Board of Inquiry into the McCrae landslide

Before: The Chairperson,
Ms Renée Enbom KC

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

Monday, 18 August 2025 at 10.00am

(Day 13)

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

Ms K. Evans KC with Mr C. McDermott 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: Thank you, Madam Chair. I appear this morning with Mr Di Stefano and Ms Kittikhoun.

CHAIRPERSON: Thank you. And I can see we have Ms Foley appearing with?

MS FOLEY: Ms Bateman.

CHAIRPERSON: Bateman.

MS EVANS: I appear with Mr McDermott.

CHAIRPERSON: Thanks, Ms Evans.

MS SIEMENSMA: I continue to appear for South East Water.

CHAIRPERSON: Thank you. Mr Costello.

MR COSTELLO: Madam Chair, expert hot tub on mitigation. Mr Pope and Mr Paul will need to be resworn.

<DARREN ROSS PAUL, AFFIRMED:

<DANE RICHARD POPE, AFFIRMED:

<EXAMINATION BY MR COSTELLO:

MR COSTELLO: Mr Paul and Mr Pope, thank you both for once again coming to give evidence to the board of inquiry. In a moment I'll give you both an opportunity to give an overview of your thoughts and solution in respect of mitigation, but before doing that there's a few preliminary questions I'd like to put to each of you. Perhaps just start with you, Mr Pope; you can answer first and then Mr Paul can answer. You've presented a report, which I will tender - Madam Chair, I propose to tender the reports at the end. I'll tender them with some other material that all needs to be tendered. We've got a list coming. So we can do a bulk tender, if that's convenient.

CHAIRPERSON: Yes.

MR COSTELLO: Mr Pope, you've prepared a report dealing with mitigation. Have you in your report considered mitigation of the land affected by both the 2022 and 2025

landslides?

MR POPE: Yes.

MR COSTELLO: And Mr Paul?

MR PAUL: Probably got to define a few words around mitigation and remediation there, but it deals with both. I deal with both.

MR COSTELLO: All right. I will come to that distinction in a moment. Mr Pope, is the clearing of the site at 3 Penny Lane a prerequisite for mitigation works that you propose?

MR POPE: Technically you can start top down while it's there. It's probably - I guess it's a matter of design whether it's better to get rid of the house now or while you roll - because you can roll out the netting and be protecting downslope while you do it. So, yeah, I think it's just a matter of --

MR COSTELLO: Irrespective of sequence, though, the land will need to be cleared?

MR POPE: Yes, yeah.

MR COSTELLO: Same for you, Mr Paul.

MR PAUL: Yes, cleared initially, yes

MR COSTELLO: Initially. That is before other work is done?

MR PAUL: Yes, yes.

MR COSTELLO: Mr Pope, is your solution developed on the basis that water infiltration is the primary risk to be mitigated?

MR POPE: It's one of, yeah --

MR COSTELLO: You wouldn't describe it as primary?

MR POPE: It's one of the main controls that you have to address, yes.

MR COSTELLO: What were the others that you had in mind?

MR POPE: Just the steep slopes themselves and the relatively unstable colluvial soils that sit on the slopes.

MR COSTELLO: Mr Paul?

MR PAUL: Yeah, so we're trying to mitigate risks associated with further landslide. Control of groundwater is one of the actions we might take to reduce the risk from further landslide, probably the way I would frame it.

MR COSTELLO: All right. Thank you. Mr Pope, is your view that what I might just describe as the landslide area generally, by which I mean top of the slope, 6 and 10-12 View Point Road, and the bottom of the slope, Penny Lane generally and the houses on Point Nepean Road closest to the site - is it your view that that area is capable of continued safe habitation in the future if appropriate mitigation works are undertaken?

MR POPE: Yes, with appropriate engineering controls in there, yes.

MR COSTELLO: Mr Paul?

MR PAUL: Yeah, risk mitigation, yeah.

MR COSTELLO: Dependent on mitigation works occurring?

MR PAUL: That's right, yeah. We use the word "safe", but really what we're trying to do is reduce the risk to a level that is considered tolerable.

MR COSTELLO: Yes. Do you agree with that, Mr Pope?

MR POPE: Yes.

MR COSTELLO: I'll come to each of your proposed solutions soon, but without descending into the detail of them for now, Mr Pope, is it your view that if your solution, if I can call it that, is implemented the risk of a landslide again occurring is significantly minimised?

MR POPE: Yes.

MR COSTELLO: Are you in a position to say whether, for

example, you would expect a rainfall event like has occurred in 2022 to be able to be resisted, if you like, by --

MR POPE: Yeah, I do expect that. So the '22 design was - we literally looked at saturating the near surface soils, like an artificially high water table, and it still withstands that, so, yes.

MR COSTELLO: Is that the same for if, opposed to rain, there was ongoing infiltration of water into the site over an extended period, would you expect your solution to be able to cope with that?

MR POPE: Yes.

MR COSTELLO: All right. Mr Paul, again without descending into detail, if your solution was implemented would you expect the slope to be able to withstand a rainfall event as occurred in 2022?

MR PAUL: You might still get a landslide. So the approach I've taken is protection, not stopping the landslide necessarily happening. It might be a different part of the slope other than where the 2022 slide occurred that could be still vulnerable to rainfall.

MR COSTELLO: I see. But, as we'll come to, you have designed features to try to prevent there being any risk to property or human life?

MR PAUL: Correct, yeah.

MR COSTELLO: Thank you. And what about sustained infiltration of water over a period of time other than by rain? Would you expect your design to be able to cope with that?

MR PAUL: I've got provision there to remove or try to pump groundwater out should it be a sustained increase.

MR COSTELLO: Thank you. Mr Pope, do you agree that there's no single correct answer as to what mitigation works should be undertaken here?

MR POPE: Yes.

MR COSTELLO: Do you agree with that, Mr Paul?

MR PAUL: Yeah, I agree, yeah. Good engineering provide options, and there's a whole bunch of considerations in selecting one option.

MR COSTELLO: Thank you. Mr Pope, in your report you have expressed your report as being in part at least so that there can be a meaningful discussion with other experts?

MR POPE: Yes.

MR COSTELLO: And so does that necessarily mean that this is the start of a process and the solution embodied in your report is not necessarily final?

MR POPE: It's definitely not final, yeah. Yes, that's correct.

MR COSTELLO: Mr Paul, is it the same for you?

MR PAUL: Yeah, it's what we call a concept design, which if it was selected to be advanced you would take it into more detailed design stages.

MR COSTELLO: So it is fair to say that neither of you have undertaken detailed design work?

MR POPE: Yes.

MR COSTELLO: That is part of what would need to occur into the future?

MR POPE: Yep.

MR PAUL: Correct.

MR COSTELLO: Thank you. Now perhaps I'll move to you for this, Mr Paul, since you raised it already. In each of your reports you acknowledge a difference between remediation and mitigation. Could you explain the difference, Mr Paul?

MR PAUL: I use the term "remediation" meaning to return the landscape as far as practical to the condition it was in before the landslide, and we'd use that - say, if there was an insurance claim on it, for example, there might be a

requirement to return it back sort of like for like, and so we tend to use the word "remediation": put it back how it was.

MR COSTELLO: And you've sought to do that by your concept?

MR PAUL: Have sought to do that, yes.

MR COSTELLO: And, Mr Pope, you have assumed in your report that remediation is not necessary; is that correct?

MR POPE: Yeah, yes.

MR COSTELLO: And why have you assumed that?

MR POPE: It's maybe not that it's not necessary. In my - my design is just responding to the land form rather than trying to reinstate the land form. Yep.

MR COSTELLO: Mr Pope, have you proceeded on the assumption that any works will require the consent of the landowners at least of 6 and 10-12 View Point Road?

MR POPE: Yes.

MR COSTELLO: Have you as well, Mr Paul?

MR PAUL: Yeah, they definitely would. It's on private property, all of it, yeah.

MR COSTELLO: Thank you. Now, Mr Paul, you first touched on mitigation and remediation in your causation report, which has previously been tendered to the inquiry, and in that report you identified four options that in some form of combination you thought could be appropriate. The four options, so far as I read your report, was - soil nails and shotcrete was one, rock fill was another, reinstating the slope with a gabion wall was the other, and there's also consideration of the installation of groundwater pumps?

MR PAUL: That's right.

MR COSTELLO: And you've identified those things as being the types of engineering elements that might be suitable for mitigating and reinstating or just mitigating?

MR PAUL: Well, a combination of. So the soil nail option is more of a mitigation; rock fill or rock fill with gabions - the rock fill and gabions are a similar type of solution - is remediation; and groundwater is a mitigation. So it's a combination.

MR COSTELLO: Thank you. And you've considered each of those options in preparing your most recent report?

MR PAUL: Yes.

MR COSTELLO: All right. Let me just go to your most recent report. This is DPA.0005.0001.0001. I'm going to formally tender this report at the end of the hearing, Mr Paul, but, once it's on the screen, this is your remediation and mitigation report?

MR PAUL: That's right.

MR COSTELLO: All right. And that report is true and correct --

MR PAUL: That's correct.

MR COSTELLO: -- so far as you're aware, with no corrections? Thank you. Now, perhaps the easiest way to do this, Mr Paul, is could you just outline what it is that you think ought be done at the site, and then I might ask you some specific questions about it. I can take you to some of the maps if you want, or if you'd like to have one on the screen immediately just say so.

MR PAUL: Maybe we bring up the drawings and I can talk to the drawings.

MR COSTELLO: Okay. Could we go to - I think it starts with 0019.

MR PAUL: Yes, that's fine. We'll start there.

MR COSTELLO: All right. Thank you.

MR PAUL: So the concept with the rock fill very simply is we know we've had soil removed and just travelled down and impacted 3 Penny Lane. The concept is to reinstate that but to reinstate it with materials that don't have the same susceptibility to landslide to the soil that was there, and

that's the simple concept of it. So we use rock fill. We use rock fill because good angular rock fill is interlocking and has good strength, but most importantly it is free draining, so any water that does seep in can seep through that rock fill and out. So this is a solution. It's very commonly used on road fill embankments after landslides take out a road fill embankment because you get the rock fill in there. It's reasonably cost effective. So that's the concept. At the base of the rock fill to just give it some support so we don't have a risk for rocks themselves to move, there's an abutment, a little piled wall down the bottom there. We do have to remove all the debris arising from the landslide and the damaged house at 3 Penny Lane, and then - so that's the rock fill solution.

MR COSTELLO: Can I just ask you a question in connection with the rock fill. So in essence it's a replacement of what was - where soil previously existed and has moved down the slope --

MR PAUL: M'hmm.

MR COSTELLO: -- rather than replacing it with soil, replacing it with rock fill?

MR PAUL: That's right.

MR COSTELLO: How big are these rocks?

MR PAUL: Up to about half a metre, yeah.

MR COSTELLO: And that is reinforced, if that's the right word, with a bored pile wall, and that's a gabion wall?

MR PAUL: No, it's not a gabion wall. These are concrete piers.

MR COSTELLO: Straight in?

MR PAUL: Yeah, that are bored in with a wall, called ground beam, connects the concrete piers together. It's only about 600 mill high, but it's just providing sort of shoring and buttressing to the base of the rock fill.

MR COSTELLO: All right. What are the other elements of your concept?

MR PAUL: With the rock fill what we would seek to do, it put back the land that was lost. So you would get the - the level area up at 10-12 View Point Road would be reinstated with this sort of solution. If we go forward there's a plan - I think it's about the third or fourth along - with the wells. Actually, if we go back to the sections I can talk to it a bit more. Thank you. The bottom left section sort of shows it there. So this is derived from the surveys, before and after the landslides, so we can see what's been removed, and we are replacing it with rock fill.

So the way that rock fill would get in there is we'd have to bring - we've had a contractor look at this. They come in from Nepean Highway and work their way up building the rock fill from the bottom up. So that's why we'd have to remove all the debris at the base, to get access to be able to do that, and place the rock fill from the bottom up, you've got to keep the rock fill wide enough so that we can safely work there to mitigate risk of materials keep coming up. But we don't really need to do anything from the top. Just build it up from the bottom. You would probably use the local granite, the Dromana granite diorite, which can be quarried from the area, so you can try to get it to match in reasonably well, and then over time it will sort of grow over and vegetate. So that's the rock fill.

Down the bottom you can see a two-by-two metre gabion wall. So as part of protecting the houses along Point Nepean Road, we've got the road reserve of Penny Lane, so a barrier. Now, that barrier could take various forms, but the purpose of it is, if you did get a rainfall-induced landslide or you've got another similar landslide to '22, you've got a barrier between where that landslide will come down and the houses, designed to prevent the debris from impacting the house.

MR COSTELLO: Gabion wall are these things that are relatively commonly seen, wire mesh with rocks inside?

MR PAUL: Correct, and, again, you would try to use the local Dromana granite and try to blend it in as best you can.

MR COSTELLO: I see.

MR PAUL: And it can be placed on the road reserve of

3 Penny Lane, so that could be put into public land and can run all the way along Penny Lane as a barrier. Now, it doesn't have to be gabions. There's lots of other forms of rockfall barrier. There are fences, there's concrete walls. But I sort of put gabions there because I thought it blends in nicely and gives good aesthetics. So gabion walls at the bottom. Then if we go forward, another element of the mitigation is the wells. Perhaps go forward a couple on that.

MR COSTELLO: Move to the next page?

MR PAUL: Yeah, just the next page is fine. I think it's the next page or the one after. That one there, that's showing - you know, we've looked at how you would get in there to put the rocks in. So a bit of work done here to work out how you would get a temporary ramp in from the bottom up to be able to place the rock fill. That's what that's showing.

MR COSTELLO: That's what that diagram is, is it?

MR PAUL: Yeah, that's right. That's showing a ramp coming in from Penny Lane. It just gets the machines up there to place the rock fill, which then that ramp is removed after. It's a temporary track to get the rock in, and to get the debris out. You've got to clear out debris if you're going up.

Next one after, I think it's the last one which shows the well locations. Next one. So exactly how we configured them, but up in View Point Road again on the public land a series of well points. So these just are wells that provide access to the shallow aquifer so that water could be removed in the event it needed to be. I looked at options of whether you would - you know, because you can have systems like this that have pumps permanently installed and, you know, once it detects groundwater raising, can turn on. But I don't feel that in this case we would need to get to that level.

These would be wells you put in in case you ever needed them, and you would bring the pumps out to pump it out. I think the frequency we would expect to see elevated groundwater it's not - you know, it's over a period of - a frequency of years or maybe even decades based on historically. So it's just a case if the wells are there,

that if we needed them we can get access straightaway to pump groundwater out should it be elevated.

MR COSTELLO: There's not pumps permanently in the wells?

MR PAUL: No. No. You could if you wanted to, but my view is you wouldn't need to because the pumps would sit there for a decade rusting because we wouldn't operate them frequently enough. It's just put the wells in so you've got access should you need it, then you bring a submersible pump out and pump out if you're required to.

MR COSTELLO: When you say "should you need it", do you mean, for example, in the event of unseasonal rainfall?

MR PAUL: It wouldn't be so much --

MR COSTELLO: What would trigger the need to --

MR PAUL: It - because what you would have is you'd have wells that are already there monitoring the groundwater pressures, and so you would have a threshold that if the groundwater rose or the groundwater pressures increased to a predesigned threshold you would then act. Now, that's looking at not rainfall-induced type landslides, which the rain is just going to fall on the surface. This would be looking at water migrating into the slope, which could be from rainfall from upslope and coming through the natural aquifers or it could be from future pipe leakages. But it's water that comes through the subsurface. It wouldn't do anything for direct rainfall infiltration onto the surface. It's similar to what - you know, similar to the mechanism that we think caused the '25 landslide.

MR COSTELLO: But that's just an extra layer of protection?

MR PAUL: That's right, yeah.

MR COSTELLO: And would allow for extraction of water in a more efficient way?

MR PAUL: Yeah.

MR COSTELLO: This is something similar to the notion that has been talked about at various points about spear pumps having been put in when there was a surplus of water

around. This would provide a mechanism by which water could be extracted efficiently?

MR PAUL: That's right, yeah. It's there. The well doesn't do anything for most of the time, but it's there if you need it.

MR COSTELLO: Could we just go back to page 0019, please. Perhaps if we could just blow up the area close to the green. So on this diagram, Mr Paul, the green is the area where the rock fill will be placed?

MR PAUL: That's right.

MR COSTELLO: And at the bottom you've got the pile wall that you've recommended to be 600 mill high?

MR PAUL: That's right.

MR COSTELLO: And how far into the ground do those piles need to be bored? Do they need to go all the way down into the granite?

MR PAUL: Well, at that point down there there would be granite from very shallow. So, yes, they would go into the granite. How far, look, it's probably something like five or six metres. A detailed design would work that out.

MR COSTELLO: And the arc that you have drawn there for the pile wall, you've considered whether or not that's likely to be structurally sound in the event that there was a slide of rock pile into that wall?

MR PAUL: Yeah, that - arches are stronger, but it's also following the contours that we've got through there to try to get it so it's level. You don't want it to be sort of stepping down the slope.

MR COSTELLO: I'm going to come to some matters of aesthetics towards the end perhaps, but you mentioned the idea that the rock pile would settle down into the ground and then it might be able to be vegetate - vegetation might be able to grow over the top; is that right?

MR PAUL: Yeah, yeah, you can do. Yeah, you can grow vegetation over the top.

MR COSTELLO: Do you have in mind sort of creepers or --

MR PAUL: Yeah, that type of thing. You can even, like, leave parts of the rock fill out and have like a pot, I suppose. But you can put spots within the rock fill or embed spots within the rock fill where you can grow vegetation on it. But they tend to grow over. Once the rock fill - even though it's rock, once it's been there for a while, they do tend to get sort of grasses and things grow over the top of them. You probably wouldn't get trees growing through it, but you could create provision for that if you wanted to.

MR COSTELLO: I wanted to ask about trees because there's been evidence in the course of the hearing about the suction power of trees. I think it was Mr Pope that spoke about it sort of having the power of a vacuum cleaner, some of these gums. There's no provision for trees here. Is that deliberate? Would it be advantageous to have trees to be drawing water out, or do trees present more of a risk than they do a benefit?

MR PAUL: It's advantageous to have trees, and you would promote vegetation other than on the rock fill, where it's difficult for trees to grow, you would certainly encourage vegetation to grow everywhere else. Yeah. The rock fill helps bring the water - because the rock fill's permeable, any water that's sort of seeping into it, any rainfall that goes on goes into the permeable rock fill and comes straight out. That's part of the design.

MR COSTELLO: So the gabion wall then is further down the slope?

MR PAUL: M'hmm.

MR COSTELLO: And you mentioned before that it needn't be that type of wall, and you say that in your report at I think it's 3.2.3, paragraph 31 you say there are other wall types. What other wall types do you have in mind?

MR PAUL: It could be there's - you can get wire type fences that are debris flow fences that are designed to absorb the energy. They're sort of maybe two or three metres high, and they've got stays that tie them back, and they're just designed to take energy of impact. They're wire. You could do concrete walls if you wanted, high

enough to do it. In some places I've seen earth bunds just used as - just an earth bund, but I'm not sure, you might struggle with the room to put it here.

MR COSTELLO: A gabion wall just sits on the ground; it's not piled in?

MR PAUL: Can do. I don't think with - again, more analysis would be needed to - but it's about how much mass has it got to absorb the energy. These things, you don't want them too rigid. They need to absorb the energy, so they've got to deflect a bit when they get impacted. But you run simulations and analysis to check that. But you can pin them down if they need to be pinned down.

MR COSTELLO: So is it fair then to say that one of the reasons that you recommended that was that you thought it would be sufficient to absorb the forces that might come at it, but also you thought it might be a more aesthetic option than some of the other options?

MR PAUL: Yeah, that's right. And constructability is easy with these. So you would prefill the gabions offsite, and then you just come and just plonk them on. So efficient to build.

MR COSTELLO: I just want to ask you one more thing, and then I'm going to go to Mr Pope to have him explain his solution. I might just put the paragraph on the screen. If we could go to 0011 of the report, please, 3.2.2. You do mention in the course of your report, Mr Paul, the possibility of an upgrade of water-bearing services?

MR PAUL: M'hmm, m'hmm.

MR COSTELLO: Which is coming up on the screen now.

MR PAUL: Yep.

MR COSTELLO: Is your screen working in front of you?

MR PAUL: I do have it, yes.

MR COSTELLO: You've noted there that some of the pipes are asbestos cement that were installed in the 1950s and are brittle. Do you have a positive view that those pipes should be replaced, or are you raising it for

consideration?

MR PAUL: Raising it for consideration. We've seen evidence that those pipes have leaked and the relatively high rate or frequency of leaks from those pipes. They are getting - they're aged. So an option could be to upgrade them.

MR COSTELLO: That's the mains water pipes at 29, and then at 30 you mention the sewer pipes?

MR PAUL: M'hmm.

MR COSTELLO: And did you have any particular concern about the sewer pipes and what they are made of?

MR PAUL: It's not so much what the sewer pipes are made of, which is the vitreous clay. It's, as we've heard, that the bedding materials around them are a conduit for ground - or can be a conduit to bring water into the slope. So it might be redoing all those trenches, and what you can do, put in a feature called trench stop. So if water is flowing down through those gravels it meets the impermeable barrier in the trench stop and it kind of forces it up so it doesn't migrate further, and that could be actually something you could retrofit and you wouldn't need to replace necessarily all of the sewers. You could come and put stops in to help control the flow of water along the trenches.

MR COSTELLO: Mr Paul, I'll come back to you, but I'm just going to pass to Mr Pope for now. Mr Pope, I'll bring your report up on the screen. It's MSC.5088.0001.0007. It's dated 11 August 2025. Does that look right to you, Mr Pope?

MR POPE: Yes.

MR COSTELLO: That report is true and correct?

MR POPE: Yes.

MR COSTELLO: Embodies your views on the question of mitigation?

MR POPE: Yes.

MR COSTELLO: Thank you. Now, I mentioned with Mr Paul the four potential engineering solutions that he had identified, being soil nails and shotcrete, rock fill, reinstate the slope and the gabion wall, and putting in groundwater wells. Have you considered each of those potential solutions?

MR POPE: Yes.

MR COSTELLO: And it's fair to say, isn't it, that your report seeks to deal with mitigation but not remediation?

MR POPE: Yeah, I'm not looking to reinstate the land form, that's correct.

MR COSTELLO: Yes. Thank you. And you have proposed two alternate solutions but you've got a preference for one.

MR POPE: Yes.

MR COSTELLO: But perhaps I'll let you explain, and, as with Mr Paul, if you'd like me to go to any part of the report so that those following can better understand --

MR POPE: I think it's probably the easiest way to do it, from figure 2(b) onwards, which is I think page 60, or 0060.

MR COSTELLO: I think that starts at 0058. 0059 is - do you want 2(a)?

MR POPE: 2(b).

MR COSTELLO: I think that's 3(a). If we start at 0059, which should be internal 17.

MR POPE: Yeah, we can start there.

MR COSTELLO: Is that a good starting point?

MR POPE: That will do. But this isn't any different to the 2022 remediation that I put forward.

MR COSTELLO: So in general - I'm going to let you explain, but just to set the scene, if you like, perhaps - well, one of the primary elements of your solution is soil nails?

MR POPE: Yeah, correct.

MR COSTELLO: And you and I have had a dialogue about that I think the very first time you gave evidence in connection with your 2022 mitigation report?

MR POPE: Yes.

MR COSTELLO: And at that hearing block I asked you some questions about reports and solutions proposed then by CivilTest, which envisaged in effect terraced retaining walls.

MR POPE: Yes.

MR COSTELLO: And you I think were opposed to that proposal. You doubted the efficacy of the proposal. At least you thought that soil nails were a better solution?

MR POPE: Yes.

MR COSTELLO: And that was only in respect of the 2022 land area. In respect of the whole of the land area, 2022 and 2025, you now propose the use of soil nails; is that right?

MR POPE: Potentially, yes. You just - it's a very similar system, and, as I said in May, you can - it responds quite well to the land form. So I basically applied the same design to the majority of the gully from the '25 landslide, but in the upper parts of the headscarp that's where the detail's a little bit different. So I'm proposing a shotcrete wall. The shotcrete wall has more nails in behind it as well. You would also sensibly have drainage behind that wall. And the only other addition is allowing for a series of tightly spaced incline drains for the colluvial layer, so where the water was coming out this year, January/February, there's a - at half-metre centres there's a whole bunch of inclined drains, and those drains themselves - Darren and I talk to this later on about maintenance, but there is some redundancy in that spacing, having them at half a metre. So you might not need them that closely - closely spaced, but --

MR COSTELLO: You're talking about the spacing of the drains there?

MR POPE: Yes, yep, yep.

MR COSTELLO: All right. Let me try and break that all down a little bit. So the first --

MR POPE: If we go forward a figure, it might help.

MR COSTELLO: Yes, sure.

MR POPE: Two pages, sorry. Go forward two pages. Yep.

MR COSTELLO: That one?

MR POPE: Yeah.

MR COSTELLO: So let me just see if I properly understand this. The first element is the use of soil nails to in effect pin the hill?

MR POPE: With the mesh, yes. Yeah.

MR COSTELLO: Together with the mesh; that's right?

MR POPE: Yes, correct.

MR COSTELLO: And the combined effect of the soil nails and the mesh is to provide a degree of stability in the slope?

MR POPE: Yes.

MR COSTELLO: And you also propose the use of shotcrete. I wasn't quite sure from your report, is the shotcrete just at the upper part of the slope or is it over the whole of the area?

MR POPE: If you go to the next page - sorry, next one again, the yellow --

MR COSTELLO: Just the yellow?

MR POPE: Yellow, yes.

MR COSTELLO: Thank you. And shotcrete is just a form of concrete that can be exploded onto a wall, in effect?

MR POPE: Sprayed onto the wall. We'd put some mesh in there, and you'd install the nails in rows, and you progressively trim that slope, put a row of nails in, shotcrete, trim the slope, put another row of nails in, shot - you just incrementally move down, install the rows and then install the shotcrete. In the shotcrete you would have some central mesh to make it more - reinforced concrete, basically.

MR COSTELLO: The shotcrete is used in that portion of the slope because you consider that that part of the slope needs a greater degree of reinforcement?

MR POPE: There's very few options there given the proximity to the dwelling, yes. Yep.

MR COSTELLO: The soil nails, are they evenly spaced?

MR POPE: Yes.

MR COSTELLO: And how do they - how do you get them in as a matter of practicality?

MR POPE: So for a site like that the two contractors that I work with, they have portable drilling rigs and they basically set them up. There's a drill rig that they have to literally physically set up there. They don't track it in. They've actually have to bring it in and set it up. It's like a hand drill but it's big. It's big. I don't want to say you lift it. I think they'd have to crane it in. But, yeah.

MR COSTELLO: Crane it in from View Point Road, would they?

MR POPE: Yes, yep.

MR COSTELLO: And then what? There's just people going down the slope on ropes?

MR POPE: Yes.

MR COSTELLO: I see. And are the soil nails then permanently visible?

MR POPE: The heads of them will be, yes. Not so much in the shotcrete but on the - there's photos at the back of

the report from an example in Geelong. But, yeah, they are, the heads are visible.

MR COSTELLO: These soil nails with the mesh are of a kind that you sometimes see on the side of roads?

MR POPE: Yes, correct. Yeah.

MR COSTELLO: Actually perhaps if we go forward about three or four pages. Yes, actually that's fine. So this is an example here, is it?

MR POPE: Yes, correct.

MR COSTELLO: That's the head of the soil nails?

MR POPE: Yes.

MR COSTELLO: And, as you propose, there's a mesh here that's also stabilising that particular slope?

MR POPE: Correct. It's almost - it's a very similar design, with the exception that that brown underlay I don't think we would recommend.

MR COSTELLO: Why's that?

MR POPE: It tends to - it's supposed to help with erosion, which it does, but it also retards growth of plants. So it's a balance of if you have it in there you don't have erosion, but if you - then you stop all the shrubs growing through. So, yeah.

MR COSTELLO: I see. So on your plan, although there are a lot of soil nails pinning the hill, there would be the capacity for plants to grow?

MR POPE: Small shrubs, grasses, yeah. You can't have trees growing through this sort of set-up.

MR COSTELLO: Are these soil nails made of metal, or do they come in carbon fibre these days?

MR POPE: You've got fibreglass options. The complexity of being near the bay that you have to think about is gal steel is not - probably not the best option unless you allow for a lot of loss from proximity to the ocean. So we

have gone with fibreglass there for durability reasons, and the mesh is stainless steel. You can do galvanised bars. So you can do steel bars. You've just got to be really careful with the detailing. Yeah.

MR COSTELLO: You haven't proposed the installation of groundwater wells?

MR POPE: No.

MR COSTELLO: But you have proposed installation of drains?

MR POPE: Drains, yes.

MR COSTELLO: And how do the drains work here?

MR POPE: You literally just incline them at - you --

MR COSTELLO: Down the slope?

MR POPE: Up. So at the - where the groundwater was emanating from the hill you'd basically get the same drill rig and you just drill it at an inclined angle back up or try and match that layer, but it will be gently inclined uphill. So you're drilling them uphill, basically. So the - yep.

MR COSTELLO: How long do the soil nails last?

MR POPE: That's a good question because - like, north of 50 years for the fibreglass. But it could be longer. But no-one's - that I'm aware of is super keen on saying 100 years. We're not too sure. But at least 50, yeah.

MR COSTELLO: You don't seek to reinstate the geometry of the land form. Is that because you think that the slope will be safer by not restoring it to its previous condition?

MR POPE: I'd rather respect what the land form's saying, where it's stable in its own - well, I don't like using that word, but I'd rather respect the land form than try and bring fill in and increase the loads again because as - you know, my view was that it was fill. It doesn't seem sensible to bring fill back in for me. You can do it, but.

MR COSTELLO: I just want to ask you about a couple of concepts that you touch on in your report. If we could go to 0048 of that document, please. Here in the design assumptions you note a couple of things. The first is rebuilding and return of people to 3 Penny Lane will be based on satisfactory future planning and building approval works that must include a landslide risk assessment. Is that a landslide risk assessment that would be conducted at the completion of these mitigation works?

MR POPE: Yeah, you'd have to wait, yes.

MR COSTELLO: I'll come to questions of timing later.

MR POPE: You should wait. I've had experience on State land where the property owner had to wait until the State has finished remediating something down the hill.

MR COSTELLO: Okay. Thank you. And we've discussed 2 already about the land form geometry. 3, you're speaking about minimum FOS of 1.5?

MR POPE: Factor of safety, yes, yep.

MR COSTELLO: And that's the minimum requirement?

MR POPE: That would be the minimum. I have a feeling that the nails and the design to bridge code would have a higher factor of safety, so the most stringent would apply. I think your factor of safety would be north of 1.5.

MR COSTELLO: That's something to be assessed once the detailed design work has been completed?

MR POPE: Yes.

MR COSTELLO: And any design would need to meet at least 1.5; is that the point?

MR POPE: Council has expressed that's their minimum requirements, yeah.

MR COSTELLO: You mention in 5 Australian Standards. Are there any relevant Australian Standards for this type of slope stabilisation?

MR POPE: There's sort of bits and pieces. So the

retaining wall standard excludes landslides. But then the fundamentals of retaining wall design are first principles engineering matters anyway. So parts of the retaining wall standard, and then parts of bridge code especially when you're tensioning nails and bolts, and there would be a little bit of AS3600 for reinforced concrete and stuff like that; yeah.

MR COSTELLO: Before I move to another topic I just want to make sure I properly understand it. Perhaps I'll just ask it to you in an open way. How does your design mitigate groundwater?

MR POPE: So for the '22 area that was - I just fully saturated the surficial soils. So it just was - I just fully loaded it with groundwater and then just set the spacing to respond to that. So it didn't need drains. It's designed to be fully saturated, which on a 40-degree slope sounds a bit wild. So it's a conservative view.

With '25, though, because you have the gully there, that's why I've got the half metre spacing on the incline drains, plus you'd have the ability to do the same with the nail design. So you can model full saturation and change your spacing as you need if - but, yeah, that's definitely a matter of detailed design. But, yep.

MR COSTELLO: I'm going to ask you each to comment on the other's concept in a moment. Before that I just want to deal with one discrete topic which is maintenance. If your works were implemented, Mr Pope, is there ongoing maintenance that's necessary to maintain the integrity of the work?

MR POPE: Yes.

MR COSTELLO: What type of work is required and how often does it need to be undertaken?

MR POPE: I've crudely just said five years. But, realistically, there's a series of things you should do with any sort of engineered system, to be honest, not just these. But basically you would - within two to five years you come back and check the tension in the nails and retension if needed. So that is the contractor would return and check the system.

Probably on that same sort of two to five years you'd be inspecting your drains. Like, you should actually get a plumber to inspect your drains at your house, but not many people do. So that's sort of a period of flushing drains and cleaning your incline drains. And then trimming of vegetation. So gum trees are pretty determined things. So they tend to grow in silly places. So you'd be coming back to prune trees as well.

MR COSTELLO: On a roadside highway side job it's pretty easy to identify responsibility for those types of works. Have you ever been involved in this type of work being conducted on private land?

MR POPE: In this way with three private properties like this, I don't think so, no.

MR COSTELLO: I want to come back to another question about soil nails in a minute but before just to keep the sequence, Mr Paul, if your concept was taken to final design stage and implemented would there necessarily be ongoing maintenance that was required?

MR PAUL: No, there's no ongoing maintenance for the rock fill. There's a structural component down the bottom that occasionally inspect it to make sure it's not cracking or something. But there's no ongoing maintenance. The wells at the top, it would be prudent I think to every now and again just check that they're clear. But that's about it, yeah.

MR COSTELLO: Just to be clear, and I ought to have asked you this before, the positioning of the wells, as you've done it on the map that we had up there, is that on council land?

MR PAUL: Yes, I've put in the road reserve deliberately.

MR COSTELLO: Mr Pope, I just want to ask one further question about soil nails while it's in my mind. I imagine that the efficacy of soil nails must be dependent at least to some extent on the soil type; is that right?

MR POPE: Yes.

MR COSTELLO: And you have given a lot of thought to the soil type here. You're comfortable that the soil type here

is one that will enable soil nails to work in the way that they're required to work to properly pin the hill?

MR POPE: Yes, yep.

MR COSTELLO: Thank you. I think what I might do at this point, Mr Paul, is give you the opportunity to make any comments that you would wish to make about Mr Pope's proposal, and then I'll allow Mr Pope to do the same thing. So let me just structure it a little and then I'll give you free range. You've analysed Mr Pope's proposal?

MR PAUL: I have, yes.

MR COSTELLO: Just as a starting point, whether it's preferred or not, do you consider that Mr Pope's proposal would work to properly stabilise that slope?

MR PAUL: It would work to mitigate the risk, is the words I tend to use, rather than stabilise the slope. It's all about risk mitigation and risk reduction.

MR COSTELLO: So let me put it in a different way then. Are you confident that - no, I'll remove the degree of confidence. Are you of the opinion that Mr Pope's proposal would adequately mitigate the risks here?

MR PAUL: It would mitigate the risk, with the caveat that it needs development still --

MR COSTELLO: Of course.

MR PAUL: -- and the proper risk assessments et cetera. But, as a concept, you could say as a concept it's a valid concept to pursue if that was the way we wanted to go.

MR COSTELLO: I see. So there's nothing that you've seen from the preliminary work that's been done that indicates that this concept would not work?

MR PAUL: No showstoppers, we'll say. Considerations, but no showstoppers I'd say at this point.

MR COSTELLO: Perhaps before I flick back to you for more general comment, Mr Pope, you've examined Mr Paul's proposal?

MR POPE: Yes.

MR COSTELLO: Do you consider that Mr Paul's proposal would adequately mitigate the risk in respect of this slope?

MR POPE: Yes.

MR COSTELLO: Thank you. Mr Paul, why do you prefer your proposal to Mr Pope's?

MR PAUL: So I guess it speaks to my background doing this type of work. One, I think the key considerations is the maintenance requirements going forward. So where I've been involved with, like you mentioned before, landslide risk mitigation works on private property, I find that councils I've worked with do not want that because who enforces the ongoing maintenance of the systems on private property, particularly if the integrity of that system is important for protection of, you know, other houses in this case downslope. So you've got a mitigation on one property which, if that mitigation were to fail, you've got an impact to something off slope.

So there needs to be some method of enforcing the maintenance of it. I've found councils are resistant to that. I have had experience of I think in my career about twice I've seen it done where there's what's called a section 173 agreement which gets entered into between the council and the landowner to, you know, put obligations on maintaining the system. But it's rare and not preferred.

I suppose the other thing I come with the background of doing this type of work in places like national parks where you've got to respect the natural environment, you've got to - you know, we can't put hard mitigation measures in place often. And so I come with the background of trying to get it to blend in a bit. So that's why those sort of - that experience, I guess, has taken me to the option I've put forward as my preferred option.

MR COSTELLO: I want to ask you - I might just go back to Mr Pope's report, which I think is on the screen at the moment. Could we just go to 0063. Thank you. Mr Paul, what's about to come up is one of the diagrams that I've already discussed with Mr Pope which includes in yellow the area of the proposed shotcrete wall. I'm sure it will come

back in a moment. While we're waiting for that to come up, do you have in mind what I'm talking about?

MR PAUL: I've got it.

MR COSTELLO: You've got it there?

MR PAUL: I've got the image here, yes.

MR COSTELLO: There's the yellow portion at the top left-hand side which is the proposed shotcrete wall in Mr Pope's solution. That's obviously a bit of the slope that Mr Pope is quite concerned about, so concerned that he thinks that soil nails and mesh might not be sufficient and shotcrete is required. What is your proposal in respect of that area? Why is it that soil nails, mesh and shotcrete are considered necessary by Mr Pope but not by you?

MR PAUL: That would be full of rock. So you'd have rock fill and the weight of the rock fill buttressing that slope, and that's what's providing the support.

MR COSTELLO: And that's a sufficiently viable solution all the way right up to very close to 6 View Point Road?

MR PAUL: Yeah, tried to match the pre-landslide surface. The rock's slightly proud of the pre-landslide surface and that's because for construction we can't have machines get too close to the escarpment. So we've got the bench width wide enough as you go up. But as far as practical reinstate what the pre-landslide surface was.

MR COSTELLO: Mr Pope, you've had a read of Mr Paul's report which is a fairly different solution to yours?

MR POPE: Yes.

MR COSTELLO: You've acknowledged that you think it could be efficacious. But why do you prefer your proposal?

MR POPE: Principally - like, a lot of it for me comes from a safety and design perspective. The system that I'm proposing, you roll out top down and your crews are protected by that system being rolled out. Bottom up is buildable. But to sit in that gully for an extended period of time is not something, as a designer, I want to do. You can do it, but it's not my preference.

MR COSTELLO: I see. So, just to make sure that we all understand that, a significant factor that's led to your concept has been the safety of implementing the solution?

MR POPE: Yes.

MR COSTELLO: I see. And you view that safety imperative as driving the soil nail solution that you've come up with because that can be done top down rather than bottom up; is that right?

MR POPE: Yes, yes.

MR COSTELLO: And is it the case that Mr Paul's method necessarily has to be bottom up?

MR POPE: I think it does.

MR COSTELLO: I know it's proposed to be, but I just want to --

MR POPE: Yeah, I don't think you can do it top down and make a mess of everything; yep.

MR COSTELLO: Are the risks associated with, in your mind, working bottom up so significant that that really needs to be avoided?

MR POPE: No, I said that with Darren last week. You can do it; you just need the safety systems. You would probably need a grid of tilt sensors. You'd need your trigger action response plans to be set up and the crews trained, which that crew is trained, to evacuate if there was acceleration of - or landslides within their work area, basically; yep.

MR COSTELLO: Mr Paul, do you want to comment on those safety questions?

MR PAUL: Yeah. It's something we deal with with any landslide mitigation is that you're working in an environment where there's been a landslide. Inherently it's a hazardous environment. And so you need to have contractors and personnel who are experienced working in that environment. Yes, you do need to have all the safety protocols in place and you need to work in what's called

safety and design. That's why I mentioned with the system I was talking about keeping the bench width wide enough so you don't have machines right up underneath an escarpment. You've got to factor all those things in. But it's doable. It can be done safely. But, yes, you've got to have the right processes and the right people involved in the work.

MR COSTELLO: And did you turn your mind to those types of questions when developing your solution?

MR PAUL: Yeah, absolutely. So we got a contractor, Whelans, who do this type of landslide mitigation work; very experienced in it. I've had them look at the site and they've confirmed to us that they believe it can be done safely.

MR COSTELLO: Before I move to another topic, Mr Pope, is there anything else that you want to say about Mr Paul's concept, pro or con?

MR POPE: The only other thing we talked about is needing - in dam design it's called a - you have a filter. Like, so underneath the rock fill in a dam - if you ever have rock fill in a dam, but anyway, you need to have a filter underneath it to stop the slope internally eroding. We did talk about it in the joint report. But it is a matter of detailed design, but it would need a drainage blanket underneath it to stop the granitic soils wanting to erode underneath the rock fill.

MR COSTELLO: The mention of erosion reminds me of something else. There's existing retaining walls at 10-12 View Point Road?

MR POPE: Yes.

MR COSTELLO: And they're proposed in your concept to remain where they are; is that correct?

MR POPE: No.

MR COSTELLO: Take them down?

MR POPE: Yeah, they'd be taken down. The reinforced - the concrete and steel post one, yep.

MR COSTELLO: Same for you, Mr Paul?

MR PAUL: Yeah, the damaged wall has to come down, by virtue it's damaged.

MR COSTELLO: But not more? Not more than the damaged wall? There's no further taking of land not currently subject --

MR POPE: Correct. I'll just double check that I haven't drawn it otherwise.

MR COSTELLO: I think there's a reference in your report, Mr Pope - I'll just see if I can pull it up - to care needing to be taken not to undermine the integrity of the wall that will remain.

MR POPE: We've basically gone up near the stonewall but we're not removing it. You would have to assess the integrity of it before you started anything. The stone balustrade rather than the concrete and steel post wall. Yep.

MR COSTELLO: I just want to take you in a minute, Mr Pope, to one of the diagrams in your report to see the extent of the works upslope and where they're proposed to stop.

CHAIRPERSON: While we're waiting for that to come up, Mr Costello, can I ask, Mr Paul, whether you have any comments in relation to the incline drains suggested by Mr Pope?

MR PAUL: Yeah, so passive drains, it's a common means of trying to keep water out of a slope. So you drill them in, and water in the ground is attracted to those drains and comes out. They can work fine. But the thing with them is they've got to be maintained. You've got to come back and take the water out. And that's why I think putting them on private property and having a maintenance requirement for a horizontal drain on private property which would need rope access for someone to come down and clear, would have to be the plan, that's a consideration that would happen.

MR COSTELLO: I'll come back to that in a minute when it's available. Can I ask some questions acknowledging that this necessarily requires a degree of estimation. In terms of the process to get works of the type each of you have

proposed fully designed and then undertaken, what sort of timeline based on your experience would you be looking at from day of deciding to develop something into a final concept through to implementation? Perhaps if I start with you, Mr Pope.

MR POPE: There's big assumptions on everyone's happy to proceed with it, but --

MR COSTELLO: No, assume that you've got to get to that point.

MR POPE: Yeah.

MR COSTELLO: You get to a point where --

MR POPE: And then we're good. 12 months. Within 12 months. That example you put up of Hamilton Highway was done within 12 months, and that was quite difficult access. So, yeah.

MR PAUL: Yeah, we had Whelans do a schedule. They've nominated a nine-month construction period. And then of course, you know, procurement time and design time probably adds another three months on top of that. So, yeah, it would be a similar timeframe, about 12 months.

MR COSTELLO: So, realistically, nine months, does that include developing the design concept fully or is that once it's --

MR PAUL: That's the construction period. So you would need --

MR COSTELLO: So you need a period of discussion leading to an agreement. You need a fully developed plan, and then you need contractors available to commence the work, and from the day that they arrive they're likely to be on site or in control of the site for 12 months; is that about right?

MR PAUL: I'd say you'd have, say - you know, develop a design, it wouldn't take too long to develop a design. This might be a month or so. But then you've got a procurement period to go out to tender. That will probably take a couple of months before you go that. Then the contract's put in place, you know, that could even take six

months. It depends on the efficiency of the process, but let's say that takes three before you're on site.

MR COSTELLO: Now, Mr Paul, you mention that you have had Whelans look at this. Acknowledging that this is not a fully worked up design, they've had a go at estimating the price.

MR PAUL: M'hmm.

MR COSTELLO: And it's come in at about $11 million.

MR PAUL: Yep.

MR COSTELLO: Did that seem about right to you based on your past experience?

MR PAUL: It's a conservative estimate, I would say, which I - you know, I said to them, you know, "Be conservative." It's a conservative estimate. I think there are efficiencies we could build into it through detailed design. For example, they've allowed a lot higher rock volume than I think probably end up needed in their estimate. They've got quite a high contingency in there. And, you know, they're pricing it as one company. So once you optimise the design, once you take it out to a competitive tender process, you know, you'd think it comes down. So I'd treat that as an upper limit.

MR COSTELLO: I see. Contrary to all expectation with getting quotes for construction work, we'll treat that as the upper limit.

MR PAUL: Yeah, these things are not cheap. They're not cheap and things tend to blow out, yeah.

MR COSTELLO: Mr Pope, you haven't had your design costed but let me just ask you and, if you don't have an opinion, you need only say that. But you've seen the estimate in respect of Mr Paul's work. Did that strike you as in the ballpark of what you would expect, not for yours but for his?

MR POPE: For reinstatement I expect it to be a significant amount of money, yeah. So it's not a big surprise. But, what Darren's suggesting, there's probably some fat in it for sure.

MR COSTELLO: Would you expect your work to be cheaper because it doesn't involve reinstatement or is that an unfair assumption?

MR POPE: It will be cheaper. I'm very confident it will be cheaper, yeah.

MR COSTELLO: Is there any rule of thumb about soil nail --

MR POPE: So council had the rates priced last year for the '22 design, and it's roughly $1,300 a square metre. Full caveat on that; who knows if you'll get the same rate again after this year. But at 1,300 a square metre for 1,000 square metres it's 1.3 million for the soil nails and mesh. That was a competitive price, though. So it's significantly cheaper, but you have the maintenance burden. Yep.

MR COSTELLO: Can I ask a question about aesthetics. Now, you're both engineers. Neither of you are landscape architects so I don't expect you to be offering expert opinion on this, but you've both got significant experience in implementing design solutions. This isn't a roadside. It's a residential area in a suburb of a particular nature. Mr Paul, do you consider that your proposal or Mr Pope's have any particular advantage from an aesthetic perspective or ultimately are they both going to green over and be the same?

MR PAUL: The solution I'm proposing uses all natural material, except for the little concrete wall down the bottom, natural materials. And, as I mentioned before, aesthetics are important in a lot of these situations. I talk particularly if I'm in a national park or something it's the number one priority for something in a park. So we try to use the natural stone from the area, and here we can. There's a quarry that you can mine Dromana granite from. And we can use the natural stone to try to blend it in, try to grow it over. So it is important and we can make it try to look as natural as possible.

I suppose the soil nails where you'll have metal plates on the hill, you have a mesh that's visible, they grow over a little bit but it's still visible. The shotcrete is certainly visible. But I think you get better

aesthetics using natural material and natural rock.

MR COSTELLO: All right. Mr Pope, do you agree with that?

MR POPE: Yeah, I tend to agree. It's still a big pile of rocks on a hill, though, or it's a lot of mesh and nails on a hill. Neither are going to look particularly good.

MR COSTELLO: Is that another way of saying that there is no design solution that will sufficiently mitigate the risk but be as aesthetically pleasing as the slope was pre-slide?

MR POPE: I can't see how you get it looking like it did in the '90s with all the trees and that sort of stuff in it.

MR COSTELLO: Thank you. I think we've got documents working again. So could I have, just to close off on that issue, MSC.5088.0001.0007. May I have it at 0064, please. So I just wanted to make sure that the extent of the work upslope, if you like, is sufficiently understood, and I thought this might be the best diagram to use. This is from your report, Mr Pope. Can you see that there's a blue line?

MR POPE: Yes.

MR COSTELLO: That seems to - I don't know if it travels along the same path as the black line or if the black line's stopped. But, in any event, there's a blue line there. Is that, as the box there indicates, the extent of the cutback?

MR POPE: That would be where your crest anchors are placed on top of the mesh, but yes.

MR COSTELLO: Does that mean - you can see there's a tiled area with some raised garden beds?

MR POPE: South of the blue line, like, down the --

MR COSTELLO: Underneath it. Well, the blue line looks like it directly intersects two of the raised garden beds.

MR POPE: Yeah, well, the assumption is the garden beds would be removed.

MR COSTELLO: I just want to understand.

MR POPE: Yeah.

MR COSTELLO: Everything on the slope side of the blue line is to go, is it?

MR POPE: Yes.

MR COSTELLO: And so just to understand how this would work once the works are completed if one was standing at or about where one of those garden beds is - you can see that there's one that's unaffected by the blue line?

MR POPE: Yes.

MR COSTELLO: At the top. If one was standing there where that garden bed is what would you be looking at? Is it a sheer drop or is it --

MR POPE: On that, I think we've got it in the temporary work side of things, the slope angles are different. So where the shotcrete is it's much steeper.

MR COSTELLO: The shotcrete is on the right-hand side of where that garden bed is where you'd be facing?

MR POPE: Correct.

MR COSTELLO: Because it's the highlighted yellow bit on that diagram?

MR POPE: Yeah. So it's probably easier to see on 0041.

MR COSTELLO: 0041. That's actually the one that I was looking for. Thank you.

MR POPE: Yes. So where the garden beds are we would be trying to tie into the terrain that was pre-garden. So 35 degrees with soil nails and mesh. It will behave - that system will behave really well there. So literally you go from a gentle slope to a 35-degree break in slope. But pretty much most of the escarpment is gentle slope to a 40-degree break in slope. So it's pretty similar, yep.

MR COSTELLO: And if we go one page back to 0040 remember

I said earlier that there was a note about being careful not to undermine the footing? That's actually --

MR POPE: That's where it is, yep.

MR COSTELLO: Yes, that's this here. So, that existing masonry garden wall, that stays?

MR POPE: Yes.

MR COSTELLO: But the garden bed, the veggie - the raised garden beds would go?

MR POPE: Yes.

MR COSTELLO: I see. Mr Paul, it might be a little bit difficult to do this by reference to someone else's diagrams but is the position the same for you or similar?

MR PAUL: No, the rock fill fills all that hole in. So where the retaining wall is now, the one that's damaged, we would try to get the level area to be in the same place as it was.

MR COSTELLO: You'd take out what's left of that retaining wall?

MR PAUL: Yeah, you would have to take that retaining wall out. That's damaged now, the integrity of that. That would come out. But you would essentially fill the hole with rock fill and bring it back to where it was.

MR COSTELLO: Bring it back to the slope angle it was pre-slide?

MR PAUL: That's right. So you would still have that - what's the veggie patch now would still be preserved, and you would have level land up there.

MR COSTELLO: Madam Chair, those are the questions that I have for each of the experts, but I think others may have some questions.

CHAIRPERSON: Thank you. Ms Foley.

<EXAMINATION BY MS FOLEY:

MS FOLEY: Mr Paul, I just have a couple of questions for you. As we've already heard this morning, one of the differences that's noted in the joint report between your design and Mr Pope's design is that Mr Pope's design offers mitigation whereas yours offers reinstatement.

MR PAUL: M'hmm.

MS FOLEY: Can I ask you to explain why you decided to adopt a reinstatement design approach rather than a mitigation design approach?

MR PAUL: It's important to note with any engineering design like this we've got to work through options, and no option is necessarily the right option because of course there's lots of considerations. You know, there's cost. There's going to be aesthetics. There's going to be practicalities. There's a whole bunch of things that have to - to go into place. But I went with remediation. I mean, at least within my experience with something like this remediation - particularly if there's insurance coverage, remediation tends to be what we would design for. So I find remediation in something like this, a landslide's happened, is more common. Take a road, for example; a landslide on a road. We've got to remediate and put the road back. So that's the approach I've taken. But I'm not going to say that's the only option. Of course there are other options to be considered.

MS FOLEY: I understand that. So is that really your answer as to why you adopted the reinstatement design approach because that's what you ordinarily would do, not because you think it's necessarily best suited to this circumstance?

MR PAUL: I also think it's better. There are some other things with the soil nails that places - there's the maintenance burden, but there's also some encumbrances which we haven't mentioned. So it's things like if you've got that steep slope there at the top we're going to have to put a balustrade around that for safety. The soil nails penetrate under the site. So if you in the future wanted to put a different building there that required piled foundations you would be encumbered there because you couldn't put the piles down, similar with the soil nails. So there's other considerations there that I felt, for the maintenance and the encumbrances, that trying to avoid that

would be better as well.

MS FOLEY: I completely understand what you say about the soil nail approach, and we've heard that evidence. But just turning again to why in this particular circumstance, given the history of this site, you felt that a reinstatement design approach was the approach to be taken?

MR PAUL: Yeah, yeah. We've got a residential area here. You know, return it back to its original functionality to me seems a better approach.

MS FOLEY: Right. Is that for aesthetic reasons? Is that a driving force in that decision for you?

MR PAUL: Aesthetics is one of, but I think to me the maintenance requirement is probably the main driver of it. I've had experience with councils and this type of thing before, and it really is an issue with how you enforce maintenance on a private property when if this thing fails, you know, there's properties downslope that are at risk. So that's a big one for me.

MS FOLEY: Is it your evidence that there aren't mitigation design approaches that could have been adopted that wouldn't involve ongoing maintenance?

MR PAUL: I can't really - as soon as you go down the track of an engineered solution, which means we're bringing structural elements into the slope like soil nails or whatever, once it's engineered and therefore it's a structure you bring in maintenance requirements. And I can't think of a mitigation that would deal - we can put a barrier at the bottom. That's a mitigation. But, as far as stopping this thing regressing back and undermining number 6 and potentially undermining 10-12, you know, I can't really think of a mitigation solution that doesn't involve a structure.

MS FOLEY: One of the reasons I'm asking you these questions is because, given that the land in its pre-landslide form was susceptible to landslide risk, on one view it might be preferable to focus on mitigation rather than trying to restore the land to what it was. What do you say to that perspective?

MR PAUL: The rock fill also mitigates. I mean, so we've

had this soil we talked about in the previous hearing, that once it got wet it loses strength and it flows. So we're essentially putting back materials that don't do that, interlocking rock fill, which people are familiar with. We use it on coasts to reinforce coasts. We use it on dam facing to reinforce dam facing. And so it also mitigates because it's putting a buttress, a load, against the slope. Importantly, it's free draining so water will come straight through it and out. So it's also mitigating. It's not just a reinstatement option. It's also a mitigation option.

MS FOLEY: All right. I just want to talk you through what might be said to be some risks of trying to reinstate this land. I believe you said in answer to Mr Costello's questions right at the beginning - and I'm summarising here, but you couldn't rule out a future landslide event here?

MR PAUL: M'hmm.

MS FOLEY: You'd agree with that?

MR PAUL: On the escarpment. Once the rock fill goes in, you wouldn't expect one there. But the rest of the escarpment is still untreated and so is vulnerable as it is now.

MS FOLEY: So, in the event of another landslide, is it correct to say that one risk of this reinstatement option is that the rock fill that's been put in might come down?

MR PAUL: It's a consideration, but we can design for that.

MS FOLEY: And you say I think that you've designed for that with the barriers that you're proposing down the bottom?

MR PAUL: Yeah, the barriers and the selection of the rock is very important as well. So the rock - what I've nominated you would use - so the quarry sell rock to a certain specification. VicRoads sets the specification for rock fill on their road embankments. I would suggest using that because that's a commonly available material. It's used on road embankments. It's got a lot of experience on that. But you've got to select the rock fill to be stable.

You've got to place it in a way that makes sure it's interlocked. But it's something we can engineer. If it's engineered appropriately and selected appropriately, we shouldn't get sliding of the rock come down.

MS FOLEY: I understand what you say about that, and of course you design to avoid that eventuality. But would you agree that that's a risk that the design that you've come up with has inherent in it as opposed to Mr Pope's design? And, just to put that more clearly, that in the event of a major landslide in this area with your design that rock fill might come down?

MR PAUL: No, I don't think the rock fill can come down. Again it goes back to properly engineered, proper QA during construction, it's an engineering design. And so I don't think the rock comes down. I would be more concerned you've got the rest of the escarpment untreated. That's what we would be concerned about. But there's lots of experience putting rock fill and buttresses in. This is not an unusual or bespoke solution. This is very commonly used.

MS FOLEY: All right. And the risks that Mr Pope has identified in relation to the construction of your design in contrast to his, you'd accept that there are risks there but you believe they can be addressed?

MR PAUL: Yeah, and when I - developing that solution, that's why I got the contractor involved because it is really, really important that we get someone involved who does this sort of work who can come to site, "Is this safe to build? Can I build this?" And that's why really I got them involved. It wasn't so much to get the job priced. It was to tell me, "Can this be built?" So that's a really important part of it, you know. So that's given me confidence it can be built; we got that professional contractor come and have a look at it.

MS FOLEY: But it's risky work? I mean, you've said that earlier.

MR PAUL: Any landslide mitigation inherently. You're going into a hazardous environment. It's like tunnelling works or anything. Yes, it's a hazardous working environment and you've got to have the appropriate controls; absolutely.

MS FOLEY: Mr Pope, I might turn to you and ask whether you've got any comment to make in relation to what Mr Paul has said, and in particular we might start with Mr Paul's evidence about whether or not there is a risk that this additional material, the rock fill that would be put in place under his design, might come down in the event of another landslide.

MR POPE: For that design it comes down to that bored pile capping beam design, and the detailing at the base, how they cut it into the hill to tie the rock fill into the hill. I mean, you can design bored piers for big loads, but it is a big load. Like, you've got the full height of rock fill acting laterally on that wall. It is arched, so it will be stronger. But there's a fair amount to do in detailed design to get that wall to work and be a no maintenance retaining wall.

MS FOLEY: But do you see there as being a risk?

MR POPE: Design risk I think you can - yeah.

MS FOLEY: In answer to a question that was posed to you by Mr Costello in relation to why you hadn't adopted a remediation approach - or a reinstatement approach, rather - you use the language of that you would rather respect the land form. Can you elaborate on that, please?

MR POPE: My view is that this gully has returned close to its form pre-subdivision. So 100 years ago looking at the old photos of the land form I believe it's failed back to a very similar geometry on the flanks of the gully. Certainly some more has come out of the bottom. But it is telling you how it behaves under load from whether it's fill or windblown soils or whatever. It's saying it's unhappy. So to me as a designer I'm not going to load that hill up again.

MS FOLEY: All right. No further questions. Thank you, Chair.

CHAIRPERSON: Thank you, Ms Foley.

<EXAMINATION BY MS SIEMENSMA:

MS SIEMENSMA: Mr Paul, I had some questions for you. In

your causation report at paragraph 216 you say it may be prudent to upgrade the aging AC pipes in McCrae to reduce the likelihood of future leaks. And then we saw on the screen today a reference in your mitigation report to say AC pipes have seen a higher rate of leakage compared to other areas of McCrae. I wanted to ask you about that. I take it you're not aware of data, say, over the last five years setting out the reason for each water leak in McCrae; is that fair?

MR PAUL: I have seen maintenance records. I don't know I've been given all of the maintenance records, but certainly the maintenance records submitted into evidence I've got.

MS SIEMENSMA: But not going back, say, over five years it sets out the reason why --

MR PAUL: It doesn't go back over five years.

MS SIEMENSMA: Or the reason for each failure?

MR PAUL: No, what I've based that statement of the frequency on is that plan that shows the mapped leaks and with a greater concentration in that area compared to outside of that area or the lands adjacent. So that's the basis of that.

MS SIEMENSMA: And is it fair to say that when you're talking about the higher rate of leakage on that map you've made an assumption that where there are leaks on the map that's because of the composition of the pipe?

MR PAUL: No, I'm just stating there is a higher rate of leakage. But I do know that - and in fact this has been in the public domain, this has been in the news, that replacement of AC water pipes is a - it's a problem for all water authorities, you know. They were put in a long time. They're aging. They're brittle. They crack. And it's an issue that all water authorities are facing.

MS SIEMENSMA: And water pipes leak for many reasons, including for reasons that have nothing to do with their composition; correct?

MR PAUL: There's lots of reasons they can leak, I guess, and you might say that pipes of some composition or more

vulnerable to leakage than others, and age is more vulnerable than others.

MS SIEMENSMA: So Mr Tully, an engineer from South East Water, has given some evidence that pipes leak for reasons that include problems with their installation, movement in soil, temperature, root damage, corrosion, accidental damage, and he says age isn't a determinative factor alone. You don't dispute that evidence?

MR PAUL: Of course pipes can leak for all sorts of reasons, but I would say that a 70-year-old AC pipe versus a five-year-old HDPE pipe would be more vulnerable to leakage. I think that would be a reasonable statement to say.

MS SIEMENSMA: And the pipe that was the subject of the Bayview burst that was a PVC pipe; correct?

MR PAUL: Yes.

MS SIEMENSMA: And sometimes pipes leak because of fittings or joins, not because of the leak itself; you agree with that?

MR PAUL: There's lots of reasons pipes could leak, yes.

MS SIEMENSMA: And, in suggesting that AC mains could be upgraded, have you costed that recommendation?

MR PAUL: No, I haven't costed that.

MS SIEMENSMA: Mr Tully gave some evidence that there are about 19.8 kilometres of AC pipes in McCrae, and to replace water pipes costs between 1,000 it $3,000 a metre.

MR PAUL: Yes.

MS SIEMENSMA: Depending on - well, that's for the 100 to 225mm diameter range, depending on location, construction techniques and so on. So if AC water pipes were replaced in McCrae it would cost in the order of around $60 million.

MR PAUL: M'hmm.

MS SIEMENSMA: Presumably you would also on your reasoning say that AC water pipes in every area where there's a high

landslide susceptibility or an EMO they should also be replaced?

MR PAUL: I'm not saying anything should be. What this is all about is reducing the risk to a tolerable level. What are all the levers we can pull to reduce the risk to a tolerable level? Now, upgrading pipes might be one of them. And it might be, for example, let's say, we had an AC pipe down View Point Road. Well, let's just do that one because that one's really, really close. Let's not do the whole area. Or are we going to try to intercept water in the event of leaks? There's lots of ways to do it. So replacement is a consideration, one of the considerations, to try to reduce the risk.

MS SIEMENSMA: And I take it that you haven't costed this, so you haven't given thought, for instance, in suggesting this - and I don't mean this as a criticism, but you haven't considered, say, the cost to South East Water customers if AC pipes were to be replaced?

MR PAUL: No, I haven't considered any of that. There's an article I saw in the paper which drew my attention which was all about this issue that not just South East Water but all water authorities have with this aging pipes and what do they do about it because, you're right, the cost of trying to replace all this stuff is astronomical.

MS SIEMENSMA: And for the customer as well.

MR PAUL: Of course it would be, yeah.

MS SIEMENSMA: Now, you've also said in paragraph 216 of your causation report it might be prudent to upgrade vitreous clay sewer pipes. Did I understand your evidence earlier to be that you don't actually have an issue with the pipe composition itself, it's really the issue of embedment; is that --

MR PAUL: Yeah, well, the pipes themselves, of course they age as well. You can inspect them for damage. But I think before prioritising the prevention of water flowing along the trenches would be what I would do because that's cheaper, it's a much simpler intervention than trying to replace the pipes themselves.

MS SIEMENSMA: Let me ask you about that issue because in

your report you also refer to trench stoppers in paragraph 216. And you raise the possibility of trench stoppers and say, "These force water flowing along the trench to the surface, where it can be detected and repairs implemented." So as I understand what you're suggesting are trench stoppers to capture a possible future leak?

MR PAUL: Yeah, or not necessarily a leak but water flowing - whether it be from rain or anywhere, water flowing along that granular backfill and that being a conduit to take it to the escarpment.

MS SIEMENSMA: And I suggest that trench stoppers don't completely restrict the flow of water like a concrete wall in a dam. There is a level of permeability but they slow the water down; is that fair?

MR PAUL: Yeah, they slow the water down. They can be quite impermeable. They slow the water down and they force - it's got to go somewhere; right? Like what we saw with the leaks in Charlesworth and all the water coming up through the road. It would do that sort of thing and the idea is, well, we can see it and it's not getting to the escarpment.

MS SIEMENSMA: And you've given evidence in the last hearing block about McCrae being an area with natural springs and that shallow groundwater is naturally present in the area; you recall that?

MR PAUL: Yeah, intermittently I think we need to qualify.

MS SIEMENSMA: And trench stops can capture groundwater as well; do you accept that?

MR PAUL: If there were groundwater flowing down at the trench. But naturally the groundwater flows through the colluvium.

MS SIEMENSMA: But say, for instance, Mr Borghesi gave some evidence about water constantly flowing in View Point Road for a period of many years. If there were water flowing down a trench, a trench stop would also lift that to the surface; you accept that?

MR PAUL: Any water flowing down the trench, yeah. The source of the water is not really relevant. It's if

water's flowing down the trench.

MS SIEMENSMA: And in terms of burst water I suggest that most of the leaks from water mains come up to the surface in any event, which is how they're detected and reported; true?

MR PAUL: Yeah, well, it's the same concept. For the water to come to the surface it must be that that's the path of least resistance. There's something impermeable in the ground, and maybe that's the trench backfill in and around the water main. The water mains don't have the gravel around them like they do in the sewer. So if a water main bursts it might be trying to flow along the trench, and then it's impermeable, or there's a pit or there's something that disrupts it and that forces it to the surface. So, like, the one at 23 Coburn we were looking at, the location where the leak was compared to where it was coming up to the surface, you know, there was distance it had come along the trench and then popped up because something inhibited its flow along trench.

MS SIEMENSMA: Can I suggest that a trench stop for the water main is unnecessary because the water comes to the surface and is detected in any event.

MR PAUL: No, I'm specifically proposing this for the granular backfill in the sewers. That's the flow path of concern because, you know, there's evidence that that was the flow path by which water might have got from the leak to the landslide. So these are for blocking the flow path in the sewers.

MS SIEMENSMA: I understood your evidence in the mitigation report to be referring to trench stops on both sewers and water mains.

MR PAUL: You can do them on both. You can certainly do them on both if we had concern of it flowing along the mains. But I would prioritise the sewers because of the granular backfill in them.

MS SIEMENSMA: I'll come to sewers in just a moment, but just before we leave groundwater it's fair to say that having groundwater come to the surface can be problematic in terms of causing a nuisance to residents, damage to roads, to gardens, soggy soil; do you accept that?

MR PAUL: Groundwater coming to the surface, damage to pavement and wet areas, yeah, that can mean inconvenience, but I'd say not as inconvenient as a landslide.

MS SIEMENSMA: It can lead to damage to roads?

MR PAUL: It can, yeah.

MS SIEMENSMA: And depending on where the water surfaces, depending on the topography of the area where the water surfaces, if, for instance, the land were to run downhill towards the escarpment it might cause the water to run towards the escarpment; do you agree?

MR PAUL: This is the thing with, say, trench stops. We can choose where they go and we can engineer it and put them in a location such that where the water - if water were come to the surface, it's somewhere we can manage it. So that would be part of what you would engineer, and that ideally it would go into the stormwater system if it came to the surface.

MS SIEMENSMA: Ideally. But if there were cracks in the kerb or some other obstruction it may well head towards the escarpment?

MR PAUL: It could, but we can engineer this. We get to choose where they go.

MS SIEMENSMA: You made a comment earlier about it being primarily for the sewer trenches. In the case of sewer mains they're located under the stormwater trenches generally.

MR PAUL: Deeper.

MS SIEMENSMA: So there's no easy path, I suggest, from the sewer trenches back up to flow into stormwater; do you accept that?

MR PAUL: Well, not into the pipe. What I'm suggesting is once it gets to the surface it would flow into a kerb and down into the pit and into the stormwater system, not directly into the stormwater.

MS SIEMENSMA: As I understood your evidence in the last

hearing block you had spoken of potential flow paths for water and you spoke about service trenches, paleochannels, and colluvium, to name a few.

MR PAUL: Yeah.

MS SIEMENSMA: The trench stop is primarily directed to water in the service trenches rather than the overflow paths?

MR PAUL: Exclusively in the service trench, yeah.

MS SIEMENSMA: And I suggest that even if you block that one path the water will just take another path; it will go out via a void or a channel, another path?

MR PAUL: This is where it comes to, this is where the engineering would come into it. You're saying if water is coming down this trench where is the best place to intercept it and where is the best place to direct it. So we have control over this. Because, you're right, all these things are considerations. We don't want to direct the water somewhere we don't want it to be. We want to direct it somewhere better than it being directed towards the landslide. And so proper thought and engineering would have to go into making that intervention at the right place.

MS SIEMENSMA: And is that why you raise the issue of impermeable fill to prevent water?

MR PAUL: Yeah, I've done that before. I've done that behind a landslide escarpment up in Frankston where we used impermeable backfill called Liquifill, a cementitious fill, around it. Same purpose. If there were to be water coming out of that pipe - well, I've tried to not get it out of the pipe. You know, there's impermeable fill around the pipe so if it leaks it stays in the pipe. That's another thing you can do.

MS SIEMENSMA: Even with impermeable backfill, even if one were to imagine that each trench in McCrae is dug and impermeable fill is put around it, I suggest even that's problematic because the fill doesn't remain impermeable forever and because of the need for valves, connections, manholes and other penetrations into the trench; do you agree with that?

MR PAUL: No engineering solution lasts forever. But the product that's used, it's like a grout, so like a flowable concrete material. So it's pretty impermeable. Maybe it cracks, but it's got nowhere near the permeability it would have if not. And, again, yeah, you could be constrained in how you deployed it because there might be manholes and the like that we didn't want to interrupt. But it's a tool at our disposal and it would be, "Is it appropriate in some places to use this?"

MS SIEMENSMA: And, given that the impermeable fill can fail and it can crack, it's the case, isn't it, that water flowing down a trench - assume you've got impermeable fill on the sides of the trench, but water flowing down the trench will look for the weakest point, will look for a fail and head out outside the trench?

MR PAUL: It's true that water will take the path of least resistance. The whole concept, say, with the trench stops is to make that path of least resistance to the surface.

MS SIEMENSMA: And, that being the case, if that is the risk, that water will look for a weak link or a fail in the embedment material, you've got a situation where you might have water travelling down the trench for quite some distance looking for a fail and then popping up many, many metres away from the actual source of the water leak; that's a risk, isn't it?

MR PAUL: If it's a water leak. Remember, I'm just talking generally about water flowing along the sewer trench. The source of that water could be a leak, it could be rain, it could be whatever. We're trying to intervene the flow on the flow path. And so where we intervene that's where we would expect the water to be redirected and we design that intervention.

MS SIEMENSMA: And if, though, the water is travelling down the trench looking for the weakest link it may come out a great distance away from the source of the leak?

MR PAUL: Well, the source of the water. We're sort of going back to leak all the time and I'm sort of making the point that we're just talking generally about water flowing along the trench. It doesn't have to be from a leaky pipe. It could be any source of water flowing along the trench.

We're trying to block the flow path. That's what it is. We're trying to block the flow path of water getting to somewhere we don't want water to be.

MS SIEMENSMA: I understand. But let's assume that it is a leak that you're trying to block. I suggest that that scenario might make leaks harder to defect because the water is popping up potentially some distance away from the source.

MR PAUL: Which it can do now. I mean, which can do now. So take the Bayview Road leak. It sort of popped up on the other side of the freeway. So I don't think there's any change to the existing by putting an intervention in like that. The leak and where you observe the water coming up from the leak can be separated now, and it could be if we did this as well.

MS SIEMENSMA: The other impact of the impermeable fill, I suggest, is that if you have groundwater or if you've got burst water from a private leak it can't make its way into the trench and out to sea; it has to stay in the colluvium and follow channels; do you accept that?

MR PAUL: Well, so if we have a private leak, again water will flow wherever water is going to flow, and that could be into colluvium, and that could be into a trench if there's a trench there. It depends on the specifics of it where it would go.

MS SIEMENSMA: But if the trench is packed with impermeable fill it can't get into the trench; do you agree with that?

MR PAUL: No, well, that's right. If the trench is impermeable that would be a route that would be harder for the water to take, and so it would go somewhere else.

MS SIEMENSMA: Mr Paul, are you familiar with the content of the Water Services Association of Australia Gravity Sewerage Code of Australia?

MR PAUL: No, I'm not, I'm afraid.

MS SIEMENSMA: Have you heard of it?

MR PAUL: I haven't heard of it, no.

MS SIEMENSMA: If I were to tell you then it's a national design on national standard for the design and construction of sewers, and if I ask you for the moment to assume this and then I'll ask you a question. I ask you to assume clause 9.10 of that national code says, "A continuous drainage path through a sewer stop shall be provided where the natural transfer of water from the trench into the surrounding ground will not provide sufficient drainage." So I just ask you to assume that for a moment. My question is this. The standards in those codes might impact on your proposal about trench stops and embedment material; do you accept that?

MR PAUL: I think it's fair to say if there is a code - and without having read the code - if there is a code and that code is, you know, enforceable in this particular application, because I do know sometimes the codes might - you know, they've got flexibility in them. If that code was enforceable then we would have to design within that code, and I suppose that's about all I could say on it.

MS SIEMENSMA: And even if it's not binding it would be a relevant consideration to take into account?

MR PAUL: For any engineering design we have to follow the relevant codes and standards; that's right.

MS SIEMENSMA: You also refer to carrier pipes in your mitigation report. And what you mean by a carrier pipe is effectively putting a sleeve around the pipe; is that true?

MR PAUL: It's a pipe in a pipe, yeah. So we do this in landslides somewhere for a number of reasons. So you've got your water-bearing service, and then you have a larger pipe around it. It does two things. If the ground moves, that pipe inside has more flexibility. But, second, if that pipe leaks it just goes into the pipe around it which then gets picked up in a pit. So it is a pipe in a pipe, is the way to think of it. It is something we do in landslides for water-bearing services.

MS SIEMENSMA: Can I suggest that it would be impracticable to have carrier pipes all over McCrae because essentially you'd have to dig up all of McCrae, and every 20 metres or so there would be a branch off to a sewer or a branch off to another water main. It's not really a

practical solution, I suggest.

MR PAUL: No. And, again, I go back to it's one of the tools in the toolkit. It's one of the things available. So if you had a particularly vulnerable part of the pipe for which we were very concerned because the water from that pipe, you know, might get out, maybe you're just treating that section. I would agree you're not going to go right through the entirety of McCrae. That would be cost prohibitive. But it is something you consider on a localised basis.

MS SIEMENSMA: Now, you are obviously well qualified as an engineering geologist or engineering geology and experienced in the geotechnical field. So I don't dispute that. But am I correct in understanding you haven't been employed by a water corporation before?

MR PAUL: I have, yeah.

MS SIEMENSMA: You have been?

MR PAUL: I've done work for water corporations before.

MS SIEMENSMA: Have you designed water and sewer infrastructure and systems for the water corporations before?

MR PAUL: I contribute to the design. So, for example, a recent example from last year for TasWater in this case where we had a water main that had to go through a landslide. I don't design the pipe, but I sit in the design meetings and provide my input on how that design should be adjusted to deal with the fact there's a landslide there. So I'm not a pipe designer, but I contribute.

MS SIEMENSMA: And primarily through the prism of a geotechnical practitioner rather than, say, a water engineering hydraulic service delivery hat; is that fair?

MR PAUL: Yeah, geotechnical practitioner. And I would say for something like that, a water service in a landslide area, that's a multi-disciplinary approach needed. You bring the relevant experts in to all provide their input to get the right design out.

MS SIEMENSMA: And, just picking up that thought, as I understood your evidence before, you're saying these are options but you haven't reached a positive determination about them?

MR PAUL: No, these are all --

MS SIEMENSMA: You just raise them for discussion?

MR PAUL: -- yeah, options and considerations of things we could think of doing in the area; that's right.

MS SIEMENSMA: And these are things that, for instance, might require further consideration including input from water engineering people from the water corporations?

MR PAUL: Absolutely, yeah, you would bring all the relevant stakeholders together - as we would with any engineering project, all the stakeholders to get the right option come out.

MS SIEMENSMA: Let me ask you: water would also use gas main trenches, water would use stormwater trenches as conduits; you agree with that?

MR PAUL: It depends what they're backfilled with. Water will use the path of least resistance. So if the gas main trench is filled full of gravel, yes, it could use that. But if it's filled full of clay it might not.

MS SIEMENSMA: On your reasoning do I understand that you would also suggest that stormwater trenches in landslide-susceptible areas should also have these measures?

MR PAUL: Potentially if they are a flow path. And, again, it depends what they've been backfilled with, how they've been constructed.

MS SIEMENSMA: Mr Paul, have you read the witness statement of Mr Chris Smith from South East Water?

MR PAUL: There's been hundreds of them. I'll need you to remind me of what it says, thanks.

MS SIEMENSMA: Yes. Mr Smith gave some evidence about South East Water's revised asset management plan that

commenced in April this year and about some documents and plans that flowed from that, including an asset risk management model. And what he said in broad terms is that South East Water undertakes a risk based assessment of its assets, including its pipes, its infrastructure, and as part of that process it then, after making an assessment, considers appropriate risk management controls. And he has gone on in his evidence to say that the process now specifically includes consideration of landslide risk. You'd agree that undertaking that risk assessment and considering risk control measures for the water and sewer assets is a prudent thing to do?

MR PAUL: Very much so, very much so, because it allows you to prioritise. You know, the reality is there's only a certain amount of money available to do this maintenance. Do a risk assessment, focus on the highest risk sites first. It makes perfect sense, yeah.

MS SIEMENSMA: And can I suggest that renewal of water or sewer mains or other control measures is best done in accordance with that approach, that assessment having regard to areas of highest need, assets of highest need, what is critical, what has the most impact, that approach, that framework that Mr Smith discusses is the best model?

MR PAUL: It's a sensible model. It's like triaging at a hospital or something. You know, you treat the highest risk patients first. It's the same type of thing. You treat the highest risk first.

MS SIEMENSMA: There's also been some evidence that you might recall about digital meters and about other risk control measures. There was some evidence about night time flow being enhanced as a result of the landslide, telemetry sensors and the like. Can I ask you if you accept that that will also greatly assist with the identification of leaks in McCrae?

MR PAUL: So you're talking leak detection methods?

MS SIEMENSMA: Yes.

MR PAUL: Yeah, well, absolutely. Leak detection methods would be a sensible thing to do in a landslide area. And not just have a leak detection. It's one thing detecting the leak. You've got to have a plan to - once you've

detected a certain threshold is reached, you've got to plan to fix it.

MS SIEMENSMA: To fix it, yes. And these measures such as the digital meters, the night time flow, the evidence is that that will continue until South East Water is confident that it is an appropriate risk control measure. And I take it you'd say that's also a good thing?

MR PAUL: Absolutely. Again, it's another tool in the toolkit that we can employ in this area to reduce the risk. So, yeah, monitoring and quick action on detecting a leak, of course.

MS SIEMENSMA: Thank you. No further questions.

<EXAMINATION BY MR COSTELLO:

MR COSTELLO: Just a few further questions, if I might. Mr Paul, you were asked a question by Ms Siemensma a short time ago about groundwater making its way to the surface, from a burst this is, and you mentioned that that will depend on the composition of the ground and other factors. I think in the course of your answer you said that most of the water will make its way to the surface; is that your evidence?

MR PAUL: So we're talking about if there was a leaky pipe and that water is flowing down a gravel backfilled sewer and we put a trench stop in, that is designed so that water comes up against that trench stop and comes to the surface. That's something that's engineered. So it's not a case of, you know, most will come. You know, we engineer it to do that.

MR COSTELLO: Yes, I understand. And so that will depend on the particular composition of the flow channel that the water is there taking?

MR PAUL: Yeah.

MR COSTELLO: And, depending on the composition of it, that will affect how much in fact comes to the surface?

MR PAUL: That's right, yeah.

MR COSTELLO: Mr Paul, if this isn't a fair question then

you can say so. It's clear enough from the evidence that you and Mr Pope have given that a significant divergence in the course of your reports is connected with a methodology, that is you dealing with mitigation and remediation and Mr Pope dealing with mitigation alone. If you were engaged to develop a mitigation solution that did not involve remediation, as you sit there now do you know what you would propose?

MR PAUL: I actually think the rock fill as a mitigation is probably the way I'd go anyway, just for those reasons of the maintenance burdens and the enforcement. I've got to think what kind of system can we put in here that mitigates the risk that doesn't mean that - doesn't involve structure and doesn't need maintenance, doesn't need enforcement of maintenance. And the only other things you can start looking at is, you know, offsets, you know, getting rid of houses or, you know, removing the elements at risk from the risk is the only other way I can think to do it.

MR COSTELLO: Mr Pope, if you were engaged to develop a solution that involved adequate mitigation but also remediation, do you know what you would propose? Again, if you don't know because you haven't had sufficient time to think about it then that's a perfectly legitimate answer.

MR POPE: I'm not aware of - yeah, like Darren said, if you're going to no maintenance solutions, it's offsets and acquisitions. I'm not sure. All engineering controls have got some maintenance burden. So, to have no maintenance burden, it's a thing people don't want to hear, which is offsets.

MR COSTELLO: What does offsets mean in this --

MR POPE: Acquisitions and offsets, yeah.

MR COSTELLO: If you were satisfied that it was safe to work from the bottom up rather than the top down would that affect your view as to the most appropriate solution?

MR POPE: I only do bottom up when I've got no other choice. So --

MR COSTELLO: I understand that. But, just for the sake of my question, just assume that you were assured by a

sufficiently qualified person that it's within acceptable risk tolerances to work from bottom up, if you had that assurance, would it affect your view as to the best solution?

MR POPE: No, I think I would go for the more economical option with the maintenance burden. I don't think - you know, yeah, no, I wouldn't change anything.

MR COSTELLO: Save for tender, Madam Chair, I don't have any further questions.

CHAIRPERSON: Thanks, Mr Costello. Mr Pope, I just have one question. Do you agree with Mr Paul that it's appropriate to put wells down View Point Road?

MR POPE: You can do them. I don't think I would. I think I talk about it in my report; like, who's going to own them? And because of the contribution from groundwater, stormwater, leaky services, like, who's actually - is it council's system to run, or if a water main fails is it still council's system to run? I think - trying to put in some semi-permanent, say, council run drainage system, I don't know - I can't see it being effective. I feel like - like, I've gone to half a metre drain spacing because I'm concerned that if you go two metres apart you don't hit groundwater, because the granite's quite channelised. So some of my boreholes hit water, and I went two metres and they didn't hit water. So you can pull the spacing of these wells in. You could do a deep trench. But, again, that's another deep trench in the land form close to the escarpment. Yeah, I wouldn't put it forward, the wells.

CHAIRPERSON: Mr Paul, do you want to respond?

MR PAUL: I'd say it's like putting a fire hydrant in or something. You put it in hoping you never need it. The well is there to provide access. For whatever reason, there was a sustained increase of water, we can come in with a pump and get it out without delay. So that's the way to think of it, you know. Would it be effective? You're never really going to know. But at least you've got something there. We do know there is water there.

As far as responsibility goes, it would be with council. I've positioned them on council land. So council

would have to maintain it. We know enough about what's happening there. We could target the aquifer. We've got the dye test and things. We know where water is coming through. That's where you would put the wells. And it's there in case it ever needs to be used, if needed.

MR POPE: There's some geophysics methods where you can actually put a charge, an electrical charge, in and find where the water is. So if you could be a bit more confident with where it is and then target the wells to where it is rather than just blindly drilling holes then they have some value.

I have put them forward in residential settings, but the property owner didn't want to do it. Essentially you need a monitoring system to tell you that it's high, which would be like the piezometers that we have in the ground. You would have to semi-permanently have them in a monitoring system. They hit a trigger and then you bring the pumps out. I think having pumps that fire, they just fail. Like, my stormwater pump in Torquay failed this year and blows a fuse, sort of thing. So if it blows a fuse during a flood they're no good to you.

CHAIRPERSON: Right. Anything further, Mr Paul?

MR PAUL: What I'm suggesting is not that you leave the pump there. You bring the pump. It's like the fire hydrant. You bring the fire engine to the hydrant. So you bring the pump out if you needed to use it. I agree, if you put something in there - we're talking about frequencies of potentially decades before this might happen again. So you wouldn't want to leave equipment there just to rust. But you've got a hole there you can put something in and pump from if you ever need to.

MR COSTELLO: Could I just ask one further question just to close off on that topic. Mr Pope, as I understand your evidence you have two sort of concerns about the wells idea. One is whether or not they'll be effective at all, and that is capable of being solved to some extent possibly by the type of geophysics that you've just spoken about?

MR POPE: Yeah.

MR COSTELLO: The second is whether or not they will be effective in the sense of who is in control of them?

MR POPE: Yes.

MR COSTELLO: And that part of your conundrum could be solved, for example, if the council was prepared to accept them as being, in effect, council property on council land?

MR POPE: Yes.

MR COSTELLO: If there was an authority with control --

MR POPE: Took ownership of them --

MR COSTELLO: That would go away; yes, thank you.

CHAIRPERSON: Thanks, Mr Costello. Ms Foley, do you have any questions about that issue?

MS FOLEY: No, I don't.

CHAIRPERSON: Mr Paul, Mr Pope, that completes your evidence. Thank you very much for coming along today to provide evidence on this topic, and you're free to take a seat in the gallery.

<THE WITNESSES WITHDREW

MR COSTELLO: Madam Chair, all that remains for me is to tender some documents, including the two reports that had regard to in the course of today's hearing and the conclave report on remediation, which we didn't go to. We have produced it in a list. There's 12 further documents for tender that involve five additional witness statements and then further expert reports that have come in, the three that I've just mentioned plus other reports that have come in subsequently. Can I just hand up a list?

CHAIRPERSON: Yes.

MR COSTELLO: I apologise, I've only got two copies, but these are being emailed to the solicitors for each party as well. Perhaps it's easiest just for those to be accepted as a tender and to be allocated tender numbers.

CHAIRPERSON: Yes, let's do that. So all of those documents, documents numbered 1 through to 12, will be accepted into evidence and exhibit numbers will be

allocated to those documents, and we will publish the exhibit numbers in the next few days. Thank you, Mr Costello.

That brings us to the end of our final hearing. Mr Costello, can I thank you for all of your work in conducting the hearings, and I also thank your juniors, Mr Di Stefano and Ms Kittikhoun, for all of your involvement in the hearings as well.

I thank the solicitors assisting the inquiry for all of their valuable work and for ensuring that the hearings have run smoothly since April.

I thank counsel for the parties with leave and their instructing solicitors. And, finally, can I thank all inquiry staff, especially Ms Moore, and thank Epiq for their assistance during the hearings.

I will now turn to finalising the report, which is due to be delivered by 10 September.

As I said at the beginning of the first hearing in April, the landslides have caused residents significant stress and significant uncertainty, and that stress and uncertainty continues. The residents need answers but they also need action, and they need action as soon as possible.

Many residents attended the last block of hearings a few weeks ago, and you'll see many residents here again today, and that shows you how important this inquiry is to them. The landslides have had a big impact on them. Some people have been out of their homes for far too long, and that can't continue. So, upon publication of my report, I urge relevant parties to take an approach that will see residents get back into their homes quickly.

So I thank the residents for continuing to support the inquiry, for continuing to provide information, and for your patience waiting for the report, which will soon be published. We'll now adjourn.

AT 12.03 PM THE HEARING ADJOURNED ACCORDINGLY

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