick with D in the table for the moment this is upwelling at the pothole, Coburn Avenue and Charlesworth.

MR BOLTON: Yes.

MR COSTELLO: Two samples, 6 January. Concentrate on EC for now.

MR BOLTON: Yes.

MR COSTELLO: EC reading of 750.

MR BOLTON: Yes.

MR COSTELLO: 22nd, EC reading of 1,000.

MR BOLTON: Yes.

MR COSTELLO: And so do you say that the uptick in electroconductivity from the 6th to the 20 - sorry, between the period 6 January and 22 January is indicative of the fact that the groundwater is returning to a more normal level rather than being diluted by another source?

MR BOLTON: That's correct. So the burst has been repaired. The water that was coming down the embedment material is now dispersing, I suppose, if that's the way to put it. And we are now seeing the background water, I guess, filling in, you know, replacing it, I guess, if that's the (indistinct).

MR COSTELLO: I see. And so as at 6 January then there was still a mixture of what you describe as background water with another source that was not background water?

MR BOLTON: Well, it takes some time on the 6th. So the repair was on the 31st.

MR COSTELLO: Yes.

MR BOLTON: And it takes some time for that --

MR COSTELLO: That's right. We're back to the water

velocity question, accepting that it stopped at one end but it's continuing to move, presumably.

MR BOLTON: I know, but it doesn't just sort of - you know, it's backing up at Charlesworth and Coburn because it's hitting that intersection, and so it's almost like a dam and it's taking a while for that water to get out of the way, so to speak.

CHAIRPERSON: Mr Costello, before you move on I think others have --

DR VU: If we can bring the graph and the table together, I don't think the graph really represents that. For example, we're talking about the location D, and he said that on the 22nd the EC was 1,000 but in the graph I saw it 1,500. Maybe I'm wrong. But graph was not good quality, but I see that it's --

MR COSTELLO: You're concerned that the data presented in the graphs is an accurate reflection of the data in the table?

DR VU: Yeah.

MR COSTELLO: And I just don't know if I can have it done. I'll try and have it done. But if I can get the graph up at the same time is that something that you can discern?

DR VU: Yeah, yeah.

MR COSTELLO: All right.

DR VU: And also, like, again, I put my opinion that the 6th is after the repair, not before the repair.

MR COSTELLO: Right. Okay.

CHAIRPERSON: Mr Bolton, did you prepare the bar chart or did someone prepare it?

MR BOLTON: I did. I prepared it and I tried to keep it - I use - I try to keep it fairly straightforward, I guess, because I was a bit worried coming into here that to try to make things complicated it would, yeah, be difficult.

CHAIRPERSON: Yes. So you prepared that yourself?

MR BOLTON: Yes, I did.

MR COSTELLO: Dr Vu, I'll try and do that for you for the moment. Just let me continue with Mr Bolton for a moment. Mr Bolton, I've just been asking you about D.

MR BOLTON: M'hmm.

MR COSTELLO: And I pointed out the two tests, 6 January, 22 January. 22 January, 1,000.

MR BOLTON: And 1,400.

MR COSTELLO: EC. No, for D, 1,000. 1,400 is Coburn and Charlesworth in the next one down. But just sticking to the --

MR BOLTON: That is the same place.

MR COSTELLO: Yes, but just sticking to those. We've done 750 and 1,000. There's then 1,400 as you point out in the next column down. And then if you drop down to F you'll see the verge opposite Waller Place. This is higher up the hill; aware of that? You're aware that that's higher up the hill? You see the testing on the same day, electroconductivity test of 600?

MR BOLTON: Yes, that says "verge opposite 5 Waller Place".

MR COSTELLO: That is higher up the hill.

MR BOLTON: I'm not sure where that 5 Waller Place is.

MR COSTELLO: Are you aware that that's higher up the hill or you're not aware of that?

MR BOLTON: Waller Place is higher up the hill; that's true.

MR COSTELLO: Yes. And yet the electroconductivity of that measured on the same day is lower.

MR BOLTON: Yes, that's --

MR COSTELLO: Lower by more than half from the 1,400

reading that you were very keen to tell me about a minute ago.

MR BOLTON: Yeah, I can't explain why that's lower. It must be --

MR COSTELLO: It doesn't sit consistently with --

MR BOLTON: -- complexities, I guess.

MR COSTELLO: Yes. And undeniably this is complex, but do you accept that doesn't sit well with your theory?

MR BOLTON: No, it doesn't.

MR COSTELLO: Thank you. Dr Vu, I'm going to move to a different topic now and we're going to have to investigate the table as against the graphs outside of the forum because I need to give other people an opportunity to ask some questions as well. Before I do that, Mr Jewell, I apologise, I've been trying to get to you. You'll recall that I have taken Dr Vu to his ultimate conclusion, and he supplemented his written evidence and conclusion with some additional evidence which was to the effect that by reason of all of the factors combined, chemistry and other, he had a quite high degree of confidence. But, based on chemistry alone, he had come to the conclusion that he's come to in his report that you're aware of, and he had a moderate degree of confidence based on chemistry alone in that. And you've heard what Mr Hitchcock said about his opinion. Do you have a different opinion to the opinion of those two gentlemen?

MR JEWELL: Well, I just say that the water arriving at the scarp, right, has to be a mixture of mains - on the assumption that mains water is contributing to it, it has to be a mixture of mains water and other water, I think, and a significant amount of other water in order to raise the salinity to the (indistinct) at the scarp, 350 milligrams per kilogram of chloride. It's probably about a 1 to 4 mixing ratio. So the water arrives at the scarp and presumably the water which triggered the slide, you know, if we accept the views that have been forcefully presented today, is a mixture of mains water and natural groundwater.

MR COSTELLO: That's your concluded view as to the water

that was exiting the scarp?

MR JEWELL: Yes.

MR COSTELLO: After the 5 January landslide?

MR JEWELL: Yes.

MR COSTELLO: Thank you.

CHAIRPERSON: Mr Costello, just quickly --

MR JEWELL: I have a high degree of confidence.

MR COSTELLO: You have a high degree of confidence?

MR JEWELL: In that statement.

MR COSTELLO: Thank you. Mr Jewell, did you say in the course of your answer on the assumption that it's reaching the scarp, or was your view that based on the chemical analysis that you've seen of water that the water that was leaving the scarp is a mixture in a 4 to 1 ratio involving mains water?

MR JEWELL: That is what I said. That's my view.

MR COSTELLO: Mr Bolton, before I hand over to others, really as a matter of fairness more than anything else, I should mention the technical memorandum of which you're the principal or sole author.

MR BOLTON: Yes.

MR COSTELLO: What was the purpose of the technical memorandum?

MR BOLTON: It was just to add, you know, further geochemical analysis that had already been done. So that included a Durov plot to try to explain the signatures of the groundwater.

MR COSTELLO: This was a report that was issued on 25 July; do you recall that?

MR BOLTON: This technical memorandum, yes, that's right, and it's after when we put the appendix E in.

MR COSTELLO: Do you present any additional views in this technical memorandum or is it really a description of the workings for views you've already reached, you've already expressed?

MR BOLTON: It's a description of the signatures of the water, but to try to categorise them into granite. That water (indistinct) interface granite, so at the surface of the granite, and then colluvium to help our understanding.

MR COSTELLO: I see. You've just heard what Mr Jewell has said as to his conclusion. Do you accept what Mr Jewell said? Do you agree with it?

MR BOLTON: I mean, I do - it's difficult for me because he's a geochemist and knows more than me, I guess. My view was that the water exiting the slope was of 1,600. So it was closer in chemistry to background water. And therefore I didn't - you know, it didn't appear to be any indication of contribution from mains water. But that also can't be ruled out, and that's why I put down minor or insignificant to minor on the conclave that we had.

MR COSTELLO: That was your view before the start of this hearing block. Having heard what you've heard from your colleagues, have you changed your view?

MR BOLTON: No, I still believe that, and I guess that's in addition to the 1,600 and the Durov plot there which shows the water being of an interface granite water coming from the slope, and also the fact that, you know, at 7 Prospect Hill we still see into February this water that is diluted water, meaning that there's - the mains water is still in that area. And the fact that the flows did drop off quite quickly coming from the scarp between the 6th and the 10th I was of the view that the contribution was, you know, minor.

MR COSTELLO: And have you been able to identify an alternative source of water other than the burst that could properly explain the volume of water that was seen passing through the scarp in the period from the first landslide and through and to and including and after the second landslide?

MR BOLTON: The volume of water, you know, on the 6th,

which was measured up to I think 0.2 litres per second, that sort of a volume equal to about 50 per cent of a garden hose. So it wasn't - I didn't feel, you know, a --

MR COSTELLO: I thought Mr Pope's evidence - and if I'm wrong I'll be corrected - was when he did the measurement on the 6th it was 17,000 litres a day.

MR BOLTON: I know, that's the 17,000 litres per day. But when you go down to litres per second --

MR COSTELLO: You're reducing it to litres --

MR BOLTON: That's litres per second.

MR COSTELLO: You mean a constantly running garden hose for 24 hours would deliver 17,000 litres in the course of a day?

MR BOLTON: Well, it would deliver more than that.

MR COSTELLO: I see. And my question was if you had identified any available source other than the burst that could explain the fact that there was 17,000 litres observed on the 6th, then a mass of water observed in the period from the burst until the second landslide throughout the McCrae area.

MR BOLTON: So the way I've looked at it is there is this skin of fill material which has been holding back the aquifer water as a preparatory factor. The landslide has occurred, and that's caused that material to - the bandaid, so to speak, to be ripped off. And, as a result, the water that was building up behind that has now been able to release itself.

MR COSTELLO: Yes, Mr Bolton, I'm sorry, I don't want to rush you. I understand the mechanics. The question is not whether or not there was fill or other features of the scarp that were holding back water and were saturated. The question is the source of the saturation. One thing as plain as day it wasn't rain. There had been very little rainfall in the period. I'm just asking you - and if the answer is "no" it's fine - do you have a plausible alternative source of water that is not the burst?

MR BOLTON: Well, one plausible source to my mind was

irrigation, that with the preparatory - and this is getting into the geotech realm, but with the wetting up of the slope due to the influx of water from the shallow aquifer that was - you know, you've got this wet area that's identified towards the downward slope. You can see that in --

MR COSTELLO: Mr Bolton.

MR BOLTON: It's page 28, on the 28 May report. So inset 40 that shows us. And then with the addition of irrigation that has - well, this is where it's getting into geotech and I'd have to refer to --

MR COSTELLO: You accept that what you've just said is a speculative theory?

MR BOLTON: Yes, and that's why I did put down moderate in my conclusion.

MR COSTELLO: And that would mean, wouldn't it, that this speculative theory as being triggering of the slide would be an event that would be disconnected from the other water events observed throughout the McCrae area, in particular the breaches of road surfaces by upwelling of water in the path roughly between, say, Coburn and the burst site? All of that might be attributable under this theory to the burst?

MR BOLTON: Correct.

MR COSTELLO: But the slide happening not far from Coburn would be attributable, on your view, to domestic irrigation?

MR BOLTON: That was prepared through groundwater that had - and also the fact that the slope is steep.

MR COSTELLO: And accepting that there's no certainty in any of this and that a flow path is accepted by others to be plausible but not definitively established, accepting all of that, just standing back with all of your training and as a matter of commonsense, does that strike you as a realistic circumstance that throughout the McCrae area there has been a noticeable saturation, upwelling of water that has damaged public infrastructure, it has got on any view at least very close to the escarpment, that somehow by

sheer coincidence domestic irrigation has led to not one but two landslides in or around the same time, and water ceased flowing out of the escarpment some time after the landslide being a period after the pipe had been repaired, just standing back applying both your experience and your commonsense is that a plausible suggestion that you can stand by as a professional?

MR BOLTON: It's based on - I'm just going off the chemistry data that we have. And I couldn't see that. But, you know, I do rely heavily on Mr Jewell. So if his conclusion is otherwise, you know, I have to go with that, really.

MR COSTELLO: I think I must make way for others.

CHAIRPERSON: Yes. Ms Foley.

MS FOLEY: Pardon me, Chair, given some of the evidence that's just been given, what I was planning to do is much shorter.

CHAIRPERSON: Yes.

MS FOLEY: Which I'm sure everyone's relieved to hear.

CHAIRPERSON: I am.

MS FOLEY: So I just have a couple of questions.

CHAIRPERSON: Yes.

<EXAMINATION BY MS FOLEY:

MS FOLEY: Mr Bolton, I just have a couple of short questions for you.

MR BOLTON: Sure.

MS FOLEY: Earlier in the afternoon you'll recall that I asked Mr Hartley some questions about SMEC's earlier report.

MR BOLTON: Yeah.

MS FOLEY: And in particular the upwelling at Coburn Avenue and Waller Place, and that the upwelling in that

report had been tied to the Bayview Road leak.

MR BOLTON: Yes.

MS FOLEY: The EC figures for that Coburn Avenue upwelling are comparable, aren't they, with the water that came out of the escarpment?

MR BOLTON: After the ones - the after ones you're saying? Yes.

MS FOLEY: Yes. The water that came out of the escarpment, the testing that was done, yes, is comparable with what was identified from that Coburn Avenue upwelling?

MR BOLTON: So that Coburn Avenue upwelling you're talking about the one that I refer to as after - the after the burst?

MS FOLEY: Yes, the one in January, and the test results that are in - the SMEC test results and also the Pope test results that are identified in the Paul report; do you recall those?

MR BOLTON: Could you give me a value, like --

MS FOLEY: Yes, we'll bring them up to make it easier. And I'll compare two different documents, if we can. Can we go first to SMEC - sorry, this is the SMEC report, SEW.0001.0002.4187, and if we can go to PDF 270. All right. So we can see here the results for EC. Have you got that there in front of you? Sorry, if we can zoom in onto the landslide seepage. All right. So you can see the column "landslide seepage" and you can see there the 1,600?

MR BOLTON: Yes.

MS FOLEY: And then you can see the figure for chloride?

MR BOLTON: The 330, yes.

MS FOLEY: All right. Keep those figures in mind. This is the landslide seepage.

MR BOLTON: Yes.

MS FOLEY: And then I'm going to take you to another

document. This is in Mr Paul's report, DPA.0004.0001.0001. Thank you. And if we can go to PDF page 102. All right. We might need to zoom in table 8.7, and I'm going to take you to the column that says "Upwelling within pothole at junction of Waller Place and Charlesworth Street"; you can see that? And you can see the EC figure of 1,200 and the chloride figure of 250?

MR BOLTON: Yes.

MS FOLEY: All right. So you'd agree that those sets of figures are comparable?

MR BOLTON: They're similar.

MS FOLEY: They're similar.

MR BOLTON: But the data's - that's what I'm considering as after the burst.

MS FOLEY: Understand. Let's just take it in stages. So you agree that the two results, one from the upwelling and one from the seepage out of the escarpment, are broadly similar?

MR BOLTON: Yes.

MS FOLEY: The EC figures?

MR BOLTON: Yes.

MS FOLEY: All right. You'd agree that one way of interpreting that is that it shows that water from the leak could reach the level of salinity in that area that we saw in the Waller Place area?

MR BOLTON: I would have to refer to Chris Jewell. I would rely on him to provide advice on the ability for that water to take on salinity. It's not an area that I can --

MS FOLEY: I'm asking you for your view based on the data that I've presented to you, and you've presented plenty of opinions in your report --

MR BOLTON: Yes.

MS FOLEY: -- based on data that other people have created. So the simple proposition is this: we've got water that comes up, an upwelling of water at Coburn Avenue and Waller Place; correct?

MR BOLTON: Yes.

MS FOLEY: And SMEC had accepted that that was connected to the Bayview Road leak?

MR BOLTON: Yes.

MS FOLEY: And we see some data about the EC figures for that water; correct?

MR BOLTON: Yes, yes.

MS FOLEY: And my proposition which you've agreed with is that that EC data is consistent or broadly similar with the EC data we see coming out of the escarpment; you agree with that?

MR BOLTON: Yes, from a background point of view; yes.

MS FOLEY: And what I'm putting to you as a professional, as a scientist capable of interpreting data, one way of looking at that is that it shows that water from the leak could reach that level of salinity, what we see at Waller Place, in this area in the same way that we see coming out of the escarpment?

MR BOLTON: Yes, but that's assuming that the 1,200 has picked up salts, I guess, along the way, which my understanding was that that was not likely when I was discussing it with Chris Jewell.

MS FOLEY: All right. And --

MR BOLTON: (Indistinct) forms a different view, then I would just have to follow - if he's telling me that it does, well, then that's possible.

MS FOLEY: All right. I have no further questions in relation to the geochemistry. We may have some mop-up questions, but that might be best done after others have had their questions on this topic.

CHAIRPERSON: Yes. Ms Siemensma?

<EXAMINATION BY MS SIEMENSMA:

MS SIEMENSMA: Mr Bolton, I just wanted to clarify one issue. You made a few comments about background tests, background testing. The water sample that was taken from the landslide site on 6 January had an EC of 1,600.

MR BOLTON: Yes.

MS SIEMENSMA: And I think it seems to be uncontentious that that is higher than the typical EC for mains water.

MR BOLTON: Yes.

MS SIEMENSMA: And then on 20 January, after the test, there is some sampling by PSM we see in the factual report of water flowing on the east side of Penny Lane which has an EC of over 1,000.

MR BOLTON: 1,200.

MS SIEMENSMA: I think it's 1,051.

MR BOLTON: The one on Penny Lane was 1,200 EC.

MS SIEMENSMA: And then SMEC, as I understand it, undertook some background testing in May up until July --

MR BOLTON: Just a second. So you said Penny Lane; right?

MS SIEMENSMA: Penny Lane, yes.

MR BOLTON: Penny Lane, yes. That's the 1,200.

MS SIEMENSMA: And then there was some background testing by SMEC in May up until July 2025, and you've said in your report that the shallow perched aquifer at the site and surrounds was between 1,000 and 1,300 EC.

MR BOLTON: Yes, that's right.

MS SIEMENSMA: Can I ask you those background tests were taken, I suppose, in the cooler months in winter and many months after the landslide. Is there anything we can draw from that, the fact that it's cooler and it's months later?

MR BOLTON: Not necessarily. It's just, you know, that was some time after the leak had occurred, like months after the leak had occurred, and water quality had, you know, returned to background levels. And so that sort of value of those ones you said there are indicative of sort of the background water quality.

MS SIEMENSMA: And broadly consistent with the water that was coming out of the escarpment in terms of an EC?

MR BOLTON: So we plotted on the Durov - in terms of an EC, yes, I mean, more or less similar; yes.

MS SIEMENSMA: Mr Vu, I had some questions for you. As I understand it you were taken to your conclusion earlier in paragraph 184. I just wanted to check that I understand. Your sentence that says, "The testing indicates that a plausible model is that water issuing from the pipe burst travelled along the pathway that included seepage through soil, service trenches or both, mixed with shallow subsurface flow or stormwater and accumulated ions along the pathway," and I understood your evidence to be that there was a mixture of mains water but you don't know whether it was burst water or mains water from another source; is that correct?

DR VU: Yeah, at the time we wrote the report we didn't have chance to read other causation reports. So that conclusion was basically - the main water can travel from the burst location along the pathway, can mix with other perched water or some sort of other water have higher concentration of metals and higher conductivity, or it can pick up the ions by absorbing the ions in the soil profile. Yes.

But then recently we have more data presented to us and, like I mentioned previously, earlier, when we assessed the travel of the main water from the leak location to the potholes and then I used chloride - as I mentioned, it's one of the tracers or inert chemical to assess the mixing ratio and work out the volume of the perched water needed to come up with the concentration of the background water. As I mentioned, there was a huge amount of volume of the perched water needed saying from 17 megalitres to, like, 28 megalitres. Then based on that calculation I don't think that would be, like, available to mix with the main water.

MS SIEMENSMA: So, sorry, you're not excluding in that conclusion other sources of mains water? You're just using this --

DR VU: Based on the time when I have data available to me to write the report. But then later on when we saw the other causation report, when we prepare for the hearing I need to reassess the data available to me, then I change my mind. I would say that the only possible source for the perched water likely, highly likely, is from the main water burst.

MS SIEMENSMA: Let me also understand - I'm not sure I followed what you were saying earlier, but with your calculations you were referring I think to 17,000, 17,000 megalitres. I wanted to ask --

DR VU: 17 megalitres.

MS SIEMENSMA: Have you assumed that 40 megalitres of water got to testing location A?

DR VU: I assume for 37 megalitres were leaked.

MS SIEMENSMA: Got to testing location A?

DR VU: No, from the main leak, the burst location then travelled to the pothole, yeah.

MS SIEMENSMA: And how much have you assumed at testing location A? How much mains water?

DR VU: So 70 per cent of 37, then the number will be 17 megalitres.

MS SIEMENSMA: 17 megalitres.

DR VU: Based on 70 per cent travelled to the pothole.

MS SIEMENSMA: Mr Jewell, can I ask you if mains water had travelled from the Bayview burst site in service trenches, wholly or partly, would it have an EC of 1,600?

MR JEWELL: I don't believe that the mains water can acquire very much in the way of dissolved solids by reaction with the granitic backfill material or embedment

material or, you know, with the granitic rock. And therefore if it's going - you know, we've seen that salinities increase as we move down the flow path, although not in a really regular way, but they do increase down the flow path. And the most likely source of that additional salinity or the salt solids is mixing with shallow groundwater or existing groundwater. I can't sort of create that salinity by reaction with the rocks. It's got to be from - hence, you know, it's been demonstrated it's got to be from water.

MS SIEMENSMA: For mains water to travel through the soil to have an EC of 1,600 how much time would it need to be in the soil for?

MR JEWELL: Even at equilibrium it will not gain that much of an increase in salinity simply from reaction with the rocks.

MS SIEMENSMA: No further questions.

CHAIRPERSON: Do you have any further questions, Mr Costello? No? Ms Foley, did you have some mop-up questions?

MS FOLEY: Yes.

MR COSTELLO: Mr Jewell, could I ask that you and Mr Hartley swap back now?

MR JEWELL: Yes, sure.

MR COSTELLO: Thank you.

MR JEWELL: Does that mean that you have concluded with me?

MR COSTELLO: I suspect that it's appropriate for Mr Jewell to now be excused, particularly given he needs to make arrangements.

CHAIRPERSON: Yes. Can I just check no-one else has any questions for Mr Jewell before he heads to the airport? No. Mr Jewell, thank you very much for coming and thank you for staying so late and for changing your flight.

MR JEWELL: That's okay.

<EXAMINATION BY MS FOLEY:

MS FOLEY: I just have a couple of questions for you, Mr Hartley, and it could be depending on the nature of the questions also for Mr Bolton. There's been evidence, quite a lot of evidence, about the volume of water that has been released as a result of the South East Water leak. To give a lay person an idea of how much water that really is a megalitre is a million litres, as we know. One of the ways to measure the size of a dam is its capacity using megalitres; you'd be familiar with that?

MR HARTLEY: I'm afraid not. I'm not a dams engineer. But, yeah, we'll go for it.

MS FOLEY: You can take that from me. The water released by South East Water based on the numbers that we've been talking over the past couple of days could be in the order of two times 20 megalitre dams. So a 20 megalitre dam is a type of dam, and we're talking two of those dams in terms of the sheer volume of water that has been released. Despite that amount of water being released by South East Water, at least until today it's been the opinion of SMEC that the landslide was not caused by the leak, noting there's been further evidence today and some qualifications and some concessions which submissions will be made about in due course.

But what I want to ask you about is the alternative theory that had been advanced, if I can call it that, by SMEC in some of the documents which was that it might have been domestic water usage. Again, noting that some things might have changed today - and tell me if any of this has changed - it has been a position advanced by SMEC that only 2,000 to 2,300 litres of water was needed to cause the slip. You're familiar with that idea and you've been asked some questions about that. If the board finds that 36,000 litres was needed to cause the slip, and there's some evidence about that figure, needless to say the irrigation could not have been that cause; you'd agree with that?

MR HARTLEY: For that volume, yeah.

MS FOLEY: So to look at the alternative theory that SMEC had proposed in its report, and I just want to ask you a

couple of questions about this, if we could go to the SMEC report - the supplementary report, SEW.0001.0002.4187, please, and if we could go to PDF page 64. Thank you. Just above section 10 you can see there - and this, as you'll know, comes at the end of a discussion about irrigation, and in the penultimate paragraph in that section you'll see the last sentence says, "For such water to contribute to the landslides it would need to be within the colluvial layer over the surface of the slope within the site raising the moisture content of this layer, but not infiltrate the underlying material." You can see that?

MR HARTLEY: Yeah.

MS FOLEY: And then it says, "In effect, the likelihood of such activities impacting groundwater levels and influencing the McCrae landslide, albeit on a very localised scale, is considered slightly higher compared to other sources." So there's the way that the opinion has been framed in relation to this other theory.

MR HARTLEY: Yes.

MS FOLEY: All right. Has SMEC done any testing to show that infiltration could have occurred in the way that it's described there; namely, within the colluvial layer, over the surface, but not infiltrating the underlying material?

MR HARTLEY: No.

MS FOLEY: All right. What evidence was relied upon to express that view in this part of the report?

MR HARTLEY: Based on the slope stability analysis of the volume of the material and, yeah, basically understanding, "Okay, if we only need that amount of - that volume of material, what are the other sources of water that could be feasible to actually create that amount of water?"

MS FOLEY: And not going further and saying, "But did that actually happen; is there any evidence that it happened?"

MR HARTLEY: Creating that in real life would be very tricky because obviously the landslides occurred and another landslide on top of that. It is theoretical.

MS FOLEY: All right. And maybe I can just ask the

question directly. Really what you've said there in that couple of sentences that I put to you is it's speculation about a possible alternative?

MR HARTLEY: I think you'd be fair to say that. The thing is is that I was - the flow of water that came through on 6 January - if it's 17,000 litres per day, right, then it's obviously 2,000 litres or so is going to be done in, I don't know, a few minutes or so. But also 33,000 litres - 36,000 litres, I beg your pardon, also is also going to be created, you know, in a couple of days.

My thing or our thing was, okay, so how can one get a situation where a failure occurred, that failure occurs with a finite volume of water where the potential source of the water, let's say for example the Bayview Road leak, has been chuntering along since - well, start August, probably most certainly affecting things since October, and from residents calling up in Waller Place, what's been going on until December, it was that kind of trying to separate what is going on here.

And then if you take the small volume that we've got you can then say, "Okay, there are numerous places where this can take place." You release the skin, as Mr Bolton was suggesting, and then you basically have got this outflowing of water which is basically coming from release of the skin which can possibly be backed up by the fact that on the 6th there was 200 millilitres per second getting out, and then a few days later on the 10th apparently from other sources it's down to 5 litres a minute, I think - no, it wasn't, it was by - it was a smaller amount anyway. So it was a "how on earth did this happen" kind of thing.

MS FOLEY: Would it be right for me to say that instead of coming to this set of issues and asking yourselves as scientists, "All the things that we've seen and all the investigations that we've done what was the most likely cause of this landslide," what you've done is come in and say, "What could it have been other than South East Water's water" and tried to find a set of facts and put them together in a way that could come up with some kind of alternative theory?

MR HARTLEY: No, I think that's a little bit unfair.

MS FOLEY: What facts then do you have to back up this alternative theory?

MR HARTLEY: It's more about the facts that make it difficult to link the Bayview Road leak with the landslide.

MS FOLEY: So does that mean we are in reality in a situation where you don't have a viable alternative theory for what happened? It's one thing to say, "We don't think it was Bayview Road." It's another thing to say, "We've put forward an alternative theory." And what I'm putting to you is that this alternative theory, as you've already accepted --

MR HARTLEY: Yeah.

MS FOLEY: -- is speculation.

MR HARTLEY: Yes, it's speculation based on - well, look, I don't - I'm not going to be cruel to my other colleagues. But, in effect, it is speculation that you've got a lump of water 400 metres away, but you don't have a direct line, but you have geological theory - which is reasonable; I'm not going to go the other way, you have geological theory - and you have a landslide which occurred five days and then another nine days after that. After the repair was done you need to assess how is it happening, and we've tried to do that.

MS FOLEY: And what we've seen - if I can interrupt you there --

MS SIEMENSMA: He's been interrupted, I'm sorry, the last three answers he's tried to give.

MS FOLEY: I'm sorry. We'll let him continue. Go for it.

MR HARTLEY: Sorry, my train of thought. We are being scientific. We are robustly testing the theories. The geochemistry thing really foxed us. We couldn't work out how you can get a flow of water which picks up the chemistry footprint and gets to the place on time. And, you know, this afternoon has been obviously very interesting. I would suggest that mains water also can come from the leak that happened at 5 Prospect Hill and such. But the conclusions from my more experienced colleagues as such would suggest that the mixing of water

is a viable reason for the chemical make-up on the 6th.

MS FOLEY: Yes. And really your opinion about the Bayview Road leak being the cause not being viable had two prongs. One was the speed. You said that it couldn't have got there in time. And what we've heard over the course of today is that the tests you've relied upon to reach that view haven't been provided; you agree with that?

MR HARTLEY: Yeah, they haven't been provided. But God's honest truth they're not, you know, numbers plucked out of the air. It's just a human error.

MS FOLEY: What I put to you is that plank, we don't have the testing before us.

MR HARTLEY: Yeah.

MS FOLEY: All right. And the second plank was the chemistry.

MR HARTLEY: Yes.

MS FOLEY: And you'd agree with me that over the course of today the evidence that we've heard now puts us in a position where the SMEC position, which was, "It couldn't have been our water," is no longer a viable position to take.

MR HARTLEY: Yes, I think that's a - it's - we can still stand by that, but the likelihood is low.

MS FOLEY: All right. No further questions.

CHAIRPERSON: Thanks, Ms Foley.

MS SIEMENSMA: Could I just ask, Madam Chair, if the SMEC report that was provided on 31 July could be tendered?

CHAIRPERSON: I think it has been.

MS SIEMENSMA: I thought it was just the first --

MR COSTELLO: I thought I did it this morning.

CHAIRPERSON: Let me just check the exhibit list. It should be exhibit CA69.

MR COSTELLO: CA69.

MS SIEMENSMA: Thank you.

MR COSTELLO: Ms Siemensma, if that turns out to be incorrect, I'll have it tendered out of session.

CHAIRPERSON: No further questions?

MR COSTELLO: Not from me, thank you.

CHAIRPERSON: No. Thank you to all the experts in the witness box for coming along. And thank you very much for all the work you've done. I know that a considerable amount of work has been done over the course of many months. So thank you very much for all of your effort and for your assistance over the last two days.

Thank you to counsel for a very long day. Thank you to all the solicitors for a very long day and other staff. We'll adjourn until 18 August.

AT 7.00PM THE HEARING WAS ADJOURNED UNTIL MONDAY, 18 AUGUST 2025

G

H

M

1215:19, 1215:25, 1215:27, 1215:32, 1215:36, 1215:41, 1215:43, 1216:1, 1216:3, 1216:11, 1216:23, 1216:25, 1216:27, 1216:29, 1216:35, 1216:40, 1216:43, 1217:6, 1217:8, 1217:10, 1217:13, 1217:17, 1217:19, 1217:21, 1217:23, 1217:27, 1217:29, 1217:32, 1218:20, 1218:24, 1218:26, 1218:30, 1218:36, 1218:38, 1218:41, 1218:44, 1218:46, 1219:4, 1219:6, 1219:10, 1219:13, 1219:15, 1219:18, 1219:21, 1219:23, 1219:27, 1219:38, 1219:43, 1220:5, 1220:10, 1220:16, 1220:20, 1220:28, 1220:36, 1220:38, 1220:42, 1220:44, 1220:47, 1221:3, 1221:6, 1221:24, 1221:26, 1221:28, 1221:32, 1221:34, 1221:40, 1221:42, 1221:45, 1221:47, 1222:4, 1222:11, 1222:14, 1222:16, 1222:20, 1222:24, 1222:26, 1222:28, 1222:30, 1223:2, 1223:11, 1223:13, 1223:18, 1223:21, 1223:25, 1223:35, 1223:38, 1223:40, 1223:42, 1223:44, 1223:47, 1224:2, 1224:8, 1224:10, 1224:13, 1224:15, 1224:18, 1224:22, 1224:26, 1224:32, 1224:37, 1224:39, 1224:44, 1225:3, 1225:6, 1225:8, 1225:12, 1225:19, 1225:23, 1225:25, 1225:29, 1225:32, 1225:37, 1225:39, 1225:43, 1225:45, 1226:5, 1226:8, 1226:17, 1226:20, 1226:22, 1226:24, 1226:26,

1226:30, 1226:32, 1226:34, 1226:36, 1226:39, 1226:41, 1226:46, 1227:4, 1227:6, 1227:13, 1227:15, 1227:20, 1227:23, 1227:26, 1227:29, 1227:31, 1227:33, 1227:36, 1227:38, 1227:40, 1227:42, 1228:2, 1228:4, 1228:6, 1228:8, 1228:15, 1228:17, 1228:19, 1228:21, 1228:23, 1228:25, 1228:28, 1228:31, 1228:41, 1228:43, 1229:5, 1229:7, 1229:14, 1229:16, 1229:23, 1229:31, 1229:37, 1229:39, 1229:44, 1229:46, 1230:7, 1230:9, 1230:23, 1230:27, 1230:34, 1230:37, 1230:40, 1230:42, 1231:1, 1231:3, 1231:7, 1231:12, 1231:16, 1231:18, 1231:20, 1231:24, 1231:28, 1231:33, 1231:35, 1231:47, 1232:2, 1232:9, 1232:14, 1232:18, 1232:22, 1232:30, 1232:33, 1232:40, 1232:43, 1232:46, 1233:1, 1233:3, 1233:6, 1233:10, 1233:18, 1233:21, 1233:23, 1233:25, 1233:27, 1233:29, 1233:31, 1233:38, 1233:40, 1233:43, 1234:7, 1234:9, 1234:13, 1234:18, 1234:30, 1234:34, 1235:1, 1235:15, 1235:20, 1235:26, 1235:31, 1235:34, 1235:36, 1235:39, 1235:43, 1236:2, 1236:6, 1236:11, 1236:14, 1236:17, 1236:21, 1236:33, 1236:37, 1236:47, 1237:2, 1237:8, 1237:10, 1237:16, 1237:19, 1237:22, 1237:35, 1237:41, 1238:5,

1238:8, 1238:10, 1238:15, 1238:18, 1238:25, 1238:32, 1238:34, 1238:37, 1238:39, 1238:42, 1238:45, 1238:47, 1239:2, 1239:5, 1239:9, 1239:12, 1239:15, 1239:26, 1239:35, 1239:40, 1239:42, 1239:44, 1240:1, 1240:3, 1240:10, 1240:14, 1240:17, 1240:21, 1240:26, 1240:30, 1240:32, 1240:37, 1240:44, 1241:1, 1241:3, 1241:8, 1241:14, 1241:16, 1241:22, 1241:24, 1241:35, 1241:39, 1242:1, 1242:4, 1242:9, 1242:12, 1242:20, 1242:26, 1242:33, 1242:45, 1242:47, 1243:2, 1243:4, 1243:11, 1243:13, 1243:16, 1243:18, 1243:26, 1243:36, 1243:39, 1243:43, 1243:45, 1244:5, 1244:13, 1244:15, 1244:22, 1244:26, 1244:28, 1244:31, 1244:33, 1244:40, 1244:47, 1245:13, 1245:18, 1245:24, 1245:26, 1245:29, 1245:37, 1245:42, 1245:45, 1245:47, 1246:8, 1246:13, 1246:15, 1246:21, 1246:23, 1246:28, 1246:34, 1246:37, 1246:42, 1246:44, 1246:47, 1247:3, 1247:9, 1247:11, 1247:15, 1247:17, 1247:24, 1247:30, 1247:35, 1247:37, 1247:41, 1247:47, 1248:13, 1248:17, 1248:30, 1248:32, 1248:35, 1248:41, 1248:43, 1249:1, 1249:3, 1249:9, 1249:13, 1249:19, 1249:22, 1249:26, 1249:28, 1249:37, 1249:39, 1249:47, 1250:2,

1250:4, 1250:7, 1250:10, 1250:13, 1250:17, 1250:19, 1250:22, 1250:35, 1250:37, 1250:41, 1251:4, 1251:8, 1251:17, 1251:34, 1251:36, 1251:43, 1251:47, 1252:3, 1252:7, 1252:15, 1252:19, 1252:21, 1252:23, 1252:35, 1252:38, 1252:40, 1252:42, 1252:44, 1252:47, 1253:4, 1253:12, 1253:15, 1253:18, 1253:20, 1253:26, 1253:42, 1254:2, 1254:4, 1254:7, 1254:9, 1254:14, 1254:17, 1254:21, 1254:44, 1254:46, 1255:3, 1255:7, 1255:9, 1255:13, 1255:15, 1255:18, 1255:21, 1255:29, 1255:35, 1255:38, 1255:45, 1256:1, 1256:7, 1256:10, 1256:13, 1256:17, 1256:19, 1256:24, 1256:42, 1257:5, 1257:7, 1257:10, 1257:23, 1257:40, 1257:42, 1258:6, 1258:8, 1258:10, 1258:13, 1258:15, 1258:24, 1258:26, 1258:28, 1258:30, 1258:32, 1258:34, 1258:37, 1258:39, 1258:41, 1258:43, 1258:45, 1259:4, 1259:14, 1259:16, 1259:39, 1260:3, 1260:11, 1260:16, 1260:24, 1260:26, 1260:31, 1260:40, 1260:43, 1261:4, 1261:8, 1261:20, 1261:29, 1261:37, 1261:39, 1261:46, 1262:4, 1262:12, 1262:22, 1262:27, 1262:37, 1262:46, 1263:4, 1263:8, 1263:14, 1263:28, 1263:44, 1264:9, 1264:11, 1264:13, 1264:29, 1264:33, 1264:40,

1264:42, 1264:44, 1264:47, 1265:2, 1265:4, 1265:11, 1265:13, 1265:21, 1265:23, 1265:35, 1265:37, 1265:40, 1265:42, 1266:1, 1266:5, 1266:8, 1266:10, 1266:15, 1266:17, 1266:20, 1266:22, 1266:36, 1266:39, 1266:44, 1266:46, 1267:3, 1267:8, 1267:10, 1267:18, 1267:26, 1267:30, 1267:33, 1267:37, 1267:44, 1267:46, 1268:2, 1268:4, 1268:9, 1268:11, 1268:15, 1268:20, 1268:23, 1268:27, 1268:31, 1268:46, 1269:2, 1269:4, 1269:7, 1269:11, 1269:16, 1269:18, 1269:22, 1269:29, 1269:33, 1269:36, 1269:38, 1270:3, 1270:7, 1270:13, 1270:17, 1270:21, 1270:23, 1270:25, 1270:33, 1270:35, 1270:39, 1270:41, 1270:46, 1271:1, 1271:6, 1271:10, 1271:12, 1271:23, 1271:25, 1271:28, 1271:31, 1271:33, 1272:24, 1272:32, 1272:39, 1272:44, 1273:3, 1273:15, 1273:20, 1273:26, 1273:34, 1273:39, 1273:46, 1274:6, 1274:12, 1274:21, 1274:37, 1274:42, 1275:1, 1275:8, 1275:16, 1275:23, 1275:29, 1275:34, 1276:3, 1276:9, 1276:24, 1276:35, 1276:40, 1277:5, 1277:18, 1277:28, 1277:34, 1277:40, 1278:1, 1278:10, 1278:15, 1278:25, 1278:33, 1279:2, 1279:10, 1279:15, 1279:21, 1279:27, 1279:37, 1279:41, 1280:8,

P

Q

R

S

T

U