SCOTTISH HOSPITALS INQUIRY

Hearings Commencing 19 August 2024

Tuesday, 10 September 2024

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THE CHAIR: Good morning. Now, Mr Connal, we have Mr McLaughlan----

MR CONNAL: Yes.

THE CHAIR: --as our witness this morning.

MR CONNAL: Edward McLaughlan, I think universally referred to as Eddie in any exchanges.

THE CHAIR: Good morning, Mr McLaughlan, and welcome back to the Inquiry because I think you have previously given evidence in 2022.

THE WITNESS: Yes, indeed.

THE CHAIR: Right. I believe you're content to affirm.

THE WITNESS: Yes.

THE CHAIR: Sitting where you are, would you please repeat these, repeat these words after me.

Mr Edward McLaughlan

Affirmed

THE CHAIR: Mr McLaughlan you will be familiar with the procedure. I anticipate your evidence might go through the morning. We plan to take a break at about half past eleven, but if you want to take a break for any reason at all before then, just give me an indication and we'll take a break. Now, Mr Connal.

Questioned by Mr Connal

Q Thank you my Lord. Good morning Mr McLaughlan. I think you've given a witness statement for the purposes of this hearing, and are you content to adopt that statement as your evidence?

A There's one minor change that I would like to make if that's okay. In the attendance at the meeting for the-- about the Horne taps, I think in my statement I say it was Ian Stewart who represented HFS. It was actually Ian Stewart and Ian Storrar.

Q Thank you. Well, that will go into the record, and that's very helpful. Thank you very much, but apart from that you're content to adopt that as your----

A I am, yes.

Q Thank you very much. In fact, I'm obliged to you for coming Mr McLaughlan because you, hopefully, will be able to at least walk us through some of the involvements of HFS in events, particularly given that, for unfortunate reasons, we don't have the assistance of either Mr Storrar or Mr Stewart, who unfortunately is no longer with us. So, I'm conscious that in some places Mr Storrar will have been leading and so on and so forth, but hopefully you can assist us.

Just to kind of set the scene, as I understand your statement, broadly

speaking – and I'm just talking broadly at the moment – areas in which you had some involvement and can help us on are the discussion over the purchasing of Horne taps in 2014, to some extent the issues over ward 4B in 2015, the issues around water in 2018 leading to a report on that topic, and then, again, to some extent cryptococcus questions in 2019.

Just before we go there, I wonder if I can ask you one or two more general questions. Your background is as an engineer, and I'm not going to ask you to go through your qualifications and experience which are set out in your statement. In fact, I think your engineering experience goes back to being in the Merchant Navy. Is that correct?

A Yes, it does.

Q At the time we're talking about here, how many engineers did HFS have available to assist health boards in Scotland?

A For most of that period, there was one engineer, although there was a period where we had duplication as we were changing over staff, and there was a period where we managed to secure the extra resource to keep and-- So, Ian Stewart was in on a temporary basis then Ian Storrar joined us and we managed to keep Ian Stewart on for about a year-- I don't have the dates, but about a year, I think. So, we had two for that period.

Q Yes, so sometimes one, occasionally two.

A Yeah, yeah.

Q Part of the reason for asking you that is that when we go through your witness statement-- I'm not going to ask you to read it all today, because obviously we have that available to us. We find at various points that advice is given on a particular issue, and then the person who asked the question for the purpose of the questionnaire, which led to this statement, says, "So, what did you do to make sure that that was carried out?" and you make the point that you had no remit to do that. Is that correct?

A Yeah. I can give you more of an explanation of the historical context, if that helps.

Q Well, I'm just keen to understand the practicalities of it because, from the perspective of someone outwith the system-- and obviously you're very much somebody who-- until you retired last year----

A Yeah.

Q -- you were within the system for a long time – it might sound a little odd if someone said, "Well, here's a problem. We bring in the-- let's call them an expert from HFS. They come in. They tell us what should be done." But then they just say, "Well, after that, it's nothing to do

with us, it's over to you," and there's no sort of follow-up. Do you agree that sounds a little odd when you look at it from outside?

A If you make the assumption that what's being done is bringing in the experts, when in truth what's happening is the the boards are bringing in peer support, and the peer support, in some cases, is the route to the experts. So, if you look at various documents, you'll find external expertise – microbiological expertise, engineering expertise – brought in. I made the point in my statement for the Lothian part of this inquiry, I didn't make it so formally in this statement, that we are generalists, you know. We can be dealing with dozens of different topics. For genuine expertise, what you want is somebody who spends the majority of the time on a specific topic or part of topic. So, it's not a case of bringing in the experts to tell them what to do. That's never been the case.

In terms of the not having a remit to follow up, that's about not distorting the accountability chain, and that comes from the earliest days of HFS. So, the accountability chain is from the staff of the board through the management of the board to the director general to the cabinet secretary, and boards are invariably allocating scarce resources to priorities, and if they then have somebody who's telling them what to do with the resources, then-- How do you put this gently? It gives them a conflict where the resources are going to somewhere that they might not choose to put them, and I'm aware that anything that's spent on dealing with any of the issues that we're dealing with here is then a resource that's not available elsewhere, and it might not be visible what the consequences of that are.

Q Yes, I can understand that, but I wonder if I could ask you a couple of follow-up questions. In your statement, you've discussed the status of documents such as SHTM 03-01, and we have what you say about that. If you take as the premise of my question an aim to ensure that the guidance contained in SHTM 03-01, just using that as an example, was followed-- Just take that as the premise on which I'm asking the question. Do you think, given your experience-- I'd be interested in your view. Do you think it would be helpful if HFS had had a-- as it were, a compliance function as well as simply an advisory function, to make sure that the object was achieved?

Q So, that has been a topic of discussion over the time I've been involved in the health service. It would be a very different model, and it would have the implications that I'm talking about here of distortion of the decision making

of the boards and the resource allocation of the boards and there would be, then, conflict between, potentially, clinicians who couldn't get the numbers of staff that they needed because the board was saying, "We've been instructed to comply with this guidance." When, really, the purer position-- and I appreciate why you're asking the question. The purer position is that the decision on the allocation of the resources is made by those accountable for distributing those resources, which is the board's accountability chain, and they are then in a position where they have advice and they are accountable for whether they take that advice and how they take that advice and how they apply that advice to their circumstances. The model that you're describing here would really embed that central support function in the decision making of the board, and it probably would entail a different structure in the health service to keep the clarity.

Q Yes, you'll understand why I put the premise to you before I put the questions, because the assumption on which I asked you the questions was that, you know, assuming that it was thought desirable to ensure that a particular guidance document was followed.

A Mm.

Q The question comes to be how do you ensure that and therefore whether an organisation such as HFS was – I know it's called something different now – could have a role to play? So, do you think it could?

A It could, but it wouldn't be as simple as changing the status of HFS and the guidance. It would be a much broader discussion, and it would involve those other things I'm talking about. It would involve the impact on clinical service provision and such like, and it would really be-- it's the kind of discussion that would have to involve government. It wouldn't be a health service discussion. It's a lot more complicated than it sounds.

Q Yes, although if-- I mean, I can understand your answer if you take it in a broad perspective----

A Mm.

Q -- but if you just look at something like guidance on ventilation, and if you assume that a view has been taken that that guidance should be followed, just assume that, then it's difficult to see why there should be any concern about not allocating resources to doing what, on that hypothesis, is the objective.

A Let me present another perspective then. So, the legal framework within which the Health Service Act requires boards to do a number of things-- and when I say the legal framework, I mean the-- I can't remember what it's

called, the Health Service Scotland Act and all the health and safety legislation that pertains to these things, all put responsibilities on the board management chain. So, the responsibilities for being sure that the guidance is followed already lie with the board. What you're talking about is an additional policing function, effectively, over and above that.

Q Yes.

A The policing function, as it exists at the moment, is organisations like Scottish Government, Healthcare Improvement Scotland, Health and Safety Executive. So, they're all already there. They have a part to play in this thing, and I make the point a number of times in my statement that it's for those choosing to do something that's different from the guidance to be able to explain why they made that decision and how they assured appropriate safety.

Q Thank you, Mr McLaughlan. Can I move on to another topic now?

A Mm.

Q We've had quite a lot in this Inquiry already about Horne – Horne with an E – taps, and I think at least in general terms you're familiar that that's, in layman's terms, a mixer tap----

A Yes.

Q -- albeit one of a particular design, and I wonder if I can take you back to a point before the hospital is opened when there's a discussion about what to do about taps in 2014, and I think if we could look at bundle 15, page 692, you indicated in your statement you had some knowledge of this, albeit I see that Mr Storrar is present here.

A Yes.

I think you're probably aware that there was an issue in Northern Ireland over infant deaths that were, at least said to be, attributed to something called flow straighteners on taps. You're going to correct me on that?

A Flow straighteners were part of the issue; they were not the whole issue.

Q And there was at least concern over flow straighteners arising from that incident. Is that correct?

A Yes.

Q And the result of everyone quite properly looking at that issue was that advice was, "Don't install taps with flow straighteners."

A It was more nuanced than that. I can talk to that if you like?

Q Well, according to this document, flow straighteners should not be installed within taps and accommodation occupied by vulnerable immunocompromised patients.

A Yes.

Q Is that fair enough?

A Correct.

Q That's what this note tells us. Can we just go on to the next page? We'll just go through here.

THE CHAIR: Sorry, Mr McLaughlan, did you say the situation was a little bit more nuanced?

A Yes.

Q Did I pick up that word correctly?

A So, yes, the guidance that came out from Chief Medical Officer, then from Health Protection Scotland, then from HFS, was all about the big picture of water systems and flow straighteners and making sure that they were considered appropriately and managed properly and removed where-- I don't remember the exact words, but removed where they could be removed, but a part of that guidance was specifically about vulnerable patients, immunocompromised patients, and I don't remember the detail of the guidance, but they were made a special case of in terms of the risks that they face.

Q Thank you. Sorry Mr Connal.

MR CONNAL: No. I just want to try and take this generally if I can.

A Mm.

Q The particular tap, that Horne, that particular manufacturer, had something that was sometimes call a flow straightener in it. That was a somewhat approximate description, but they had a part of their structure that performed a similar function. Is that correct?

A Yes.

Q Yes, and therefore there was a discussion as to what to do because Horne taps had been-- I think at that time ordered-- ordered and installed, can you remember?

A They'd been, if I remember right, bought but not installed.

Q Bought but not installed? So, Horne came along and explained, as I understand it, you couldn't take the flow straighteners out. It wasn't just a simple question of "Delete that part."

Q Yes.

A That was not something could be done. Is that correct?

Q Yes. So, the question was, “Well, what do what do we do now? Because we've got a tap that has been ordered but appears to contain part of its structure that could cause an issue similar to that identified in Northern Ireland.” So, can you remember how that discussion then proceeded?

A The discussion at the meeting?

Q Yes.

A As you're aware, I wasn't at the meeting----

Q But you----

A -- and I will have some difficulty separating what I knew at the

time from what I know now.

Q Well, just do your best to help us on this.

A So, we were asked by the board to support them in this discussion, and we provided Mr Stewart and Mr Storrar as part of that support, which is appropriate, that's their role. That group that the board brought together. In terms of how decisions should be made from a health and safety perspective on an issue like that, that group's exemplary. It's got a wide range of people with knowledge of the subject together to advise the board on the decision.

Important, I think, to take the hindsight out of this. So, that group at that time would not have been aware that the system was contaminated. They would have been working on the assumption that they were dealing with a brand new water system in perfect conditions.

Q Essentially, that group was discussing the issue which had been highlighted by the Northern Ireland outbreak, which was----

A Yes.

Q -- how do we deal with taps with this type of structure and the----

A So, how the meeting came about was the board was aware that the SHTM guidance had been updated to reflect the Northern Ireland issue. So they were asking the question what the implications of that were for the project that they were currently involved with.

Q Yes. Can we just then carry on to the next page of the note, because there's some discussion about the technicalities of it. So, you've then got a situation, as I understand it, that taps had been ordered, they've got flow straightener in or something equivalent to that, you can't just take them out.

A Yes.

Q So you can't solve it that way, as might have been thought to be helpful. So, where does the discussion end up, as far as you know?

A So, what I can read here-- and it does make the point that the taps are already installed here in paragraph 5.3. The conclusion the group appears to come to here is that the guidance is not retrospective. There's a number of reasons why guidance isn't applied retrospectively, so when it comes out, the ask on the board is to consider the guidance in the light of its circumstances and apply it as appropriate, and that, I think, is what the board is trying to do here. So they have come to the conclusion that the board should treat the guidance as a piece of advice they have received rather than being applicable to their project.

Q So, I understand your point about retrospectivity, if I can get my

tongue around that. You thought they'd been ordered but not installed. There's some reference to them being installed in these minutes, but you have got a tap structure that has been identified as potentially causing a health risk?

A Potentially, but that's true of lots of bits of water systems. So, we've subsequently found out that there was lots of flexible hoses, for example, wrong kind of pressure vessels, lots of things in the water system that are a risk, and the objective with the water system is to manage that risk. So, the bit that's missing here-- It's unfortunate that the notes are as detailed as you would hope retrospectively going back and looking at them.

Q Yes.

A That's a function of how we were told by our employers to record meetings, unfortunately, but there will have been discussions about the broader implications of it and the pieces of guidance don't cease to exist because there's a discussion here. So that's----

Q But am I right in understanding the guidance – and it was just guidance – to not use these taps in areas where there were vulnerable patients----

A Yes.

Q -- just to use that as a general term, that didn't change, did it?

A No.

Q And the issue of possible biofilm creation causing an issue, that was still a live issue at that time. No one had suggested that was wrong or that the Northern Ireland outbreak was a bad sign.

A No, we did-- I don't know if it was at this point or when the board realised that they had issues with their water systems. I think it was the latter. We did a check with all other boards that have these taps installed and none reported problems with them. So, it may be that the problem's not inherently with the tap. It's with connecting the tap to an already contaminated system.

Q Yes. If at that time-- and we are going back sometime. At that time you've had an incident in which flow straighteners have at least been said to be part of the issue and children died. Advice is don't install them in areas with immunocompromised patients. Now, if you're going to keep the taps, which essentially seems to have been the conclusion, there's a reference in 5.3 to "Risks being managed as part of the routine management process."

A Mm.

Q Would that be something that you would have regarded as essential?

Q So, I wouldn't put myself in a position of judging the competence of that group of people, most of whom I know

and all of whom I have are-- all of the ones I know, I have a lot of respect for, so they will have taken this issue very seriously and they will have considered all the implications given the information that they had at that time. So, I'm not going to sit here and say that we're all wrong.

With hindsight, there are implications that the tap may have been a contributory to the problems because, at the point I left, there was no hard evidence. Nobody was saying the taps are definitely the issue, and there was definitely evidence that other parts of the system were the issue but, all of that said, there are particular requirements for patients who are susceptible to microorganisms that the general public is not susceptible to. When we get to the ventilation stuff, we'll talk about the particular requirements that are applicable there, but that applies to water systems as well. The patient has to be presented with an environment that their immune system's capable of coping with.

Q Yes, as you can probably appreciate, Mr McLaughlan, a variety of views have been expressed about what was done at that time. If I can focus it at one end of the spectrum, one view might be, "Well, this is the board deciding that, rather than spend the money on putting in different taps, they'll save the money by managing the issue in some other way, having had the issue identified." Would you regard that as a fair depiction or not?

A So, the "save money"-- It's emotive language. I prefer the description, "Spend the money here rather than there," because the board has to make decisions all the time on where it puts its resources. I don't think the board was cutting any corners here. That group of people-- there's some industry heavyweights in there, there's some people that really know things about water systems, and as far as this minute indicates, they're in agreement about the approach that's taken. I think the concern – and, again, it goes beyond these minutes – is that the board then didn't do some of the things that they would be expected to do in managing that water system and managing the environment the patients were exposed to.

Q Well, I tried to ask you that earlier and I didn't get the question right, which is my fault. I think what I had taken-- and maybe I'm applying hindsight as well, but what I had taken from the decision that was recorded there was, "Okay, problem identified, guidance isn't retrospective, what we'll do is we'll carry on with these taps, but any issues that might arise of the type that we've been discussing at these meetings-- we will deal with that by managing the taps in

some way," and we've heard from other witnesses, for instance, about thermal disinfectant routines and so on. That would be, would it not, an essential part of the decision-making process? If you're going to keep them, you have to manage them properly.

A Absolutely, absolutely, and water systems have to be managed all the time. It's very-- Water systems are very-- you've probably got this by now, very complex and require very serious consideration, very diligent management, otherwise you start to build up risks. Now, the fact that some of the risks were built up by the time this system was put into use is relevant here. There's a distinction-- and the minute doesn't pull it out. There's a distinction between what it might be sensible to do in the water system in general, and what it might be appropriate to do where you have a vulnerable patient group, and of course, because the guidance is not retrospective, that doesn't mean that the guidance is not available to the board in making its decision. So, the board must still be able to show that it considered the guidance and it made an appropriate decision at that time.

You know, what that implies for immunocompromised patients is probably-- that's the issue we're really talking about here, the general population. It's probably not that-- It is a big issue because biofilm on taps is a big issue, but it's----

Q Sorry, I didn't quite catch that last bit. You said something about taps being a big issue?

A Yes, biofilm anywhere in the water system is a big issue and has to be dealt with, and that's why the board went to the extent of putting in chlorine dioxide treatment----

Q Yes, which is at a much later stage.

A Yes, and that's separate from what you do for an immunocompromised patient because they are potentially susceptible to organisms that the rest of us are not.

Q Yes, and it was biofilm that was identified as the potential issue in relation to the flow straighteners in these taps, according to the discussion?

A Yes, so the risk to the patient is the microorganism, the biofilm just makes it difficult to eradicate the microorganism.

Q Thank you very much. I'll move on to another topic now, if I may. I'll try and now work back through the order of your statement, but I won't ask you to go and read all of it, but the next area in chronological order that you had at least some involvement with was the ward 4B saga that this Inquiry has heard

quite a lot about, a situation where there was an adult bone marrow transplant unit, which was coming from the Beatson and moving into the new hospital, and I think your organisation was called in to assist at a time when an issue had arisen. Is that correct?

A Mm, yes.

Q I wonder if we could have a look at bundle 12, 744, please. Now, I think we need to scroll down to get the sequence here that-- Sorry, 745. We see there an email dated December 2015 from Shona Frew to you, which appears to follow up a meeting you'd had with Peter Moir, and you were asked to look at some-- you being HFS, asked to look at some "as-built ventilation drawings." That suggests there was some kind of a meeting with Peter Moir and yourself before that email was sent. Do you have any recollection of that?

A I've racked my brain on that one. I don't remember specifically meeting Peter on that subject. I've dealt with Peter a number of times over the years, and I wonder if it was a side issue from a separate meeting on the theatre block, but I don't know for sure. I do recognise the emails, and I do recognise being asked to help on that one.

Q Yes, and in broad terms, what-- presumably you were given some kind of indication of, at least roughly, what the issue was.

A Yes, so, what we knew at that time was that a decision had been made – I don't know how or why or by whom – to move the adult bone marrow transplant into the Queen Elizabeth building. We subsequently found out that was because of the ITU coverage they didn't have in their old building, and we were aware at that time that there were modifications required to the ventilation system to provide the kind of ventilation system that's appropriate to that patient group.

Q The Inquiry is aware that the decision that the new hospital should have the adult bone marrow transplant unit was not a decision taken in 2009 or 2010, or even shortly thereafter when the general hospital was planned. It was taken at a later date. Were you given any information as to when or how that was done? Can you remember?

A It's not even really a thing that we would expect to be told. We tend to focus on the issue that's in front of us, so it would have been casual conversation if we were told at all, and I don't have any memory of that. So, the focus would be on, "How do we make this environment appropriate for the patient?"

Q Because the kind of broad narrative that the Inquiry's been hearing about is essentially one where the adult bone marrow transplant team moves

across as part of the normal migration in 2015, and then concerns are raised about the-- shall we say the quality of the environment, just to keep it neutral, and ultimately, those concerns are so significant that the troops all go back to the Beatson, which must have been quite a dramatic event at the time. Do you remember being told about that?

A Again, it wouldn't have come up in the discussion at that time, but subsequently, it's become clear that the unit was designed as a general ward, and they tried-- I don't know how or why, tried to move bone marrow transplant patients into a unit that was designed as a general ward, which is not appropriate, not safe.

Q I'm asking that question simply to see if you can help us at all on it, because obviously, as you just said, putting bone marrow transplant patients, which, we've heard from other witnesses, are probably some of the most vulnerable to certain issues, into a ward designed as a general ward is not safe, and you weren't given to understand how that had happened?

A So, I can't tell you anything about Glasgow's decision-making process, but I can tell you that there's a comprehensive description in the guidance and specifically in SHTM 00 of how you should make sure that you have identified your needs and communicated your needs to the people who are going to build the place for you and how you make sure that they actually deliver what they should have done. So, the expectation of what should have been done there is, I think, pretty clear why it wasn't done. I don't know.

Q You don't?

A No.

Q Just so we can catch up with where we are in your statement, can we just go to page 9 of your witness statement? Hopefully, we'll get the page numbers right.

A Yeah.

Q We see there that, in question 10 and the answer to that, that it's essentially the answer you've just given us, that:

> "The ward was not intended to house a specialised service such as bone marrow transplant and, as such, the existing ventilation would not be suitable."

In fact, you said, "would not be safe," and I think you go on to say that you asked one of your team to help: a Colin Clarke.

A Yes, that was an unusual situation because Colin still isn't part of the engineering team. I don't know why we didn't have any engineering resource available at that time. I don't know what

was on at that time, but we were stretched all the time; for my entire time in the health service, we were stretched for resource. In the discussion, Colin, who is a chartered engineer, electrical chartered engineer, volunteered to take that piece of work on and he's perfectly competent to do it, so that's how he ended up involved.

Q Were you given any information, for instance, about air change rates, which might have been thought to be an important feature at this stage?

A Yes, we were given the drawings. So we were given the as-built drawings, which turned out not to be what was built, but that was a theme right through the hospital, and then Colin stayed involved with the board while a design was created. Now, I will have discussed the piece of work as it was going on with Colin. We did speak on a very regular basis, but I don't think I got any detail on the design as it started out or the design as it finished up, other than there are specific requirements for housing immunocompromised patients and it requires higher change rates, good filtration and a pressure cascade, none of which were in the original build.

Q Can I ask you just to go back to an answer you gave at the start of that statement, if you wouldn't mind, just so we're clear about it. Your colleague was given the as-built drawings, and then you said that it turned out these were not drawings which actually showed what had been built, and you said that was a feature that applied elsewhere. Can you just help us to understand that so his Lordship is clear?

A So, most of what I'm about to say comes from the work we did on water because we did much more work on water than we did on ventilation, but there's-- and this is not legal advice, this is my interpretation. There's a legal obligation on the people designing and building a system to provide the users with comprehensive as-built drawings that reflect what was actually built and operating instructions and safety instructions.

When we went looking for that information for the water, we found that there were significant gaps in the information available. Now, I'm very cautious here because the information that we saw-- When I say we, I mean Ian Storrar. The information that we saw was the information that the board was able to make available to us, not necessarily all the information that was available, but it looked like the handover documentation that's required in the construction design and management regulations wasn't provided the way it's supposed to be

provided.

Q Just going back to Ward 4B – and if you can't remember, just please say so – did the-- sorry, how did it come to light that the as-built drawings weren't showing what was built?

A I probably shouldn't go beyond that. That was a brief discussion. I'm not even sure we have any documentation to that effect. It's not uncommon, I have to say, in construction projects to go in and find that what's handed over as an as-built drawing is what was designed originally rather than what was installed, because there's often changes on site as a system is built. So, is it likely to be significant in terms of the function of the unit? Probably not. It's just more significant in terms of the board having accurate records of what was given.

Q Now, just so I understand the remainder of the evidence you're able to give, on page 12 of your statement you give an answer, to some extent which you've touched on already today, which is you weren't closely involved with the specification and what was ultimately done on 4B. But you appear to indicate in the answer to question 20 there that you're at least aware of some of the challenges that were faced in trying to achieve what guidance might have suggested should have been available. Is that correct?

A So, the space available in the building, in any building when it's built, is the minimum space that the building can be built to because buildings are expensive, and the more space you provide, the more it costs and the less money you have to put in other parts of the service. So it's natural to design buildings without excess space, and if you have to boost your ventilation requirements by something of the order of 100 per cent, that involves doubling the size of all your plant and ventilation duct work, and that space was unlikely to be available.

Q So, the challenge faced by those dealing with this issue at the time was that there wasn't really the space to put in what, in theory, should have been desirable. Is that right?

A Yes, it is.

Q And it wasn't your-- or HFS's role to work out what the answer was, that was for somebody else. Is that----?

A Yes, we're not designers, so we weren't involved in the design. What we were involved with was the decision making and the application of the guidance.

Q Right. Thank you. Well, I think I'll leave Ward 4B, and we'll come back to the topic that you – and I'm sorry, if I say you, I don't always mean you personally, but you being HFS – had

involvement in, which is water, and in the way that these things tend to do in statements that we've gone back to taps again on the next page. So, could I look, please, at bundle 12, page 922? And I'll preface my question by saying this, Mr McLaughlan. I'm aware that there were lots of issues over water and, to some extent, we're picking on individual items, but I'm going to come to the water technical review report later to pull them together.

So, here we have Mary Anne Kane writing to you and copying various others, particularly on the Estates side, in. Did you understand that there was a-- the question of Horne taps had come back up again onto the agenda?

A Yes, but I'm slightly vague on the circumstances. So, this meeting came from another meeting, probably the water technical group, and a decision was made-- About this time, the board was engaged in removing and disinfecting these taps and replacing them, and there was discussion about the nature of the taps and, as part of, I think, a bigger meeting, there was a decision taken to bring in Horne and get them to explain what the taps were supposed to be doing again and to bring in this additional support. I don't know who EI is, but Dennis Kelly and Tom Makin are the authorising engineer and the

microbiologist you've already spoken to.

Q So, the idea at this time is is that you've heard from Horne in 2014 when there was a decision about keeping the taps, “Let's get them back in and see what they can add to the discussion.” Is that right?

A So----

Q And you say it'd be helpful to have actual taps so we can look at what actual biofouling is taking place.

A Yes.

Q And do you remember what happened then? Was there a meeting immediately after that?

A There was.

Q Horne, I think, had a view about what their tap could achieve, whether it was subject to biofouling or prevented biofouling, and I think you've been asked about that. Can we just look at page 15 of your witness statement? Because you quite correctly point out at various stages of your witness statement that a lot of the material is pulled together in the report, which we'll look at shortly. You record, at the foot of page 15, the evidence you gave us earlier about checking with other boards to see if they'd had problems with Horne taps.

Just for those of us who are not carrying schematics of Horne taps around in our heads all the time, in the answer to 26, you say the design of the tap was

"slightly unusual." You just see that in the middle of page-- answer to 26, "design of the tap was slightly unusual." Can you just help us understand the point that you're making there?

A So, that's this idea that you retain the water within the body of the tap. So, Horne's explanation of that was, going back in the history of water systems, somebody had an idea that if you drained down shower hoses, you could reduce the risk of colonisation and potentially infecting patients, and it was found out that didn't work. So, they drained down the shower hoses; that left a warm wet environment that bacteria could grow in. Horne's view was that in this tap, if you retain the water within the body of the tap, it reduced the surface area exposed to air to an absolute minimum, which should reduce the potential for colonisation from the tap side to the body of the tap. Of course, it doesn't stop contamination from the system side, but that model, as far as I can detect, was theoretical. That was Horne's own logic said that. They didn't provide any evidence that the tap had been tested to deliver that performance.

Q Just so that the lay people here are understanding you, am I correct to understand that the point you're making is if you have a space which has been wet which is a confined space, it's wrong to think that just because the water isn't there it's safe, because a confined, possibly warm, space may in fact grow, you know, microorganisms.

A Yes, more than that. So, we could get very detailed here. Thermostatic mixing taps are more complex than ordinary taps in their design, and what we subsequently found out was the flow straightener, the outlet fitting as Horne would call it, was not the only organic component in that tap. There were other plastic components further back in the tap body. So, there's possibilities beyond the flow straightener for organisms that like organic materials to be able to grow. Whether retaining the water in the tap helps or hinders that, I don't have a view, but the principle of thermostatic mixing taps – I think I've said this in my statement – was to eliminate the dead leg. We used to-- water is supplied at hot at 60 degrees and cold under 20 degrees, and if you want to get it to a patient at 41 degrees, you have to mix it. We used to mix that in a valve further back in the system, usually a foot or two behind the panel in the wall, and that left a dead leg at 43 degrees which is the ideal growing conditions for Legionella bacteria, so the tap – the thermostatic mixing tap – was to move that to the end of the system. But, of course, it added complexity into the

system, which is what we're dealing with here. Sorry for the complexity.

THE CHAIR: No, it's-- There's no reason to apologise for that.

A And the complex-- Sorry.

Q Did you use the expression "organic" to refer to the plastic?

A Plastics, yes. Plastics and rubbers.

Q Plastic and rubber, yes. Right. Thank you. Sorry, Mr Connal.

MR CONNAL: Yes. So, the Horne tap, on further examination, there was this issue about retaining water, which they had a view, and then you found later that there were, as you put it, organic components elsewhere in the tap structure, and they, did you say, are at least potentially places where microorganisms can grow?

A So, taking a step back to the regulatory regime for water systems, you've already asked questions about WRAS, the Water Research Advisory Scheme, which is the scheme that advises on the compatibility of materials with water systems. So, I would expect the components of that tap will have been through WRAS approval, or the tap as a whole will have been through WRAS approval, but because it passes WRAS approval, just means it's approved. It doesn't mean it's perfect, and organic components are potentially a source of nutrients for some bacteria, but also the complexity of the tap introduces crevices and nooks and crannies that you wouldn't get in a much less complex tap that also provide places for bacteria to potentially grow.

THE CHAIR: Now, you used an acronym there, or at least I think you used an acronym, to refer to a source of component approval. Just for my note, what----

A Water Research Advisory Scheme, often shortened to WRAS.

Q Right, thank you.

A And that scheme is relevant if we come on to talk about flexi-hoses and things, because they're again organic materials and they all have to be through that process.

MR CONNAL: There is-- Ultimately, I think we've had evidence – and I'm probably not going to trouble you with it – about whether you should or should not have flexible hoses for that very reason that they contain organic material which may give rise to an issue. Is that right?

A The guidance says only have flexi-hoses where they're essential, which was not the case with this system.

Q Now, I don't want to take you through every meeting that you attended to do with water otherwise we would be here for a very long time simply noting

that there were meetings at which certain things were said, but I would like to ask you one or two more questions about water because the Inquiry has been calling things "the water incident," which is a gross oversimplification, no doubt, of the complexity of what was happening.

I wonder if I could ask you just to look at bundle 12, 938, please, just to help us understand the context of some of the things. This is another Mary Anne Kane email to Tom Steele, but copied to Ian Storrar and to yourself, among others. That appears to be, if we scroll down to see where it comes from, a discussion about the decanting of Ward 2A and 2B. Can you remember why HFS was involved at that stage?

A So, originally when the board started-- Actually, a period after the board started detecting high TVC counts, they set up the incident management team and we were invited, I think, through colleagues in HPS/ARHAI, to support the board because it was about the water system. The IMT then set up the water technical group. I know you've asked questions about the provenance of that. We can talk about that if you like. So, this would have come from the discussions at the water technical group.

Q And in fact if we see in the middle of Mary Anne Kane's email, "The water technical group comprises," and then there's a list of individuals to visit, (inaudible) Iain Kennedy etc, etc, and, “Ian and Eddie have all the papers Ian Powrie has produced to bring you up to speed.” So, what-- was it you just starting to catch up with what was going on there?

A Trying to catch Tom Steele up. So, Tom is a construction professional. He's not an engineer, but he was the director. So, when this was being discussed between Tom and the senior management of the board, we had to bring him up to speed with all the discussions that we'd had.

Q So, what were you and Mr Storrar doing on this group then? What was your role?

A Our role in that was the same as our role in every interaction with every board which is to support them as much as we can. The support generally tends to center around the guidance and it often interprets-- often centers around the board's interpretation of the guidance, but we are both very experienced engineers and we have a lot to contribute beside that.

Q Well, we'll just look briefly at one or two items relating to the water technical group if we can. Can we have bundle 10, page 92, please. This seems to be a meeting on 20 September 2018 at which at your present, Tim Wafer, I think

is an external advisor----

A Yes.

Q --Tom Steele that you mentioned and various other parties who are named including Mr Storrar – I'm sorry I missed him out – and at that time you're trying to work out a solution.

A So, this appears to be beyond the working of the solution because we talk about installation progressing. So, Tim Wafer of Water Solutions Group is a chlorine dioxide specialist, and he would have been involved in advising the board. I don't know if he was involved in the actual procurement of the chlorine dioxide dosing system, but he's certainly been involved in the advice aspect of it. So, at this stage, a decision had already been made to go to chlorine dioxide dosing, and that's-- Just so you're aware of where we stand on chemical dosing of water systems, that's not the preferred method of keeping hygienic water systems. The guidance is-- certainly in the iteration that was relevant at this time, the guidance is built on the view that you can design, build, and operate water systems and keep them hygienic for the use of patients without the need for chemical dosing. Chemical dosing is an admission that something's gone wrong.

Q Yes. That was, I think, in a version of SHTM 04 that was live at that time, from what I can recall, and I think it said just what you said, that dosing is an admission that the building maintenance and management isn't capable of keeping the system safe.

A Chemical dosing is another one of those things that's much more complex than it sounds. It introduces a whole new raft of risks around manual handling and overdosing. We've had issues with overdosing in the past. It's potentially damaging to all the seals in the water system. You know, there's a lot of thought needs to go into it, but by this stage some kind of chemical dosing was pretty much inevitable.

Q And one of the issues that's identified in this minute, you see the paragraph starting "There is no guarantee…" fairly near the bottom of the page:

> "There's no guarantee any system we install will negate the gram-negative bacteria from all aspects."

Is that also an issue?

A Yes, because you'll have detected that almost none of this stuff is black and white; everything's directions of travel. There would probably have been good confidence, and the "no guarantee" is about how contaminated parts of the system are and, you know, how that-- When you start dosing with chlorine

dioxide, it causes the biofilm to be stripped progressively from the inside of the system and that, of course, can then accumulate further down the system, which if you don't have good penetration of the-- the biocide can then present you with a problem at your outlet, for example. So it's very complex and it's very-- needs to be managed very carefully.

Q And would I be right in thinking that in a building as complex as the new Queen Elizabeth Hospital, getting a chlorine dioxide system to work in the way that you would like it to work is also very complex.

A Everything about a system as large and complex as that's complex. So, even going back to the position of the guidance, which is you should be able to design, build and operate that system clean, in a system that size you have, as you're probably well aware, problems with the default method is disinfection, which is high temperatures because the system wasn't built to be sectionally disinfected.

Q Yes. Well, I-- Maybe you could just help us on one point we have had some evidence on. Would I also be right in thinking that it's not just a question of rocking up with your dose of chlorine dioxide and instantly the entire system is clear. It'd be likely the whole process of installing it, getting it into operation and

then waiting for results, would be likely to take some time.

A It's weeks to months, depending on how contaminated the system is.

Q Weeks to months. Thank you. I just want to ask you about one more-- just while we're on that topic, could we have a look at 166 of the same bundle, please? This is another meeting. We're now into June 2019. You are present again, I don't think Mr Storrar is there, and that meeting seems to be looking at test results. Do you know why you're still involved in 2019?

A A piece of information you probably don't have is why Ian may not have been at that meeting. There were three lengthy periods during the period that we're considering here where either he or I weren't available because of, in his case, recovering from two operations, in my case having a bad head injury. So, probably three months in each case. So, there was an awful lot of covering going on and trying to keep the job manned. I'd have to go through this minute and----

Q Well, we'll just move fairly swiftly. I think you're in attendance by telephone actually I notice.

A Mm-hmm.

Q And we see near the foot of page 166 that there were certain microorganisms being reported, further

water sampling to be done, and some discussion of that. Can we go on to 167? It's a long discussion. I don't really need to get you to take me through all of this. About halfway down the page, I just wondered whether there's another issue with chlorine dioxide:

> "DK noted that this CD [which is presumably the chlorine dioxide] is killing off the bacteria it was installed to remove and therefore could be potentially giving other more resistant bacteria an opportunity to grow by removing the biofilm."

Are you aware of what that's about?

A Yeah, it's a-- you'll have heard it already from Tom Makin about competitive bacteria and the first ones you kill are the weak ones, the ones that assist in medicine, as it's well known. You kill off the weak ones and you're left with resistant strains, so that's an issue. The principle with the dosing of chlorine dioxide would be that you dose at a level that is able to keep whatever's in there under suppression. So, you're constantly monitoring it, and you keep it under suppression.

One of the challenges with chlorine dioxide is the limit for the use on water for consumption by patients is very close to the limit – one down way/one up the way – the limit that's needed to control bacteria. So, half a part per million, which is what you typically dose it at. I don't remember what the limits are in each direction, but they're not very far apart. You don't have a lot of scope to increase it.

THE CHAIR: I wonder if I can just check with you that I've got that. You made a general point that although a decision to dose with chlorine dioxide-- one may come to a situation where it's the best option, it introduces a number of risks. The risk we're discussing at the moment is that, depending upon the concentration, it will kill microorganisms in a discriminative way. In other words, kill some and not kill others, and if it doesn't kill others, you're essentially giving these others the opportunity to develop. Now, I'm really just checking with you that I've-- I'm following your evidence.

A I'll refrain from giving microbiological advice, but that's my understanding of it is is that the ones that are easiest to kill are the first to be killed. One of the challenges with chlorine dioxide is the bacteria that survive are the ones that are embedded in the biofilm, which then when the biofilm's sloughed off gets deposited somewhere else in the system and the bacteria can then grow there and you don't-- although the

principle is have a level of chlorine dioxide throughout your system, the truth is you don't have that through your whole system. You have varying concentrations in various places, and chlorine dioxide-- and again, always always cautious not to overstep the limits of my knowledge here, chlorine dioxide is particularly susceptible to temperature. So, in a hot water system it's much more difficult to keep the concentrations up than it is in a cold water system, but what we're with here is the lesser of several evils, you know. The board's already got a problem, and it's trying to introduce a solution to that problem without creating a bigger problem,

MR CONNAL: And the time scale-- you said weeks to months, I think we see here it-- just immediately after the paragraph we were looking at a moment or two ago, that TW, I think Tim Wafer, says that:

> "The system is relatively new and it's been for other sites to have three or four years of similar treatment prior to clear results. "

And then there's the reference to disturbing organisms that you mentioned.

A So, Tim's expertise is far in excess of mine on this subject, but I don't have any experience of the process taking years.

Q Thank you. We'll just move-- If we just move on to the next page just in case of anything else we should pick up in this particular minute. Probably not. Next one, 169, 170. I think we'll leave that minute, thank you very much. I'm going to try and jump ahead for convenience as much as for anything else, Mr McLaughlan, because in the course of giving your evidence, you referred to a water technical report or water report, and we understand that that is in fact the HFS water management issues technical review of March 2019 which is in bundle 7 at page 70.

Just-- I'm aware that you are not the sole, or even principal, author of this document and, for the reason we discussed earlier, I'm using you because you're available to us and you were one of the people that was involved with it, and in fact I needn't go electronically to the tailpiece of this document, but in the acknowledgments at the end, you are mentioned together with a Dr O'Brien and a Colin Clarke. Who is Dr O'Brien?

A Dr Geraldine O'Brien. She is HFS's head of research, and she's also the person responsible for SCRIBE, which has been much discussed here.

Q Yes. So, you and Colin Clarke, who we've heard about, and Dr O'Brien from your organisation, a Hayley Kane from HPS----

A Mm.

Q -- a list of people, including Dr Inkster and Mary Anne Kane from the board, Tom Makin, Suzanne Lee, and a Ginny Moore, seems to be from Public Health England. These are the individuals who are credited, if you like----

A Yes.

Q -- as having contributed to the report which then goes out under the HFS banner, if we like. So, I'm just going to ask you to help us go through this report and understand what it says.

A Mm.

Q And probably the easiest way to do that is to go to page 73, because there we have the summary of the issue that the board had found organisms in the water system and linked these to bloodstream infections associated with Ward 2A, and after extensive sampling, it became apparent the organisms were widespread and not limited to Ward 2A. We've had different witnesses helping us with that, and then the brief is set out to review the available information about design, construction, commissioning on the hot and cold water services installations. Now, we can all see in due course the contents of this report, but it's fair to say it was a fair old amount of work to get to this stage?

A I think it was one these pieces of work that started much smaller than it ended up, and it was a process of discovering things and digging further because of that.

Q Right. Yes, and what, obviously, the executive summary is aiming to do is to try and take that material and put it together into some kind of summary of what the issues seem to be so far as you found, and I think in terms of dates, just so we're clear, there's a caveat there, that only information presented by the board up to 25 July 2018 has been taken into account, notwithstanding that the actual date of the report is March 2019. You can see that. Now, it doesn't read very positively about things that have been done is a fair summary, is it not?

A So, having experience of a significant number of new buildings, none of them are perfect. A lot of them are quite imperfect, but we were surprised at what we found here. Again, I've been very cautious because there are likely to be debates about the difference between what was handed over to the board and what was then subsequently available to us. There are issues around electronic storage. I don't know if anybody's mentioned this. There's hard drives that crashed and information that was allegedly there before that wasn't subsequently available, but of the information that was seen, there was

information that couldn't possibly be correct; there was information that was demonstrably not correct; there was information that wasn't what we would have expected to have seen knowing the guidance and the requirements of the CDM regulations. So, yes, it's not a good report.

THE CHAIR: When you use the word information at this point, Mr McLaughlan, are you referring to what you would've anticipated to be provided by the contractor at handover, or is it something else?

A It was more than that. More than that. I've mentioned already, there are requirements for what should be handed over in terms of what's called Operation and Maintenance Manuals, and the Operation and Maintenance Manuals should have all the as-built drawings----

Q Sorry, my fault entirely. Operation, second word?

A Operation and Maintenance Manuals.

Q And maintenance.

A So, they should have all the as-built drawings, all the operating manuals, all the safety information, all the maintenance information, but beyond that, there's the routine testing that should have happened. So, there's tests that were missed in here and bits of routine safety management information that either wasn't available or wasn't acted on, which no doubt we'll come to.

MR CONNAL: Because in way of executive summaries, let's start at the paragraph from the bottom of that page is in a sense a summary of a summary----

A Mm-hmm.

Q -- because it says that:

> "... best practice has not been followed in a number of activities from designs, through installation to handover, and subsequent operation and maintenance... Each of these may have impacted on the water system."

So, that was your conclusion or your----

A Yes.

Q -- organisation's conclusion? Can you just help us with the next little paragraph because it may highlight-- it's an issue that's been highlighted by at least one other witness. You say that the Estate's Team wasn't part of the client's Project Team and had no influence with regard to design of M&E systems or any input into the practicality of maintaining these services. What's the point that you're making there?

A So, that statement has since been demonstrated to be at least partly wrong. So, we know, and you know, that

Ian Powrie was involved with the construction process, and he was from the Health Board's team. What that statement's about though is there's a perennial conflict between construction programmes and operational maintenance teams where the operational maintenance teams will introduce delay into a project because they will go through all the things that should be there and they'll ask for them, and that will cause delay in the project, which causes the price to escalate, which causes the project to be delivered late, so there's a constant tension there. I think the reason that's in here is because that tension was seen to be more in this project, possibly because of the scale of the project than is normal.

Q Well, let me put to you, given what's said there, a suggestion being made by at least other witness, that if you have a situation where the person building the building and the person who's going to maintain the building afterwards are one in the same, at least in the sense of being in the same, perhaps, group of companies, such as an old-style PFI contract, then it's been suggested – and I welcome your thoughts on it – that the people who are going to have to do the maintaining, probably over a long period, are very keen that everything should be up to make that as easy as possible and will then tend to influence the people who do all the building to help them with that, if I can put it that way. Whereas, if there's no influence by those doing the maintaining on the building, you lose that benefit.

A The influence by the people who are going to maintain it is crucially important. Retrospective advice, but my advice to the board in these circumstances would always be to have your authorising engineers engaged in the process. Now, it's in the builders'-- it's not in their interest, it's in sometimes what they perceive as their interest, to hold these experts out because they ask difficult questions, but it's in the interest of the patient that authorising engineers and any other specialists that the board has are involved in the construction process and asking these difficult questions.

THE CHAIR: Right, can I just make sure I'm following this? We're talking about the period of construction----

A Mm.

Q -- and an authorising engineer is someone who has (inaudible); that's an expression that we take from, for example, SHTM 04-01. That defines what an authorising engineer is-- or am I wrong about that?

A Yes, the main source of advice on authorising engineers is actually SHTM 00. It's then replicated-- SHTM 00

is the overarching management document that describes that whole engineering structure.

Q Right.

A It's a very good reference in terms of the things people should do and when people should be involved.

Q Right, sorry. Yes.

A So, the authorising engineer is the board's specialist advisor. He's the guy who knows the difficult questions to ask, and – I'm doing this from memory – SHTM 00 asks that they be involved at the earliest possible stage and every stage beyond that.

Q So you're right to correct me that the source document is SHTM 000, and a feature of the authorising engineer is that he is independent of anyone involved in the construction of the project and therefore has only got obligations towards the client, who in this case is the board. Is that right?

A Yes, actually independent from both, other than somebody has to pay the bills, you know. So, the structure-- It's actually drawn in 00. The structure has the authorising engineer sitting off to the side, appointed by the responsible person, who's usually the director of facilities, and reporting into the head of engineering in terms of the things that he finds. So it's intended that the authorising engineer will be as far as possible removed from the daily pressures of either the operation of the board or the construction of a project.

Q Thank you. Sorry, Mr Connal.

MR CONNAL: The point of having people involved in the maintenance, involved in the construction, is, as you put it, that they ask awkward questions, they ask difficult questions?

A Yes.

Q So, well, you mentioned Mr Powrie, but Mr Powrie gave us evidence – and I'll be paraphrasing it – when he said he'd been told by one of his colleagues that please don't bring Mr Powrie to any more meetings because every time he comes it costs us money. Is that the kind of point that you're trying to make?

A Very much so. Very much so. Now, I've known Ian Powrie for a long time, and he is a man who will make sure things are done the way they're supposed to be done. That's his mentality, so I can totally understand why people don't enjoy being asked those difficult questions.

Q Thank you. Now, we can just run through some of these because we can all read the detail in due course, but essentially what the executive summary is trying to do is pull together a whole variety of features which it's thought all contributed or may have contributed to the issues of a water contamination. Is

that correct?

A Yes, yes.

Q So we see, for instance, at the foot of page 73:

> "It is likely that the hot and cold water distribution pipe work installation was contaminated ... during installation."

Top of 74, let's get there, "pipe work ... not adequately protected," "pipes left unopened ... unprotected," "water was in the pipework in some areas of the building in August 2014."

Why is that an issue?

A I've subsequently seen information that suggests the water was in the system before that. So, the guidance says that to protect the microbiological integrity of the system, the water should be introduced at the latest possible time before handover, and what that means is you fill it, you test it, you fix anything that needs fixed and you hand it over. Realistically, we're talking weeks, not months, possibly days if you can do it on a smaller project. When the water system is filled, the management of the quality of the water must then be rigorous. So it's got to be turned over regularly, almost as if it was in proper use, and monitored and treated if necessary.

Q Thank you. Now, some of the other things are featured here:

> "Independent governance of testing and commissioning was relinquished to the contractor."

So there was no third party, which is noted by you. Then there's identification of E. coli and high-- That's your TVC, total viable count at the initial stage, and there's a question as to who was told about that, and then a question as to whether-- even if it was dosed, whether that was effective and whether you have any record to that effect, but that's obviously something that concerned you?

A Yes. Absolutely, so I don't use the word "rigorously" lightly. These things have got to be done and they've got to be seen to be done, and you've got to have a record that they were done properly. They've got to be done by properly trained and skilled people and, at best, there was a lack of evidence of that.

Q Then you go on on the remainder of that page to talk about some work that may have been done where you're not quite sure what testing and disinfection was done. You refer to, I think, what we now know to be DMA Canyon, who were the people brought in to do the Legionella assessment, and you'll be pleased to know I'm not going to ask you lots of stuff about the DMA Canyon report because we've heard a lot

of evidence about that elsewhere, and there's a question about the maintenance of the hot and cold water systems. It's about temperature control. It's the "From reviewing an interpretation of all available literature."

A So, there will be a number of things there, temperature control will be part of it, but there's also-- Again, I'm going from memory. I think there's a periodic replacement of those outlet fittings. I can't remember what it is. I think there was a lack of evidence that that was being done appropriately. There's testings in there; if anything's found, taking the taps and sterilising them is part of it.

Q One of the questions that's been raised by at least one other witness is that, if you have a disinfectant approach which is based on temperature, making sure that you don't get into the bit in the middle which is warm, tends to be either cold or hot, and I'm not using the figures, forgive me for that. Is that not quite difficult to do on a system as complex as this hospital?

A Yes. Yes, so, there are conflicts all over the place when you're designing and building any building, but a hospital in particular. If you make certain decisions, they have impacts on other decisions, and one of the issues with water systems is the pipework tends to run in ceiling spaces which is the same place that other heat emitting devices like lighting exists, and it's common for ceiling spaces to get to temperatures above what's ideal for water. If you're then not turning over your water on a regular basis, it sits there and it gains heat, so the temperature goes up.

So, that's possible to design out of a building, but how practical is it in a building of this scale? That's a whole different question. Now, that's a question that should be addressed very early on, and nobody should be saying, "We're going to build this building and run the water in the ceiling void, which is going to get to 30 degrees, and we're going to accept that the water is going to go up to 30 degrees." That should be a red flag. They should be stopping the project at that stage and saying, "How are we going to solve this problem?" Now, it might be that the solution to the problem is chemical dosing, but they should be thinking it through. They should be coming to a conclusion about how that issue is going to be managed.

They should have-- There will have been, I have no doubt, modelling of the temperatures in this building. It's a requirement of-- As time has gone, the requirements have become more stringent, but you're required to model the temperatures of buildings in certain

areas, so that information will have been available. People will have known ceiling voids get warm, no indication of what decisions were made on that basis.

Q Your point is you have to be very clear in advance that you can actually achieve this consistent temperature control, otherwise you're building in a problem?

A Yes. Yes, so, if there's nothing done to ensure that the water is maintained-- I'll finish my sentence, nothing done to make sure that the water is maintained at the temperature that it's intended to be at, you're introducing risks, and you are legally required to have taken steps to foreseen those risks and taken mitigating measures.

The reason I stopped mid-sentence there is there is another conflict there, which is, although the health service is required to maintain water below 20 degrees, the water authority is allowed to supply it up to 25, so the board must understand what temperature the water is likely to come in at to know-- sorry, board/designer must know what temperature the water is likely to come in at to understand what needs to be done with that water, and we have several projects in recent experience where they've moved to chilling incoming water because the expectation has been that it will come in at above 20 degrees, and that, like chemical dosing, is not a panacea. It introduces a whole raft of other issues.

Q Thank you. Well, I'm conscious of time. I haven't finished with this report, but we have reached 11.30.

THE CHAIR: Well, if it's a convenient moment to break for coffee, we'll do that. Mr McLaughlan, could I ask you back for 10 to 12?

A Certainly.

(Short break)

THE CHAIR: Mr Connal.

MR CONNAL: Thank you, my Lord. Mr McLaughlan, welcome back. Can I just ask you a question about an answer you gave earlier on just to make sure we have on record what the point is. We were talking about the date when the system was filled-- the water system was filled, and there was a date quoted in the report and you said, well, actually, you've subsequently had information it was an even earlier date. Can you tell us what the earlier date was?

A Not without looking it up. I think that's a piece of information I gleaned from the information that you sent in support of my statement.

Q If you don't have it to hand, it's fine. We'll find it.

A I think the implication was it

had been full for a year before it was handed over.

Q Right, thank you very much. Mr McLaughlan, I'm going to go back to the water report we've been looking at, but I'm coming away from the summary, and I just want to pick up one or two parts of the content, and if, when I go there, these are parts you can't help us with because you weren't directly involved or whatever, please just say. Can I go to the same document at page 95? I'm going there just in part because this was a report on the water, but we now have a heading, "Dust during construction." Why was that relevant to the water? Can you remember?

A So, I think this refers to contamination of pipework before it was installed. See the reference to pipework?

Q Well, it may not matter, but can we go to the, effectively, the end of that section, which you find on page 96? What we have there, after a table which is dealing with dust and so on, we see there was anecdotal evidence of complaints regarding levels of dust, no written evidence available, and then there's a reference to cleaning chilled beams, which I'm not going to ask you about, and then there's a reference to particulates being generated and Aspergillus. What's the point that's been made in that final paragraph?

A Aspergillus is an organism that is associated to some extent with construction work, particularly in ground works where it's a-- It's a soil dwelling organism, but it's also found in certain construction materials, particularly plasters. So, anything that generates dust from any of those processes will release it to some extent, and where it then subsequently ends up is the problem you're trying to deal with.

Q I think it's one of these items that can cause particular difficulties if you have people who are vulnerable exposed to it.

A Again, I wouldn't venture into microbiological advice, but that's my understanding.

Q Thank you. Can I just ask you about another point, again so we can make sure we're understanding it. On the next page, 97, we turn to commissioning of water systems and also the use of disinfectant and a product known as Sanosil which seemed to have been used by the contractor. On page 98, just before the heading "Impact of chemicals on pipework," we see, there, a conclusion that there's a discrepancy with recommended concentrations. What was the problem here?

A The evidence that we saw indicated that the concentration that had been used to disinfect the system was

less than the manufacturer recommended, and quite substantially less it would appear.

A Yeah, 150 parts per million versus 500.

Q Did your investigation find out why that was, or was it just something you found?

A No, the limit of the investigation was to be able to advise the board what information they had. So, we would have expected the board, if they wanted an answer to that, to go and find the answer.

Q Thank you. If we go on to another point, on subsequent pages, one of the things that's being discussed is testing and testing of taps for disinfectant and so on, and if we can jump, please, to page 101, what we've got above at-- part of page 101 is a table of results, and then there's a comment about how easy it was to actually get hold of results that could make sense of. That's my paraphrase; it's not what the report says. Was that quite a difficulty?

A Yes, so Ian Storrar spent several weeks extracting this information from ZUTEC.

Q Did you say weeks?

A Weeks. I don't have the exact time, but I was aware that I didn't have access to him for several weeks when there were plenty of other demands for

his time. I wasn't involved personally. I don't have any personal experience of how difficult it was, but it was certainly a topic of conversation.

Q So, it wasn't, then, readily available?

A No.

Q And after the comment about the difficulty of getting the data, which you've helpfully elaborated on, we see at the top of page 102 there's a comment about E coli having been found and whether it'd had been escalated. Was that an issue of concern?

A Yeah, so, again, staying within my competence, I believe E coli is an organism that deserves special attention in terms of making sure that it's eradicated, and all the people who would need to be involved in making sure that there was no E coli in the system would need to be informed, and I think what Ian's saying here effectively is there's no evidence that they were informed.

Q Yes, I-- just-- So, when you say there's no evidence that they were informed, are you saying they weren't informed or just that you couldn't find any evidence that they were?

A So, in all cases, when we're referring to this report, all we're saying is there was no evidence found, not that things didn't happen.

Q Well, just on the same theme,

could we go to 107? Because here comes NHS GGC Infection Control again, who were mentioned in the preceding discussion, and you said:

> "There's no documented evidence of NHS GCC Infection Control being involved in the handover process."

So, if we just stop there, there's no indication of being involved at all.

A Yeah.

Q And then you record that the NHS GGC Infection Control lead – now, that was Professor Williams – provided a statement that he was involved in reviewing water testing methodology during commissioning and handover. Any indication he was involved other than that single item?

A So, if you bear with me for a bit of context, there has been, over a number of years, a challenge of bringing the specialisms between Estates and clinical together, and Infection Control obviously is on the clinical side. Infection Control people have not traditionally been trained to understand the Estate information. They look at a building drawing, and it's just lines on a page to them, and Estates people have not been trained in the Infection Control implications, and that's-- The whole work that Geraldine O'Brien's been doing for the last probably nearly 15 years now on HAI Scribe is to enable those disciplines to work more together to ensure that everything's taken into account to make the patient as safe as possible. So, in this process, there's no conclusion as to whether Infection Control were invited and didn't engage for one reason or another, or whether they weren't aware of that they had a role to play. So, that stuff's all opaque as far as this report's concerned. At the end of the day, the only conclusion is the lack of evidence of adequate involvement.

Q I understand that this issue that you just described cuts both ways in the sense that traditionally-- Please tell me if I'm not correctly recording what you've said. Traditionally, Infection Control specialists were not trained to understand Estates documents and material. Is that correct?

A That's correct.

Q And, traditionally, Estates specialists were not trained to understand Infection Control issues.

A Yeah. So, the earliest attempts to help Estates people to understand Infection Control issues was the publication of Scottish Health Facilities Note 7 I think – we can check up on that – which was the precursor to HAI SCRIBE, and that-- I think that was 2007 or thereabouts. That's not to say

there was nothing going on before that, but that was the first formal attempt to bridge that gap.

Q And you said that attempts to bridge that gap have gone on ever since?

A Yeah and they've made, in my view, significant progress.

Q That's helpful, Mr McLaughlan, because obviously one of the issues that has arisen is whether Infection Control team members understood, for instance, the technical details of ventilation systems and the like.

A It's-- From my experience, it varies by individual. Both Infection Control and Microbiology and, for that matter, Estates, their interest and ability to grasp what other disciplines are involved in varies from person to person. Some are very, very good at it.

Q Thank you, and the implication, perhaps, of that answer is some are less good?

A Yeah, and that's why all the work on Scribe and all-- with the creation of NHS Scotland Assure with Infection Control and Estates in the same organisation is all part of that.

Q Can I ask you to look at 118? I'm just trying to understand the significance of what's said there about water sampling because there's been some discussion about what sampling pre-occupation, for instance, was

available, and here we have discussion of sampling of water from April to December with the main tanks in October 2016, and then there's a note there are positive results for Legionella in certain areas, April 2015, 41 samples, with 15 being out of specification, and then positive samples, again, November, December. What's the importance of highlighting these matters?

A Essentially, what these paragraphs are describing is a water system where there is evidence of contamination. When a general hospital water system is built, the design principles and the maintenance principles are intended to reduce the ability of organisms in general to proliferate. It's not specific, although the guidance does talk about Legionella a lot because that's where it comes from, but they're designed to be environments that are not conducive to multiplication of microorganisms, and what this is saying is there's evidence that that's not being effective.

Q Thank you. Can we look at 126? Now, we've discussed water temperature as a method of disinfectant earlier, and I'm not going to go back on that, but I just want to be clear that we're understanding what's said here about available data because there seems to be an issue about data being lost.

A That's that point I was making earlier about the difference between what the builder thinks was handed over and what the board was able to show us. So, that Schneider reference, that's the reference to the system that the data was stored on, and there was some failure in that and the data wasn't recoverable. So, what was lost in that, I don't think anybody has a good picture of, but the Health Board would be able to advise better on that.

Q So-- but the significance of that, if I understand the paragraph, is that up and-- for the period before 1 January 2018, you didn't have data on temperature. Is that right?

A So, that data was part of what was lost, yeah.

Q Well, let's just try to wrap up this report by looking briefly at the-- what are described as the conclusions and hypothesis which appear at 1, 4, 5 and thereafter. To some extent, we've been through the executive summary, but not all of the same points emerge in quite the same way here, because here we're dealing not only with conclusions but also, if you like, the hypothesis as to why. So, this section starts by saying that:

> "…incoming water supply not infected, incoming mains pipe contaminated, water tanks not clean."

So, we've had the reference to the hot and cold system contaminated during installation, possibly from various sources, and providing a basis for biofilm proliferation. Presumably, that's undesirable?

A Yes, highly undesirable.

Q Highly undesirable.

> “There's evidence that flushing took place without the main water system filters in place. ”

Is that an issue?

A Yes, so, you'll have heard various evidence about the effects of the filters of the incoming water which are able to remove microorganisms. It's important for context to say that that's not why those filters are specified. They're specified because it's a stainless steel system and stainless steel is susceptible to corrosion of-- caused by very organic matter. So, originally the move from the standard filtration in hostile water systems, which was 5 microns, to the specification here, which was 0.5 microns, was about corrosion of stainless steel. They do remove microorganisms, and that is a benefit, but that's not why they were specified. I think not everybody understands that.

Q So, they provide a benefit, but that's not why they were originally designed to be there----

A It's not why they appear in the guidance.

Q But if you don't use them when you're flushing, that could cause an issue, presumably.

So, it allows organic material to be deposited in the pipework. So, not only was the 0.5 micron system not used when the system was filled and flushed, but there was no 5 micron system, which is the one that removes sand and dirt and organic particles that then form a coating in the inside of the pipe.

Q Thank you. The next point is about the strength of the disinfectant agent that we've already done. Manufacturers of the taps, talking about hydrogen peroxide having a detrimental effect. That's the Horne manufacturer's view, isn't it, that if you use chemical disinfectant, it can cause difficulties for their taps?

A Also, not stated there, but the the pipework system is made up of compression joints with synthetic rubber seals in them and they are susceptible to degradation caused by chemical disinfectants as well, and there are tens thousands of them in the system. There's long-term risks associated with that.

Q I see. So, the next point:

"Water commissioning results show initial high levels of TVC, not isolated to particular systems, included E coli, and the suggestion is that biofilm may have survived."

Do you know why that conclusion was reached?

A Yeah, biofilm's difficult to remove even under ideal conditions, so the evidence says that the system was heavily contaminated with microorganisms prior to handover, prior to disinfection. It was then disinfected using less of a concentration than the manufacturer recommended to get it under a level that could be handed over. Then there's a lack of evidence that it was properly maintained.

Q Yes. Thank you. Some of the next points are ones that we've already touched on, so I won't repeat them. Can we go on to 146, please? Again, the first point on 146 is one that was covered by the summary at the start of the report, but there's a specific paragraph here, the second bullet point, which deals specifically with the conclusions on the Horne tap, and the conclusion is that the type of flow straightener became a site for organisms to grow, particularly gram-negative organisms, and as a result of investigations, the contamination was shown to be widespread. That's the conclusion that was reached after all the work on this report.

A Yes.

Q And just so we're understanding it, this biofilm – so that's the biofilm in the tap structure – may have caused retrograde contamination? Now, what do you mean by that?

A So, some of these organisms, Pseudomonas in particular, is what Tom Makin will have referred to as an "obligate aerobe," which means that it has to-- it thrives in the presence of oxygen, and Pseudomonas is typically found in the last couple of metres of pipe work. So if you can introduce Pseudomonas to the tap, you can then back contaminate the system, but only as far as the oxygen will allow it to thrive. That's what he's talking about there.

Q Yes, and if I'm understanding it correctly, if it develops in the tap – I'm just using the tap and its structures – what this report is saying is it can then go back into the system more generally. That's----

A Yes, and some organisms will do that better than others depending on their need to be near oxygen.

Q Yes, thank you, and then there's reference to, prior to point-of-use filters being installed, it's probably the drainage system became contaminated. So the point-of-use filters were to ensure that anything that came out of the tap, regardless, was filtered and safe.

A Yes. I might, with hindsight, have worded that differently because it conflates two points there that may not be appropriate. So----

Q Okay, well, please explain that to us so we understand.

A So, the contamination of the drainage system may not have been from the tap.

Q Right.

A Drainage systems are inherently dirty places. The risk with the drain is not once you get well into the drain; it's the bit that can be accessible to the wash hand basin and therefore the staff and the patient. The issue with the drains, as you've got good information here, is those particular wash hand basins had horizontal outflows with a rubber seal or a synthetic rubber seal, which, when it was compressed, protruded into the drain and caused a lip and the water was retained in the lip, and it's likely that that's where the organisms proliferated. Whether they came from the tap or they came from whatever was put down the drain is unclear. What we do know with the point-of-use filters is that they were installed because there was contamination found within the system, and that was not to be allowed to get to the patients.

Q Yes. Thank you for that clarification. Now, subsequently, we go on to touch on the DMA report, but the essential conclusion there is that the

maintenance that should've been done as a matter of routine, there was evidence it hadn't been done.

A Mm.

Q Is that fair?

A Correct.

Q And then we go onto temperature again, which we needn't trouble with. Can we go to 147?

A Yes.

Q I'd just like to ask you about the first bullet point on that page:

> "Indicators that a system-wide contamination issue may be present manifested in ... positive organism results in 2015."

Then the report says, "Due to the focus on Critical Care areas, the scale of the problem was missed."

A Mm.

Q That's quite a significant statement, isn't it?

A Yes, and it's one that I'm not particularly close to. I don't know what results are being referred to in 2015 or why they were missed. By that stage, I don't think we were engaged in the IMT, so I don't know who was involved at that stage, but Ian would have been picking that from the records.

Q Well, thank you very much. I'm going to leave the report now. I don't think I need ask you about the other conclusions.

THE CHAIR: Could I just ask help on a matter of detail? You identified a particular risk, as you say, manifesting itself-- That's probably the wrong way. You identified a particular risk associated with the drainage system----

A Yes.

Q Now, you talked about a horizontal-- is it horizontal outflow from a basin?

A Yes. So, there's various bits in the evidence about these-- In a normal wash hand basin, your drain's vertical.

Q Mm-hmm.

A It's common. So there has been a long discussion about wash hand basins and whether the tap can discharge directly into the drain, whether that causes splashing and contamination. So Armitage developed this wash hand basin, as I understand it, to take away the drain at the bottom of the sink and take it to the side of the sink, but it then has to be joined onto the drain and how it's joined on-- how it's sealed is there's a rubber or synthetic rubber seal which is tightened up to form that seal.

My understanding from these ones is that when they were tightened up they were overtightened or they were the wrong size or something was wrong, and it caused a lip and, of course, the water is only flowing out horizontally, so by the

height of that lip, there's a puddle of water that gathers there. It's exposed to air. It's got whatever was in the water when it went there. It's a breeding ground for bacteria, and that's where biofilm was found in several sinks.

Q Right, and you tie that in with Pseudomonas because that's a bacteria that thrives in an oxygen environment?

A I didn't intentionally tie it in with Pseudomonas. The point I was making was that biofilm was found and biofilm could contain any number of organisms. The Pseudomonas point was only about the ability of it to grow back through the system, to the point where the oxygen is no longer sufficient.

Q Thank you. That's helpful.

MR CONNAL: Thank you, and the final topic I want to ask you about, and perhaps not for very long, it's Cryptococcus.

A Mm.

Q And one of the questions you were asked in your witness statement – and, for reference, this is on page 22 – was whether you'd ever come across Cryptococcus in a healthcare environment in your many years of involvement in one form or another, and the answer to that was “no”?

A It was “no”, yes.

Q So this must have been an unusual event to come across?

A It is not the first time I've come across a novel organism. Cupriavidus was also a novel organism when it was brought up, and really my knowledge of microbiology, as you've probably worked out, is very limited. So when Cryptococcus was discovered, I got the same explanation from microbiological colleagues as everybody else got about what it does and where it comes from. So I learned it comes from soil and pigeon faeces, but that was my first experience.

Q And we know that investigations took place into the issue of Cryptococcus in the Queen Elizabeth Hospital and, you know, the whys and the wherefores of that. Now, I understand from your statement that the principal source of support on that topic was provided by Mr Storrar, although you deputised from time to time?

A Yes, that was the theory. All these interactions were rightly the domain of the principal engineer but, as you can imagine, with the points I've made about the resource implications, there was an awful lot of coverance, so you would get one or other of us there unless there was a particularly contentious period, in which case we'd both be there if we were available.

Q Can I just ask you briefly about one or two of the documents that were generated during that time? Could we

have a look, please, at bundle 9, page 5? It's obviously redacted for patient confidentiality reasons, as you'll understand, Mr McLaughlan. This is a minute of a meeting in February at which you appear to be the one present, you know, from your organisation. So, what were you contributing to the discussion? What was your function there?

A I would contribute anywhere I was able to contribute, but my primary function was from the perspective of the engineering guidance.

Q And why was engineering guidance significant in the discussions that were taking place?

A So, the concern was that, potentially, the organism was being introduced to the patient areas through the ventilation system. There had been pigeon droppings found in plant rooms. I actually visited one of the plant rooms with Colin Purdon and Darryl Conner, saw some of the pigeon droppings on the floor.

Q If we just look at page 6, that discussion continues.

A Yes, so, there was a discussion there about where pigeon droppings had been found, and then, ultimately, the discussion moves on to various hypotheses that were being discussed as to how they may or may not be getting to infect patients.

Q Now, were you assisting with the discussion or leading the discussion? What was your function, can you remember?

A I was an active participant in the discussions.

Q Because it seems that Mr Hood is the driver of much the discussion, at least so far as it's recorded here?

A Yes, a significant part of the discussion was microbiological in nature, so that's probably appropriate.

Q Page 7. So, you'd already been to see-- had you seen plant rooms before or after they were cleaned, can you remember?

A So, I've subsequently seen pictures that show much heavier contamination than I saw when I was there. What I saw when I there was a couple of little spots of pigeon droppings, but subsequent pictures showed a lot more. So I don't know if it was a different plant room or if it was a different time, but certainly there were dried pigeon droppings on the floor.

Q Thank you. Could we also look at page 12 of that same bundle for completeness. Now, in this one you appear to be joining with Mr Storrar but both by telephone rather than in person. Again, we've moved on a small period of time, but any change to your role at this

stage? What are you contributing?

A It's the same. The role of HFS was to provide whatever support we could to the Board at any time, and of course, they're dealing with a very significant issue and it has potential implications for the ventilation system. So we are trying to support them in that. Peter Hoffman, for that matter, who was also on the telephone, has both microbiological and engineering expertise, so he was very useful for that. Yes.

Q All I really need to ask you now is that-- I think you're aware that there were a series of hypotheses discussed at various stages and in various formats as this group continued, and debates no doubt took place, am I right, about each of these hypotheses?

A Yes, indeed.

Q But when it comes to the, sort of, final conclusion, are you aware that there was an issue taken by your organisation with the final conclusions? Is that correct?

A I was, yes.

Q Sorry, that was correct?

A Yes.

Q Could we look at bundle 24, volume 3, page 117? Now, this, in source terms, is a response sent by NSS to a request for information and material issued by the Inquiry, and it asks about the response by NSS, and I'm now using NSS-- to documents showing the results of the Cryptococcus discussions. Now, in fairness, I'm not going to trouble you with some of the text because it's much taken up with whether drafts were issued, whether drafts were correct, what control there was on different drafts and so on and so forth which, if we need, we can find out.

So, can we just move through that? 118, please. Now, you'll see about halfway down 118, there's a reference to a paper which records a statement that:

> "The hypothesis that the air from the plant rooms, via the air handling units, was a likely source... has subsequently been categorically ruled out as it is not technically possible."

Then, at the foot of that page, another statement, at this time attributed specifically to Mr Steele saying:

> "Six hypotheses considered... all of the hypotheses considered were ruled out due to a number of factors, and it was concluded that the likely source was spores brought into the building from the incoming outside air."

So, if we can go on to 119 just to see what happens about that, do we see there a reference to a communication

from NSS which essentially says that they don't agree with the statements that particular hypotheses had been ruled out? You can see the first two bullet points, in particular. Were you involved in these exchanges or not?

A I don't think I was involved in that in any detail. So, I was aware that there were concerns about the approach that was taken by Dr Hood on the production of the report. My view-- personal view is much closer to what's in bullet point 1 here than it is to Dr Hood's view on the previous page. There was no evidence when I was involved that would have categorically ruled out pigeon faeces in the plant room being the factor. I would say my view was it was also unlikely to be significant. I think I've said this in my statement.

For context, not all ventilation system plant is housed in plant rooms, so there are lots of hospitals across the country where the ventilation plant sits on the roof and the pigeons sit on the plant, so it's not-- the plant rooms-- they should be clean. As a matter of discipline, they should be clean. Are they a risk of contamination? Possibly, but not probably. The air intake for that ventilator-- those ventilation systems is large and draws in a large amount of air, and the outside environment has a significant number of roosting sites for

birds, particularly parapets immediately around the area where the plant rooms are located. So, my view is that's a much more likely source of any Cryptococcus that was drawn into the system than all that size on the site of a ventilation plant.

THE CHAIR: Sorry, just give me that again. My fault for not paying close enough attention. You're explaining that you would-- under reference to the first bullet point, you would not go the distance of “not categorically ruled out” but, if I'm following you, you thought possible but not probable, and then you developed another alternative?

A The outside air seems to present much more opportunity for Cryptococcus to be drawn in. There's one-- Sorry to complicate. There's one relevant issue, which is that the Cryptococcus that would be available in the faeces in the plant room was likely to be dry and, if it was disturbed, could produce dust, whereas in the outside environment it would likely be dry for some parts of the year. Having said that, it would also be much less likely to be cleaned up.

MR CONNAL: The point you make, I think, in your statement is that if the hypothesis of air being drawn in and picking up something from roosting sites or whatever – leave aside whether there should be roosting sites – was correct, it

went through a filter, but not a filter suitable for protecting vulnerable patients?

A That, I think, is the main point here, that those ventilation systems don't appear to have been designed for the patient group that was housed there.

THE CHAIR: Thank you.

MR CONNAL: Can we shrink page 119 again, just for a minute? Yes, I just wanted to pick up the last part just so we complete this process, because you've been very helpful in that comment. Near the foot of the page, there's a reference to another email from NSS talking about, "No clear methodology," and then, from the layout of the report, that's, I think, criticism of Dr Hood's report. It reads as though it is presumably biased, and the evidence base has been used to back up a potentially biased view of the situation. That appeared to be the final NSS position so far as we can find.

A Yes.

Q That correct?

A My involvement at that stage was very limited, but I can understand where that kind of comment comes from.

Q Thank you. My Lord, I have no further questions for the witness. I've had no indication of others, but whether the my Lord wishes a check to be made, I'm happy to hear that.

THE CHAIR: Well, just put it beyond doubt. What I propose to do, Mr McLaughlan, is arise for no more than ten minutes to allow Mr Connal just to check that there's no questions that anyone in the room wish to be added to the questions that have already been asked. So you'll be taken back to the witness room, and I hope we won't require you to wait for more than about ten minutes. Thank you.

(Short break)

THE CHAIR: Mr Connal?

MR CONNAL: I have no further questions for Mr McLaughlan, my Lord.

THE CHAIR: Mr McLaughlan, there are no further questions, and that means you're free to go, but can I thank you for your attendance on two occasions and the significant amount of work that will gone into preparing, first of all, your written statement and, secondly, in preparing for your attendance. So, thank you for that. Your evidence has been very helpful, but you're now free to go.

THE WITNESS: Thank you.

(The witness withdrew)

THE CHAIR: Now, our next witness, I understand, is Dr Lee, who is going to be questioned by Mr Maciver.

MR CONNAL: That is correct, my Lord.

THE CHAIR: Well, we'll take an early lunch, as it were, and sit again at two o'clock.

(Short break)

THE CHAIR: Now, Mr Maciver, are we ready to begin with----

MR MACIVER: Yes.

THE CHAIR: I think it's Dr Lee. Is that right?

MR MACIVER: Dr Lee, my Lord, yes.

THE CHAIR: Good afternoon, Dr Lee. As you understand, you're about to be asked questions by Mr Maciver, who's sitting opposite to you, but before that, I understand you're prepared to take the oath.

THE WITNESS: I am, your Lordship. Thank you.

THE CHAIR: Thank you. Sitting where you are, could I ask you to raise your right hand and repeat these words after me?

Dr Susanne Surman-Lee
Sworn

THE CHAIR: Now, Dr Lee, I'm hard of hearing. We've got quite a large space to fill and we're concerned that we hear your evidence. Now, you should have plenty of help with these two microphones, but can I encourage you, maybe, to speak a little louder than you would in normal conversation. I anticipate your evidence will take us to about 4 o'clock, but if you want to take a break at any stage, just give an indication and we'll take a break.

THE WITNESS: Thank you.

THE CHAIR: Now, Mr Maciver.

Questioned by Mr Maciver

Q Could you tell the inquiry your name, please?

A Dr Susanne Surman-Lee, for professional purposes.

Q And your occupation?

A I'm a consultant clinical scientist, public health microbiologist, and director of Legionella Limited.

Q And is Legionella Limited the organisation that you work for?

A Yes. We're a very small, independent public health microbiology services.

Q What is its business?

A Preventing, detecting waterborne infections, supporting hospitals to develop water safety plans, supporting water safety groups. So it's public health microbiology, but really focused on water, the prevention of

waterborne infections.

Q Now, you completed a written statement concerning your involvement with the Queen Elizabeth University Hospital in Glasgow. Is that correct?

A That's right.

Q And are you content to adopt that statement as your evidence to the Inquiry today?

A Yeah.

Q Now, I may have cause to take you to your statement from time to time during your evidence, if I do, or if I need to refer to any other document, it will come up on the screen that's in front of you.

A Yes. Thank you.

Q Now, you'll be aware that we're interested in your involvement during a period in 2018 regarding the water system at Queen Elizabeth. Now, in brief terms, what was it you were asked to do?

A I was initially contacted to ask if I knew anything about Cupriavidus and I-- as a result of my background, being involved in lots of waterborne outbreaks, particularly in healthcare, I contacted Teresa Inkster and we discussed the problem and she invited me to-- Well, I suggested I came up because it's very difficult to get your head around what is going on unless you actually can see the premises. So, we arranged that I would go up and visit the children's ward.

Q Okay, and then, as I understand it, you subsequently produced a report following that visit.

A I did.

Q I have two dates which may be relevant to that. I have 16 March is the date of the initial contact. Would that be about right?

A Yes, I think so.

Q And I have a date of, I think, 25 April for your visit.

A When I visited, yes.

Q Okay. I'm interested at the moment in the initial contact. Who was it that contacted you, can you recall?

A It was an email from Phil Ashcroft from-- who I'd previously worked with when writing the HTM series with him.

Q And, just in general terms, what did that email tell you?

A It was just a request if anybody knew anything about cupriavidus and that he'd been contacted by Ian Storrar, I think.

Q Could we have up on the screen, please, from bundle 14, volume 2, page 101. Now, we see here – and you should be able to see this clearly – this is the end of an email chain. The title of the email chain is "Fwd, block URL, external to GGC, Fwd Cupriavidus pauculus, URGENT," do you see that?

A Mm-hmm.

Q And unfortunately the way these things print out is they are reverse chronological order. So, if we go to page 103 we should find there the start of the email chain. At the very foot of that page, it starts off with an email from Ian Storrar, whom I think you mentioned.

A That was forwarded from Phil Ashcroft.

Q So, the one above is the email that you would have from Phil Ashcroft?

A Yeah.

Q And the general content of those two emails is if you said does anybody know anything about Cupriavidus pauculus, and that's the first contact you had, as you say.

A Yes.

Q At the top of that page, we have something beginning "Dear Phil." If we skip forward one page to page 102, we should see the header to that email. At the foot of that page, we see this email header, and this is your response. You see that if we're looking at the foot of page 102?

A I can just see at the bottom it says, you know, there's certainly a little bit----

Q Yes. There's your name, sent 22.50 on 16 March to Phil Ashcroft and others, and it's the same title. So, that closes page two of the chain, and then if we go forward one page to page-- you should see. I've fallen into the trap that I tried to avoid; that'll be page 103. So, at the top of page 103, "Dear Phil," that's your response. Is that right?

A That's my response to Phil Ashcroft, yes.

Q So, here you're saying:

> "Sorry for the delay. I have forwarded to Mike Weinbren. I agree with Jenny it is an uncommon pathogen, [and you're talking there about the Cupriavidus pauculus]… it would be good to have more information. I haven't had any personal experience of dealing with this but I suspect it might be difficult to remove. If the BBC report is correct that bottled water and mobile sinks are being used I would be a little concerned about the use of bottled water with highly immunocompromised patients though, it is not the same as sterile water and as there have been previous P aeruginosa outbreaks in ICU associated with bottled water it is important there has been sufficient quality assurance to ensure it's safe for this patient group."
>
> "I also have concerns with the use of the mobile sink units unless they have been thoroughly

disinfected first. Following the Dutch lead and removing water from the highest risk areas and relying on alcohol gel and sterile water only."

So, that's what you've written. There's quite a lot in that email. I wonder if you could perhaps explain that to us in your words?

A I could. Well, people tend to assume that if they buy a bottle of water, that is sterile. The general perception is it's sterile, but that's far from the case, particularly if it's in, you know, you've got glass bottles-- in plastic bottles, because the plastics in the bottle provide a nutrient source, and the naturally occurring organisms in water will use that to grow. So, from the time it's bottled to the time it's consumed, there's continuous growth. So, I was aware of an outbreak in Germany where they had six intensive care units where, because they had a problem with distributed water, they used bottled water instead.

Q When you say outbreak in Germany, that would be an outbreak of what?

A Pseudomonas aeruginosa.

Q Okay.

A And they were able to show from an unopened bottle and the patient's strains that those strains were the same, so it was the bottled water that was contaminated.

Q Okay, and if you recall the question that was put to you was, does anybody know about Cupriavidus pauculus? The outbreak you mentioned was Pseudomonas.

A There are similarities. They're both gram-negative organisms. They are both associated with biofilms in water as with a whole range of other gram-negative organisms. So the fact that it was a different organism, the likelihood that it would behave in a similar way and would come from a similar source was high.

Just to clarify, perhaps, one thing at this point, and it may be that this comes from me putting too much emphasis on the name of your company, but your company is Legionella Limited. You are, by profession, a-- you said you were a microbiologist.

A It's a pun on Legionella and our name.

Q That I understand. My question was should I take from that that you have particular specialism in Legionella or is it microorganisms in general?

A It's waterborne microorganisms in general.

Q And would that include the ones that we've mentioned so far: Cupriavidus, Pseudomonas?

A Yeah, Cupriavidus is quite a rare organism, and it's not one that I was

aware there had been an outbreak of before. It had been called other names in the past, including (inaudible). So, I knew of its existence, I knew it was gram-negative, and knew that it had been associated with water, so in all likelihood it would behave very similar to Pseudomonas aeruginosa, although there are slightly ecological differences with all of these organisms. They have their own niches and biocide-- whether they are sensitive to biocides and antibiotics, etc.

Q Okay, well, I'll come back to much of that as we go on, but the basis for that view is essentially that you have an across-the-board knowledge of microorganisms in water.

A Yes, and I've talked-- I've developed an MSc for the London Medical School in Queen Mary's on waterborne organisms, which cover the whole range of waterborne organisms, so I've got----

Q Okay.

A -- quite a lot of experience, yes.

Q Okay, now, just to conclude the email chain, at page 101 we see that's-- just below the top we've got an email from Jennifer Armstrong to a number of people. You're not one of those people. Is that right?

A That's right.

Q And it seems to be setting up a conference call of some kind, presumably discussing the Cupriavidus.

A I assume so. I know as much as you do about that----

Q No, no----

A -- particular email.

Q -- that's fair, but the point is that it terminates in a meeting that you weren't at?

A That's right.

Q Could you now have up your statement, please? That starts at page 30 of this week's statement bundle. The part I'm interested in at the moment will be on page number 69, and you'll see there's a short section of your statement dealing-- It's titled, "Communication with the GGC and Dr Inkster." "Refer to email correspondence of 16 March 2018," and that's the correspondence that we've just looked at.

A Yes.

Q And you see at question 18 you're asked if this was the first contact that you'd had regarding contamination at the hospital, and you've said yes; 19 asks if you had any knowledge in advance of this. You said "no", or "none"; 20 is noting that it was referring to Cupriavidus. Then 21's asking the question:

"Following this email, did anyone from GGC contact you to

follow up on your advice?"

Then there's some follow-up questions for that, and you've responded, in the last two lines:

> "None except [you] received a nice email from Ian Storrar thanking me. I did receive a forwarded email from Director of Facilities, Allyson Hirst, via Dr Inkster asking for availability for a joint meeting with Tom Makin; however, I was told when I replied to Dr Inkster this was no longer needed. Dr Inkster told me later when I asked about why, that they did not allow her to invite me again as they didn't like what I had said."

Now, just to clarify the timeline here, in that last answer, what date are you talking about when you are disinvited from the meeting with Dr Makin?

A Well, I didn't-- I think it was a few days later I answered the email, I think. I can't remember exactly, but it was after certainly after the meeting, and I can't remember the exact date I got the email. I can't access my emails because I lost my computer, and I can't remember the exact date of that.

Q That's fine. The exact date's perhaps less important then. You say that-- The email was 16 March and you had a visit on 25 April. What I'm interested in is whether the disinvitation happened a few days after the email in March----

A No.

Q -- or the visit in April?

A It was quite a bit longer than that because I just thought it was odd that I hadn't had any contact to go back, but they'd obviously decided they were going to invite Tom Makin instead, so I just took it that Tom was going to provide microbiology services and they didn't need me anymore.

Q When you say it was odd that you hadn't been invited to go back, does that mean that this disinvitation that you're talking about would've been after your visit in April rather than----

A Yes.

Q -- after the emails in March?

A Yes, yes, it was after my visit.

Q Okay, thank you. Well, you conclude that answer just by saying that-- there are the words, "as they didn't like what I had said"; you've given that as the reason for not being invited back. What did you understand that to mean?

A Well, they weren't too happy with what I said, and I can't remember exactly what I'd said, but I know we'd talked about-- I was quite amazed that they hadn't put a disinfection system into the hospital. So, normally – and particularly when you've got a high-risk

population – you would use a belt and braces approach and have both temperature and biocide control----

Q Okay, well----

A -- and it's a very large hospital with very sick children in it. I would have expected that and----

Q Okay, so----

A -- I'm assuming that's what they didn't like.

Q I'll come on to those specific matters later, but am I right in saying that those are things that you brought out in your report----

A Yes.

Q -- when you issued it at the end of April? So the words, "they didn't like what I had said" would refer to things that were in the report and not to things that you'd said in this email about the bottled water. Would that be right?

A Oh, I don't-- No, I don't think it was anything to do with the bottled water, no.

Q Okay, thank you. Now, you mentioned Dr Inkster, also, in that answer, and I think you also mentioned that you'd had some contact with Dr Inkster between the initial email and the visit? What was the nature of that contact?

A Teresa phoned me up from time to time to ask my opinion or just to get support in her thinking that she was along the right lines, but I can't-- I haven't got any notes or anything from those. It was just a general conversation about, you know, what was happening, I think, and----

Q Would you say----

A -- whether she was on the right lines. It was really just to give her a bit of support in her thinking, I think.

Q That would be her-- Would that be her thinking about the Cupriavidus issue----

A Yes, yes.

Q -- that you were initially contacted about?

A Yes, and what was going on with the water, and I know we had conversations about the drains at some time, so it was just ongoing, you know, as things were developing, and I can't tell you exactly how many telephone conversations or emails we had though.

Q Okay, so it would be occasional contact about----

Q It'd be occasional contact, yes.

Q -- and it might be about a number of things to do with the water system?

A Yes.

Q Thank you. Now, over what sort of period might you have been contacting her?

A I really can't tell you, because I've had regular contact with Teresa ever

since I met her, and I respect her. I've actually invited her to be part of committees that I chair, writing guidance and standards and, sorry, I couldn't pinpoint exactly.

Q That's fine. It goes way beyond, though, this particular----

A Yes, yes.

Q -- email chain in March and the meeting in April?

A Yes. Yes.

Q Well, if we move back to that visit on 25 April, you describe-- If we move right to the beginning of the statement at page 31, at question 2 you've given some description of the visit, and then on the next page, at question 3, you were asked about limitations on the visit, and you say there, at the start of your answer, that the intention of the meeting was what you understood to be a preliminary visit to visit Ward 2A of the hospital. Why did you have the impression that this was a preliminary visit that you were being invited on?

A Because I'd had a phone call-- an email, sorry, from Teresa to say that she'd had discussions with her colleagues, and they would like me to be involved and to put it on a proper footing. I can't remember the exact words, but something along those lines.

Q You may have answered this already, but wouldn't you say you'd had an indication that colleagues wanted you to be involved, that would mean involved in what?

A In supporting them in regular visits to help them manage the situation, with regards to the water and the drainage systems.

Q Again, would that be Cupriavidus specific, or was that more general?

A No. I think we'd realised by that stage that it was not just a single organism. If you've got something like that, it's almost certainly to be biofilms with lots of different organisms in it which could pose a threat, particularly for that group of patients. They are so immunocompromised that any potential opportunistic pathogen poses a risk to them, and it was likely if Cupriavidus was there then others were likely to be there as well.

Q Okay, but, in the event, that general involvement didn't come to pass, did it?

A No.

Q And you did say later on that you never received an official remit----

A No.

Q -- or instruction. So, if we'd restrict ourselves for the moment, just to the periods March and April of 2018 What did you understand was being asked of you around that time?

A Well, I think the discussions with Teresa, it was that I would go up and visit the ward so I could see where the water systems are, what they had, what the problems were, and it was specifically for that ward initially because we knew it was only going to be a short visit because of my time limitations, really, and I guess I expected that there would be a meeting with others from the team, the Estates team and the Infection Control one. I was there and, yes, that's how it usually works, and it did on this occasion.

Q Okay I'll come on to those meetings in a moment, but you mentioned "that ward" is visiting, which ward was that?

A 2A.

Q And 2A would've been within the Children's Hospital? Is that correct?

A Yes.

Q Now, I'll come on to the visit in just a moment but, now, before I do that-- you may have answered some of this already, but we discussed Legionella, Cupriavidus, Pseudomonas. Are these specifically waterborne organisms?

A Pseudomonas can be spread by lots of different ways, from water but also splashes from water, but people are also colonised on their skin and in their gut, so there is a potential person to person transmission and staff to patients and the other way round, and then from

patients to outlets, handles, surfaces. So there's many different ways of transmission of Pseudomonas in particular.

Q One other that comes up in your report is Stenotrophomonas----

A It's another gram-negative and, again, associated with waterborne infections and growth within biofilms, and there's a whole list of others----

Q Yes.

A -- that would fall into that same category.

Q Okay, the four I've mentioned, do they have similarities with Legionella?

Q Well, only in that they are gram-negative. Legionella is slightly different in that it tends to grow systematically within the system. So it tends to be throughout the system, whereas Pseudomonas and some of other gram-negatives, particularly Pseudomonas, requires oxygen for growth. So it tends to be in the more aerated parts closest to the outlet, where it will grow sometimes in quite dense biofilms if the outlets have not been flushed.

Q But all of those would be matters of concern to you, would that be right?

A Yes, absolutely.

Q Now, it-- I mentioned I'd come on to your visits. Could we have bundle 8,

page 134, please? After your visit, you prepared a report. Was that right?

A Yes.

Q And would this be the front page of the report?

A Yes.

Q Mentioned 25 April for the visit. Reports also dated, you – you'll see right in the centre of the page, 25 April. Did you finish the visit and then type this up straight away?

A No, I should have actually put from the meeting on that, but yes.

Q How long after the meeting, can you recall? Could you----

A I can't remember. Probably because I was going into hospital for a treatment, so it was probably two or three weeks. I can't remember exactly.

Q Now, I'll take you to parts of the report as necessary when we go along, but just to summarise, it's primarily in the nature of being a series of recommendations. Would that be correct?

A (No audible response).

Q And if we look at page 1, so that'll be page 135 of the print here, we see your introductory paragraph, 1, limitations. You've said "This reports an overview of the meetings which took place on 25 April '18," and then you give some details:

"In the morning was with [some names] Dr Inkster, Annette Rankin [some other names]... and in the afternoon, Teresa Inkster, Annette Rankin [again, some other individuals present at that one]."

Then, the last two lines:

"Because of the limited time, the discussions focused on the children's hospital only and included a visit to ward 2A."

So, at that point-- Can I take it from that, that you are still expecting that there might be other matters that you would have to address?

A Yes.

Q I wondered if you could describe those two meetings that you mentioned in this paragraph?

A Not really, it's a long time ago----

Q I understand that, yes.

A -- and I've done lots of similar meetings since.

Q Insofar as you can then, I wonder if you can give me details? We know who was there because we've got the names in front of us----

A Yes. Well, I think I had to ask Teresa who was there after the meeting. I mean, we sat down and we discussed the issues. I remember we talked about biocide treatment, and I was given an

overview of the situation to date with the accrued providers, but other concerns-- I think we mainly talked about the lack of biocide treatment, but I really can't remember the detail, I'm sorry.

Q That's fine. It is more than six years ago, at this point.

A Absolutely, and I visit lots of hospitals, so----

Q Yes, and sitting in plenty of meetings, no doubt.

A Yes.

Q Perhaps visits might-- or walking around might be the sort of thing that sticks in your mind a little bit more.

A A bit more, yes.

Q You did, in fact, undertake a site visit, as you say there. Can you recall who accompanied you on the site visit?

A Teresa and, I think, Dr Gibson, but I can't be 100 per cent sure of that.

Q How much of the site did you see?

A Just the ward. Just the children's ward really. The walk from where we were sitting and to the children's ward because I'd flown in in the morning and I was flying back the same day, so there was not much time.

Q So, the layout of the hospital is-- You may recall there's a very large building, which is Queen Elizabeth Hospital, and there's a smaller but still large building which is the hospital for children's. The children's ward is in the latter. How much of that latter building did you see? Was it simply one ward, or was it a tour of the building?

A No, I think we only looked at the one ward, as far as I can remember. Time was an issue.

Q You think that was ward 2A?

A Yes.

Q In fact, it says here, "Ward 2A." Thank you. What were your reactions upon seeing the site?

A How big it was, which is always a concern from a water perspective because it means that there's a very large system, and the larger the systems, the more difficult they are to control, but apart from that, not a lot. I mean, it was, you know, obviously a new hospital, but I see lots of new hospitals.

Q Okay. Well, it might help you if we look at your statement, then, page 35 this time of the statement bundle. The question here, question 7, is about the water supply and what you might have expected to see. Your answer, you start off:

> "I was surprised that such a large hospital, particularly one intended for use by high-risk patients with compromised immune systems, was not designed to

protect patients at high risk of waterborne infections with good design and engineering and a multiple barrier approach to prevent waterborne infections."

Now, I wonder if you can explain what you mean in that short passage? You're referring to "good design and engineering." What do you have in mind there?

A So, I've just been involved-- My answer might be a bit tempered because I've just been involved with writing some new guidelines to protect high-risk patients from waterborne infections, which followed on from the Papworth outbreak.

THE CHAIR: When you're talking about guidance, is this the HTMs, or is it other guidance?

A This is a new technical bulletin to supplement the current HTM.

Q Right.

A It was published on 27August by NHSE.

Q NHS England?

A Yes.

Q Sorry, Mr Maciver.

MR MACIVER: I asked you about what you might have expected to see as an example of "good design and engineering."

A Yes. Well, one of the problems – and it's been a problem for decades – is that hospitals are built with a large single water distribution system, so plant room and then the water is heated and distributed around the wards through various risers and loops which go around the ward and back again, drop back down to the plant room, but we've known for decades that we can't control those because they're just too big.

There are so many outlets – we're talking, in a big hospital, of thousands of outlets – and it's impossible to make sure that they are all used all of the time, and it's really important to make sure that the water flows right up to every outlet so that whatever you're using-- Whether you're using temperature, whether you're using temperature and biocides, there's no point unless you're actually going to get the water containing those right up to the outlet, and with outpatient departments you've got en suites with patients who are far too ill to get up and use them. There are all sorts of areas that are never going to be used constantly to achieve that amount of control throughout the hospital. So it's better, particularly for where you've got very high risk patients, is to have a smaller unique system for that unit.

Q What would examples be of the sort of thing you might hope to see as examples of "good design and engineering," but didn't see?

A Well, mainly that there was no

secondary control. WHO have, since 2003, advocated the water safety plan approach to managing water supplies initially, but then it was realised there were far more risks associated with the buildings that the water supplies were going to be in. So we worked for a couple of years and published Water Safety in Buildings – I was part of the WHO group that wrote that guidance – which advocated that this water safety plan approach was then used to manage, particularly in large buildings, how water was managed, sorry for repeating the same word, so that it was safe for the types of users and the types of systems that were in each building.

And the amount of care that you put into designing and managing a building would depend on the user group. So, if you are designing a hospital, you would expect far more care to be put in to how you were going to protect those patients than you would if it was a leisure centre with lots of healthy people using it, for example, and----

Q Would the separate systems for high-risk patients be part of that aspect?

A Yes, they would, and also having a multiple barrier approach so that, if one failed, you have a backup. So, if temperature failed, which it did, there was still biocide in there to protect the patients.

Q Okay, so can I take it then, from that, that's two specific examples of good design and engineering that you'd have hoped to see but did not?

A Yes.

Q The second of those was secondary control. Is that what you mean when you refer to "multi-barrier"?

A Yes----

Q "Multi-barrier approach."

A -- and that's the biocide-- would have been. So, if they're relying on temperature as their primary control, then having a biocide dosing system would have been their secondary backup control, in effect.

Q Okay, I follow that. So, in your view, biocide control, secondary control, would have been appropriate for the hospital that you inspected?

A Absolutely.

Q Would that be so for all hospitals, or is it specific to a hospital of the type that you were looking at in April 2018?

A If it was a small community hospital that didn't have large, reticulated, multiple loops – so a multi-storey building in effect – then it may be possible to manage without a biocide, but in such a large building, I don't believe that you can possibly make sure that every single outlet is going to be protected with just

temperature control.

Q Thank you. Moving over the page onto page 36, there's reference there-- at the foot of the page, question 8 is about an interim measure that was in place: point-of-use filters.

A Yes.

Q Did you see those when you were in the hospital?

A I think so, but I'm not 100 per cent sure.

Q Now, you're asked a series of linked questions here at question 8:

> "As an interim measure, point-of-use filters had been put in place in the children's hospital whilst a longer-term measure was sought. What was your view on the use of point-of-use filters? Was this appropriate solution? What, if any, was the risk in using [them]? In your experience, how can any such risk be mitigated? Were any such mitigation measures in place in [the children's hospital]?"

Now, you start out by giving your view in your answer that point-of-use filters are sensible precautionary measures.

A Yes.

Q You would agree with that?

A Absolutely.

Q Then, if we go over the page to 37, you set out a list of some relevant factors to consider when deciding whether or not to install these. Now, I will summarise, but I shan't perhaps ask you questions about all of those, but number 1 here on the list is about, "When filters are fitted, it reduces the activity space." Can you explain that to me please?

A Yes, so that is the space between the tap and the basin floor, if you like, where you've got room to wash your hands effectively without touching the tap or the basin. So, you need to have a decent amount of space so that you're not actively contaminating the outlet as you're washing your hands.

Q When you say, "Contaminate the outlets," how does that happen?

A If you touch them. So-- and particularly if you've got a point-of-use filter, you don't want to touch the outlet, because if you get soap onto the outlet – and it applies to taps as well – that acts as a nutrient source for Pseudomonas to grow, and other organisms as well.

Q So, the problem you're hypothesising here is that it's as simple as the filters might be large, reducing the space.

A And they reduce the space from the outlet-- the end of the outlet to the floor of the basin, so it's-- You know, instead of having your outlet end up there, it's actually down here and the

basin is here, so you've got very little-- it's very difficult to wash your hands without touching the outlet.

Q Item 2 in your list here, you're referring to an air gap. Is that linked to that particular problem?

A It is. An air gap is required under regulations so that you don't get backflow from the water in the basin up through the outlet and contaminating the water supply that's coming in through that tap. So, that air gap is required to prevent backflow up through the tap or up through the filter when you've got one in place.

Q So, in its simplest terms, the air gap means that the tap should be higher than the theoretical highest that the water can reach?

A Absolutely.

Q Did you see any indications that that was an issue when you looked around the hospital?

A I think so, but I think there was a small-- these silly cloakroom wash hand basins that if you fit a filter to, then there isn't room to-- they're bad enough anyway because you get splashes from them as soon as you turn a tap on in a hospital environment but, with a filter on, then that's even worse.

Q Okay. Number 3 we don't perhaps need to look at, that relates to the potential for the filter becoming blocked.

A Yes.

Q Number 4 is you're considering the risk of splash back from the configuration----

A Again, that's because the filter is much closer to the drain than an outlet tap would be.

Q In its simplest terms, would that be that the water comes out directly into somewhere where it might----

A And creates

Q -- cause splashing?

A Yes, creates splash back with drain water, in effect, onto the surface of the filter.

Q Why is that a particular problem, if it's drain water?

A Because drain water is an ideal, nutrient-rich environment which lots of bugs will grow in, including Pseudomonas, lots of other gram-negatives, all sorts of organisms, and if the sink has been used for disposal of waste water from patient hygiene, you know, from bowls of water used to wash them, for example, or sometimes antibiotic giving sets are put into the basin because there's nowhere else to put them and they're wet, then there's the possibility for bugs to acquire antimicrobial resistance, and they will swap those within the drains. So, the drain is a nutrient-rich, growth medium for

bacteria, in effect.

Q Okay, that's very clear on how that might create a problem. Again, was this something you saw in the hospital?

A I didn't look down the drain, but it's something you see in every hospital. Every hospital has a problem with growth within the drains.

Q Okay, thank you. 5, 6 and 7 on the page are dealing with potential for other sources, potential for contamination, poor fitting cleaning, or improper sampling techniques. Would those be things that you saw during your visit?

A No, I didn't, but again there are common things to watch out for when there are filters in place or you're considering filtering-- putting filters in place. So, that would be on my checklist, for instance, of things that we should consider if point-of-use filters are going to be used.

Q And if you'd come back for more visits, then you might have been looking specifically for that. And number 8, just for completeness, is relating to what might be potential defects in the filters themselves if they're fragile.

A And, again, it's doing due diligence to look at the validation of the filters. So, different manufacturers have different types of filter and different types of casing. So, I would look to see their data to see what validation they carried out for any particular filter.

Q And again, would that have been something that wasn't for this visit?

A It would be something I would advise the water safety group to do before they decided on which filter they were going to fit.

Q Okay. Over the page, on page 38, there's another list where you've given examples of how those risks can be mitigated and, indeed, the first one is the due diligence approach that you've mentioned. Other matters you're referring to are proper fitting, awareness training, training sampling, and fitting and reporting processes. Again, were these-- did you see indications during your visit of those mitigation measures?

A No. Again, that would be things to consider when you were deciding what filters you were going to use.

Q Thank you. I'm going to ask you now about, once the visit is complete, your general assessment of the system. Now, again, can you summarise for me the question at the time of the visit that you understood you were being asked to address?

A Really it was to look at the ward to see if I could identify any particular issues that might lead to contamination of the water system and

drainage system.

Q And did you come to a conclusion?

A Well, the design of the ward wasn't ideal because the way that the sluice rooms were at either end meant that if you had been bathing a baby or using water for any use in the patient area, it was a long way to walk to actually dispose of that water down the sinks, and there are risks, physical risks, with that such as slips and trips, but it increases the likelihood that nurses are not going to want to leave their patients and spend a long time walking to either end of the ward to dispose of water so that it increases the risk that they'll actually put them down the wash hand basins in the patient area.

Q In general terms there, are you describing a design issue?

A A design issue.

Q Certain features have been put in the wrong place----

A Yes.

Q -- and those features are sluice rooms.

A Yes.

Q I'll perhaps come on to those in due course. Since we've got page 38 up on the system, at this point you're being asked for your views on a number of discussion points. Now, am I right in thinking these discussion points are the same points that arose when you were compiling your report?

A Yes.

Q And in the questions that follow, which-- we'll come to some of them, but you're discussing things like water temperature, pipes, fungal contamination, training, a myriad of things to do with the water system.

A Yes.

Q As I said, these things are addressed both in your questionnaire and in the report. The questionnaire is considerably longer, more detailed than the report, so I'm going to stick for the most part to the questionnaire.

A That's fine.

Q That's fine. Now, you start off, the first question, question A there is asking about the importance of maintaining temperature control, and you go on to speak about poor temperature management and the scope that that allows for the proliferation of organic material. Now, just in general terms – and you described this later but I'll summarise it for now – there are issues that arise from temperature moving outside certain parameters, and those parameters are broadly that the range-- if the range is kept for cold water below 20 degrees and for hot water above 55 degrees. Would that be right?

A That's right.

Q That's where microbial proliferation is generally under control.

A Yes.

Q And one of the things you know later on in your statement is that the aim should be to keep water in the cold water tanks 2 degrees less than 20 degrees to allow for heat gain between the tank and the outlet.

A Yes.

Q The reference there is the foot of page 84 of the bundle. I don't need to take you there, but I wonder can you explain what you have in mind, therefore allowing for heat gain between tank and outlet?

A Well, what you want is to achieve ideally less than 20 at the outlet but, particularly in a large building, there is going to be quite a distance between the water storage tanks and the outlet. So, it allows for you having a maximum of 18 degrees, in effect, coming into the tank and still being able to achieve, if the design is right, less than 20 at the outlet. So, it allows for that-- what we know is going to be heat gain during its distribution during the system, but a well-designed system should be able to achieve that two degree tolerance.

Q As I understand it, when it came to write your reports, am I correct that you didn't, in fact, have data relating to the temperatures?

A No, I think there was a problem with the database. I think it had been lost at that time or just around that time, so it wasn't possible to look at any data.

Q But I understand also that you had-- in fact at the foot of this page, the last four lines here, you indicate there was evidence of ongoing issues with poor temperature management in draft review of issues related to hospital water systems risk assessment, and you say that was sent to you prior to the visit.

A Yes.

Q Just give me a moment please. Bundle number 8, at page 150. If you could bring that up, please? Is that the document that you're referring to?

A It's got a slightly different front page from the version I saw, but I think it had a “draft” on it when I saw it.

Q Okay, well, perhaps I'll come back to that, maybe in a slightly different context in a moment. The specific point that I would like you to explain to me is you've been mentioning that well-designed system should be able to cope with movement from tank to outlet with no more than a two degree heat gain. Did I pick that up correctly?

A Yes, in a well-designed system, yes.

Q And the indication that you'd seen was that that was not happening

and in fact temperatures were going outside the parameters?

A The information I was given, if I recall correctly, was that they were seeing some warmer cold water temperatures and cooler hot water temperatures.

Q Okay, well, in the context of what you said about good design being the method for managing that, what is it in the design that would cause-- that would either be good, meaning that temperature was maintained within the parameters, or was bad, meaning temperatures varied outside them?

A It's avoiding long legs from the water-- So, you have a loop of water, from hot water source, so it goes up a riser and then on each floor you will have a loop that goes backwards and forwards, and from that loop you will then have a spur to each outlet.

Q Did you say “hot water system” you're describing?

A You're talking about hot-- Sorry. Yes, you asked me about the cold, didn't you?

Q Yes.

A But similarly from the cold. So, from the cold water distribution system, it will go to various risers around the hospital. So, that's the pipe that takes it up, sometimes it'll take it down if the tanks are on the roof, and then that will

be fed through to each ward and there'll be (inaudible) coming off it that would feed each outlet or equipment or whatever is on the end of it.

Q Did I pick you up right where you said specifically it was the length of the legs that was determining the----

A Yes, so, the longer the leg, the more likely it is that if somebody only turns the tap on for a short period of time, then they might not empty that little-- draw water through that is at the same temperature as the supplies. So, ideally, if you're flushing, you want to make sure that the water that you're getting out of the end of the tap is at the same temperature as the water that's coming in from the supply, but that doesn't happen because the taps aren't used often enough, generally, in hospitals.

THE CHAIR: Mr Maciver, your question was – at least, if I was following it – what are features of a water system which will mitigate or prevent temperature gain in a cold water system? Now, I'm not quite sure that – I'm sure the fault's mine – I've got an answer to that.

A Well, yes. I mean, I need to----

Q I understand what you say about risk, but I think you were being asked about what are the features of a system which would prevent or reduce that risk? I mean, if I'm following where we are.

MR MACIVER: Yes.

A Well, okay, to be clearer-- Sorry if I wasn't quite as clear. So, to prevent that happening, you keep your legs as short as possible. You keep your water flowing. You have sufficient insulation to make sure that there was no heat gain from the hot water. Ideally, you want to separate your hot water pipes from your cold water pipes so that there's no transfer of temperature from hot to cold, and the other way around from cold to hot as well, so that you're maintaining those temperatures. So, the design should be to achieve the target temperatures at each outlet within 30 seconds for the hot water and 2 minutes for the cold, which is within the Legionella guidance, the HSC Code of Practice.

Q Okay, so those are four specific design features that you're describing.

A Yes.

Q Short legs, more flow, isolation of hot from cold----

A And good insulation.

Q -- and good insulation. Now, my question was did you see examples of, or lack of, those on your visit?

Q I didn't look at the distribution system, and so I didn't go and look at the risers, for example, on this occasion. I would have done-- It was really to get my head around the ward and to see what

was on the ward rather than looking in detail. Normally, I would have looked at the risk assessment for the building at some point but it was just so I could see for myself how the ward was laid out and if there are any risks that I could easily identify as being a problem.

Q Okay, so, your observations on the specific system at the hospital, would those have been based upon the information-- should we understand those to be based upon the information that you had about temperatures drifting outside parameters?

A Yes, absolutely.

Q They're not based upon having seen the pipes that were----

A No, I didn't go around taking temperatures or looking in risers, etc., on that occasion.

Q Thank you. Now, you've already mentioned that there are other measures beyond temperature and movement that can be used to control the water system, specifically dosing-- biocide dosing. You may have already-- In fact, I think you've probably already answered my next question. So, can I direct you to the minutes of a meeting of the water technical group which will be at bundle 10, page 18 please. Now, you recall that your visit was 25 April 2018. That's right?

A Yes.

Q And this appears to be the minutes of a water review meeting on Friday 27 April, two days later. Again, you're not recorded as having been in attendance here.

A No, I wasn't.

Q If you look at the names, some of the names will be the same names that you that you met. I'm interested in the section two pages further on. Page 20, there is a section, second block on the page, "chemical cleaning" is the heading. Do you see that?

A Yes.

Q Now, you're mentioned in there. I think perhaps I should read the whole block to you.

> "It was noted that Raigmore and Tayside have silver copper ionisation plants. It was agreed to speak to these boards to ascertain their experience using these for decontamination. Sanosil concentration used to clear biofilm. We've used 1 ,000 parts per million and 3,000 parts per million, but there is thoughts that higher than 3,000 would be sufficient to remove biofilm. Susanne Lees reported [which I take to be you] that higher dosage of this product is more effective and would bring us in the short term but the impact on the pipes and taps from the higher concentration would need to be known. High dosage of hydrogen peroxide can damage the water systems and IS will forward this information but noted it causes less damage to the brass within the system. (Inaudible) asked what can be done in the meantime to aid with patient safety."

Now, first-- There's quite a lot in there. First question I have is that you're recorded-- or first observation I have is that you're recorded, as I read it, as having discussed the benefits of something called Sanosil over something called hydrogen peroxide. Is that a fair reading of what's written here?

A Sanosil is a silver stabilised hydrogen peroxide, so it is both silver and hydrogen peroxide. It is not something that I would never advise using in this situation. It is a very strong oxidising agent, and when you know you've got lots of biofilm in a system it tends to get mopped up and doesn't get as far down the system as you would like it to. My----

Q Can you explain that to me? You're painting quite a vivid picture here of being mopped up and not getting far into the system. How does that actually work?

A So, if you think about silver hydrogen peroxide being quite a

voracious animal and it's very hungry and you've got lots of food on the surfaces of the pipes----

Q The food being?

A Sorry?

Q What would the food be in this-----

A The biofilm and the bugs on the biofilm, but it's only got enough energy to eat so much. So, it'll eat its way along until it runs out of energy, and then it can't go any further. So, some other biocides are not quite as strong an oxidising agent. So, their energy lasts a lot longer, so they can get a lot further down the pipe, and therefore they can get nearer to the outlets than hydrogen peroxide. That's maybe a strange way of putting it, but I hope it gets a picture across.

Q No, I get the picture. The one point I wish to clarify there is when you talk about energy, would I be right in understanding that that's effectively the biocide being used up as it does its job?

A Yes, that's its oxidation power, in effect, so it uses up-- if you think of that as an energy cell, it uses that up.

Q Okay, but Sanosil would be-- silver hydrogen peroxide would be a material that could be used up quickly.

A Yes, more quickly than other biocides, because it's such a strong oxidising agent.

Q So, in fact, your position would be that you wouldn't be recommending Sanosil?

A No, my experience, my partners and colleagues as well, is that it is not effective in a highly colonised system. I do know in Scotland there have been some success stories with Sanosil, because the water is softer and you don't get the scale developing on the interior of the pipework, which sort of provides a framework for biofilm to attach to, and I haven't previously had any experience in Scotland of using it but certainly our experience in lots of different buildings has been that it hasn't done the job in the long term.

Q Okay. You may or may not be aware that chlorine dioxide was used to dose the system at the Queen Elizabeth. Are you familiar with chlorine dioxide as a biocide?

A Yes.

Q I wonder, do you have any familiarity with its corrosive properties?

A All biocides will have an effect on the materials within the system, so they will all reduce the life cycle. So, that's the length of time that's estimated that the system would last if they hadn't had a biocide in them. Then, for example – and this is just out of the top of my head – they may last 25 years, but if you're using a biocide, then plastics will harden

and can crack and you can get corrosion of metals. So, they will affect both the plastic components and the metallic components within a water system.

Q Presumably, the amount by which life cycle is reduced will depend upon strength on dose material used and so forth.

A Strength, dose, contact time, yes.

Q But does it follow from what you're saying that these are all matters that would have to be taken into account at the time when deciding whether or not to use them?

A It's a balance, and most engineers I've worked with know that there is going to be a reduction in life cycle, but the effect of reducing risk to patients makes that an acceptable risk.

Q Okay, thank you. Turning back to your statements at page 39 of the statement bundle, please. This is a section dealing with question 10 at the foot of the page I'm interested in. This is a question dealing with pipe work-- contamination of pipe work, and again you-- the first two lines of your answer are referring to the draft review of issues relating to----

A Yeah.

Q --that's maybe the document that referred you to earlier.

A Yes, yes. That you showed me earlier, yes.

Q Now, what you're saying about it there was that it identified-- that document identified there was documented evidence that there were open-ended pipes on site. I wonder if I take-- just take you to that document. Again, it was bundle 8, page 150 that it started. If we look at page 157, then in the main section of the page, "source of contamination," I think seven lines from the top there is a statement that "there was evidence that pipework was contaminated during construction." You see that?

A Yes, I can, yeah.

Q And four pages further on, page 161, there's-- what would be right in the middle of the page. It's towards the bottom of the screen here. We've got a list one to four, and just below that list, there's a paragraph beginning, "It is possible however," see that?

A Yes.

Q

> "It's possible, however, the original microbiological seeding of the hospital's water system happened when the system was filled with unfiltered water due to the level of breakdown experienced with the filtration unit. There was also some evidence that materials

handling, and hence cleanliness of the interior of water pipes, was not entirely efficient during the construction phase of the hospital which may also have introduced contamination in to the systems. ”

Now, do you recall having seen that before you did your work in producing the report?

A Yes.

Q And so if we go back to your statement, page 39----

THE CHAIR: Do you remember who gave you that document?

A Dr Inkster.

Q Dr Inkster, and you have got that before you prepared your report?

A Yes. I think it was still in a draft form.

MR MACIVER: And if you recall what I took you to at the start of your answer to question 10, "It was documented evidence that were open-ended pipes on site." The parts I read out to you, are those in effect what your evidence was?

A Yes, I think we also discussed it at the time I was walking around. I can't be 100 per cent sure what we said, but yes.

Q Thank you. What conclusions did that lead you to?

A It was very frustrating that the water had been bypassed the filtration system, because that was designed in to minimise the risk of any contamination from the water supply.

I talk about contamination. It's not really contamination. These are organisms that naturally live in supply water, so they're not contaminants. This is their natural home, their natural environment.

Q Okay, so you mentioned the bypass there, but you're also talking about presence of nutrients.

A Yes.

Q And also about pipes being left open-ended. Could you describe what your concerns are there?

A If the pipes are open-ended on site, that means they're not actually looking after the components that they're going to be building the system with, and it allows for dust, nutrients, insects, potential rodents to get into the pipework and leave nutrients behind, and those nutrients then will provide a food source for bacteria and other microorganisms to feed on. So, having made those observations or reached those conclusions, I'm interested in how that feeds into your report, so if we could have that up on screen again it's-- this time page 136. Now, towards the top of the page there's a bold block, "Recommendation 1," you see that?

A Yes.

Q And there you're saying:

"Water systems should be pressure tested with gas whenever possible and systems filled with water as late in the build as possible. Once filled, they should be disinfected and flushed to remove nutrients such as cutting fluids etc. and kept flowing disinfected as if the building was in full operational use. Records should be kept when the system is filled, commissioned, handed over, and occupied together with all disinfection, monitoring, and flushing, and any remedial works that need to be carried out."

There's quite a lot in that paragraph. I wonder if you can explain to me your main concerns.

A I was really concerned that they hadn't followed best practice in filling the systems in the first place. So, ideally, you want to put water in as late as possible. So, until the recent guidance, the water used to be pressure tested initially with water, but then that meant that it was sitting there while all the fitting out, etc., was being done and not managed appropriately. So, it's been in guidance for a while. I'm not sure, I can't remember off the top of my head whether it was in the 2013 guidance, I think so, in that if you pressure test with air first, then you can sort out most of the problems if you've got a problem with an unsealed joint, etc., you should be able to see a pressure drop.

Q So in that scenario, effectively, air or gas is acting as a substitute for water.

A Initially, so that's the first stage but then when you're ready to fill the system, then you will do an additional check to make sure that all the joints, etc., are effectively stopping any leaking.

Q And that filling, you said, should be as late as possible?

A Yes.

Q So, do those two elements, in fact, go hand in hand in what they are both bearing upon is the idea that the system should not have water in it before it needs to?

A Absolutely.

Q So, looking at your recommendation, you've mentioned those as parts of what you've written here at recommendation 1, but presumably this is too late to be any use to this particular hospital.

A It is for the systems, but it's applicable to any equipment that they may subsequently add to-- or secondary systems to systems, so it's worthwhile putting that in as a reminder.

Q Okay, thank you. If we move on in your statement, please, to page 43

and here's an entirely different subject matter, something called aspergillus. Firstly, can you explain what that is?

A It's a fungus, so it can cause fungal infections. It has spores which can live for long time dry areas. It is a particular problem when buildings are demolished and that the spores are released and it can then cause infections, particularly in people who are highly susceptible to infections.

Q Now, fungal contamination was an issue at the hospital. In your reports-- I'm not going to take you there for simple reasons of time, but in your report you've said it's likely that fungal contamination is a consequence of ongoing demolition work and if you see-- if we're going to page 44 of the statement, here, you are asked a similar question at C at the top of the page, and your conclusion:

> "Dust and debris released during demolition is recognized as a source of fungal spores. Please see answer above for alternative sources. In my opinion it is possible that the contamination came from demolition works."

Now, the word "likely"-- I can take you to your report if you doubt this, but you may take my word for it. In your report, you've used the word "likely" in your answer you've used the word "possible" for contamination coming from demolition works. Is there any particular reason for the change of words between report and questionnaire?

A No, well, except that when there are lots of-- when demolition work is carrying out, it is considered a high risk. So-- but I didn't have the information or any data to say that there was a problem with dust and debris at that time, so I didn't-- it was a supposition; it wasn't that I had any data to come to any conclusion.

Q So, in actual fact, again, here should we understand this as being a general observation as to how things such as Aspergillus might arise rather than something specific?

A Yes, and this wasn't something that came out during my visit this was-- came up afterwards.

Q Thank you.

THE CHAIR: Sorry, I'm-- Where does this leave us, Mr MacIver? I think--

MR MACIVER: I think----

THE CHAIR: On possible/probable, I'm on "possible."

MR MACIVER: We have "possible", as your Lordship's seen, at page 44. I should have given your Lordship the reference for. "Likely" was the wording in the report. It's the same sentence but "likely" rather than "possible."

THE CHAIR: I beg your pardon. Right, I think Dr Lee has retreated from "likely."

MR MACIVER: In any event, it's paragraph 3.2 of her report.

THE CHAIR: And the assumption that there is fungal contamination depends on the GDC document that we've been looking at or does it not?

MR MACIVER: As I understand it, yes, my Lord, but I don't have a reference for that.

THE CHAIR: Sorry, I understand-- I mean, the report talks about Aspergillus in a generality, and a possible source of that is demolition work. It's no doubt my fault for not keeping up, but do we have any-- do we have a source that indicates that prior to the time that Dr Lee was being asked to advise there was fungal contamination including Aspergillus?

MR MACIVER: I should perhaps ask the question of the witness. (To the witness) What was your basis for understanding that fungal contamination might be an issue at the hospital?

A I think this came from a telephone conversation, as far as I can recall.

Q Telephone conversation with whom?

A It would have been Teresa. I really only corresponded with Teresa.

THE CHAIR: Sorry, I didn't hear that.

A With Teresa-- Dr Inkster.

Q Right, okay. Thank you.

MR MACIVER: And turning back to the report again, bundle 8, at page 136, at the foot of the screen here we've got section beginning "Training," and it concludes in two recommendations over the page. We see recommendation 2 is to summarise essentially that all operational staff and contractors be given wide-ranging training.

Recommendation 3 was more specific that there be a separation of tools used between clean and waste water systems. Did you have any indication that these things were not happening at the hospital?

A No, but-- No, not at this hospital, but the indications from the lack of care with the pipes that were being installed led me to have some concerns about whether there had been appropriate training on how to keep systems safe during the construction and installation process.

THE CHAIR: Right. Can I just take that in steps? Source of information about pipes, I think, comes from the GGC----

MR MACIVER: Yes.

THE CHAIR: -- document. "Indicates lack of care." From that you infer other failures?

A It infers that there hadn't been

appropriate training so that those contractors and installers knew that they should keep the pipework capped and prevent ingress into the pipe during the installation process.

Q All right, thank you.

MR MACIVER: If we look at the statement at page 46 and the answer to question B there, beginning:

> "See previous answers. Also, due to time limitations, I did not go into training during my visit."

Because you were under the----

A That's true, yes.

Q Because you were under the impression this was a preliminary visit.

A Yes.

Q So, again, we should take it that your observations on training, for example, and your recommendations there are-- should be understood in the nature of general observations rather than specific feelings that you've observed for yourself.

A Yes, but taking account of the fact that there was observations that the pipework hadn't been well looked after, for example.

Q Going back a page to page 45, you have mentioned in the top paragraph, the page begins with the "HSE Approved Code of Practice" and you're explaining there that's:

> "...intended to help to explain the requirements necessary to comply with legislation and explain the duties for those with responsibility for health and safety under the law."

And you mentioned associated guidance HSG 274, part 2, with examples of good practice and how water systems can be managed safely. You then say:

> "Whilst it is not essential that the ACOP and guidance have to be followed, the onus is on those responsible for health and safety usually in a large organisation the Duty Holder supported by the Board, to show that if they do deviate from the ACOP and guidance the outcome should be as good or better than if they had fully followed the ACOP and guidance."

Now, a couple of questions coming out from that. Who was the Duty Holder at the Queen Elizabeth? Are you aware of that?

A That's a good question, and it's quite often one that's difficult to answer. It's usually the CEO and/or the Board. So it may be-- It's the person who has ultimate responsible (sic) for health and safety on site.

Q When you're speaking here of deviations from the Code of Practice, did

you have anything specific in mind that you'd seen at the Queen Elizabeth?

A The Code of Practice says if you can't achieve your primary control temperature at all outlets, then you should have an alternative control measure in place, and it-- in such a large hospital, you're never going to be able to achieve control just by temperature alone for all the reasons that we've discussed already.

Q Okay, so if the requirement in the ACOP is either temperature control or alternative measure----

A No, no, no. Temperature is always-- it's seen as the traditional means of controlling-- The ACOP is all about *Legionella* primarily. So it's all about-- That is the traditional way – I know that we're very careful about the wording – of managing Legionella in large buildings, not just hospitals, and if you can't achieve that, then you have to have an alternative means of control.

Q And the responsibility for having that alternative means in place would fall upon who?

A The Duty Holder.

Q And did you see any indication that that had been fulfilled in the Queen Elizabeth?

A There was no biocide, and there were problems with temperatures, so, no, it hadn't been fulfilled.

Q Two pages further on in your statement at page 47 there is a section dealing with water safety group. Now, I'm not going to ask you about the group, but I do wish to ask you about a couple of references you've got within these answers. Firstly, on page 48, you mention in the last block of text there-- and here you're discussing-- the question being asked is "in what way was it geared towards Legionella," and you've said:

> "For high-risk patients [in that last block] such as those in the children's haematology oncology, whilst it is important to effectively control the risks from Legionella, this is not the greatest risk to these patients."

And you then go on to explain that that immunocompromised state means that other pathogens – Pseudomonas is the one you mention – might be a greater risk, and then again, over the page at 49, question B there is where you're asked about your recommendation for changing the composition of the water safety group, and again your answer there starts off:

> "Prior to the issues ongoing at the time of my visit, the focus of the scheme of control is focused on the risks from Legionella."

Now, in summary, is it fair to say

that what you're saying here is that there's too much focus on Legionella and that this should be diffused somewhat?

A I wouldn't say there was too much focus, but the primary focus was on Legionella. You still have to control Legionella in any hospital system. It affects not only patients, but visitors and staff as well. So there is a requirement to control Legionella, but you have to be aware, particularly where you've got patients at the highest risk of waterborne infections, that you have to manage those as well as Legionella, not instead of, but as well as, in addition to.

Q So perhaps rather than saying there's too much focus on Legionella, the better way to summarise it would have been there should have been similar focus on other things too?

A Yes.

THE CHAIR: Could we maybe just tease out what you mean by "too much focus on Legionella"?

A I didn't say "too much focus on Legionella."

Q Well-- Right. Well, correct me on this.

A I said it was "focused on Legionella," which meant it was----

Q Mr Maciver has drawn your attention to an answer which says:

> "Prior to the issues ongoing at the time of my visit, the focus of the scheme of control is focused on the risks of Legionella."

Is that a good thing or a bad thing or a neutral thing?

A No, that's a bad thing because they were only focusing on Legionella and not on the other potential waterborne pathogens as well. So they were ignoring the other risks to patients.

Q Now, again, just trying to understand that answer, does that mean that-- Are you thinking of a situation where water sampling does not indicate the presence of Legionella and the person doing the water sampling is therefore content that there is no infection risk, or are you thinking of something else?

A No, I'm thinking that all the risk assessments that they were carrying out were only looking at Legionella and not at the other waterborne pathogens that could have been in the system as well.

So the risk assessments were following the British Standard for Legionella risk assessments, but not also following the British Standard for Pseudomonas and other waterborne pathogens as well. So they were only looking at the risks from Legionella. They weren't looking at the risks from Pseudomonas and other related gram negatives.

Q How does that manifest itself in a practical way?

A Because Legionella is primarily growth within the whole of the water system and you can control that by having good hot water temperatures and good cold water temperatures, but Pseudomonas Aeruginosa and these others can be-- can grow at the outlets by contamination from somebody external to the water system or something external to the water system. That doesn't happen with Legionella.

So, people can be colonised with Pseudomonas Aeruginosa and these are the waterborne pathogens and can touch an outlet, contaminate it, and it can then grow backwards up the outlet into the water system. That doesn't occur with Legionella. So there are lots of not just engineering aspects that you need to look at when you want to make sure that your water system is safe; it's also how people are using it, how they're touching it, whether there is any splashing. That isn't a Legionella risk. That's a risk for these other organisms, including Cupriavidus, for example.

Q So, what was it that you either observed or were told that indicated that the potential for organisms other than Legionella to present enhanced infection risk were-- I mean, the measures were not being taken or----

A So, the measures that they had in place to manage the water system were only managing the aspects of Legionella. They weren't managing the aspects at the outlet and the drain as well. They were only focusing on systemic growth of Legionella within the system, so whether there was hot temperatures, cold temperatures, whether there was flow, but not whether there was contamination potential from the drains, for example, which would be a way of these other organisms causing infection.

Q Right. Sorry, Mr Maciver.

MR MACIVER: No, that's helpful, my Lord, thank you. Perhaps I led that confusion myself with my questions, but to summarise your answer, it's not that focus on Legionella is a bad thing, it's that there has to be focus on Legionella and----

A And the others, yes.

Q And it's the "and" that was missing, from your perspective.

A Yes.

Q Now, at this point, I'm going to take you forward in your statement to page 54 where there's a long section dealing with design issues and various aspects of design, and one of those, in particular, you alluded to at the very start of your evidence. Now, there are a number of heads to this question. I'm

certainly not going to take you to all of them, but I'll pick out, perhaps, three or four that might be of interest, and I'll just ask for your observations on those, but I'll take you to the first.

The first one is the one that you mentioned, page 60, which is, I think, sub-question C in relation to sluice rooms. The question being asked of you there is:

> "Can you explain the risks associated with the positioning of sluice rooms? How does the positioning of sluice rooms relate to water contamination? Did anyone else share your concerns in Ward 2A?"

Firstly, before we do any of that, what are sluice rooms?

A So, these are the-- So, there are, sorry, clean and dirty sluice rooms usually, but the dirty sluice rooms are where, for example, bed pans would be taken to be put into a macerator where they might clean things like drip stands and wheelchairs, and so it's where they carry out the dirty aspects of cleaning on the ward to prevent infection ideally. So, cleaners will use the sluice rooms to empty their buckets and that sort of thing, as well.

Q Okay, did I misunderstand, but there are also such a thing as clean sluice rooms?

A Yes, well-- Yes, depends on the hospital. Sometimes they're called "clean sluice rooms" or "clean rooms", but they're areas that are staff only areas and, in the clean sluice rooms, they carry out things like drug preparation and that sort of thing, not really relevant to what we're talking about.

Q Okay, so, we're primarily interested in the dirty sluice rooms for getting rid of dirty----

A Yes, water use for personal hygiene as well as water you use for cleaning floors and that sort of thing.

Q Okay, and these are necessary things to have in any hospital?

A Yes, absolutely. Yes.

Q What are important things to take into account from a design perspective?

A So, ideally-- There's very few sluice rooms that are built with enough space to actually carry out their function properly, so you should be able to have a flow through the sluice room so that-- and enough space to set dirty objects down before they're cleaned, and then have a process where they're cleaned and then they're put to another area where the clean items are separated from the dirty end. So, ideally, you should have a dirty end space to set things down before they're cleaned or put into a bed pan

macerator, for example, and then another area on the other side of that where you don't have the potential for cross-contamination from the dirty objects back to the clean ones.

Q Okay, so, there are rooms with at least two distinct areas, one for dirty objects, one for cleaner objects.

A Yes.

Q What physically is in the room? Are these drains in the floor? Are there sinks? Are there machines?

A There's usually either a bed pan macerator, there is usually a big sink for emptying mop buckets in, there's other sinks for what-- putting water for patient hygiene-- that's been used for patient hygiene down, space for cleaning wheelchairs, that sort of thing, that have been used by decontaminating between patients.

Q In short, the space is for dirty items to be either----

A Cleaned, yes, or----

Q -- cleaned or----

A -- disposed of, yes.

Q The sluice rooms that you saw at the hospital, what was wrong with those?

A Well, the distance from the nurses, where the nurses were actually carrying out their activities, so if they had been, you know, washing a patient, then they had a long way-- If you imagine a

bowl of water and you've got to walk a long way to dispose of that, time is an issue, being away from a patient who's very ill, but also the risk of dropping water on the floor and slips, trips and falls, but it's really keeping somewhere where you're going to be using water for patient care, there should be somewhere to dispose of that in close vicinity to where their activities are being carried out.

Q It's proximity that was the failing that you identified?

A Mainly, yes.

Q To attempt to summarise that, the distance acted as a disincentive to using the rooms, would that be a fair way to put it?

A Yeah, it was a horseshoe-type ward with the sluice rooms at either end, so it was a long way from the middle where the patients were to get to each end to dispose of the water.

Q If we go onto page 77, you see at 45 here you're asked a general question about your concerns regarding the design of the wards, but in actual fact, your answer here is specifically about sluice rooms, and you've told us here pretty much what you've told us a moment ago, the need to walk relatively long distances made it difficult for staff, as well as posing risks of slips and trips, but then, in the last sentence, there's a different aspect:

> "There had not been any consideration of the practicalities of using the ensuites for parent childcare, for example. It was very difficult to fill baby baths, and so filters were removed; the sinks had also not been designed to take POUF [point-of-use filters]."

Firstly, are those-- These all appear in the one answer that starts off with-- the bulk of which is about sluice rooms. Are these concerns around baby baths and filters-- Are these separate issues, or are they part of your concerns about sluice rooms?

A The question was the concerns regarding the design, so they're both concerns regarding the design was, one, the sluice rooms, and the other was that the ensuites were not well designed for their intended users.

Q Okay. Well, I'll come back to the ensuites shortly, but just going back to page 62 this time, we have a different section, also confusingly numbered C, "Flow straighteners/aerators." Can you describe these items, please, and the risk that comes from them?

A So, flow straighteners or aerators are inserts that are put into the inside of the outlet.

Q By outlet, you mean taps?

A The tap, yes. Sorry, the tap outlet, so that-- and they are like a mesh, can be made of plastic, can be made of metal, and they're there to either make the stream of water less likely to cause splashes or, if they're aerators, they're there to inject air into the water that's coming out, so you actually use less water, but the implications of both of those is they create a huge surface area because of the mesh, and they collect particulates – so bits of scale, corrosion, metal coming from the pipework – which increases the surface area in the end of the outlet as well where these aerators are, which provide a really good surface for bacteria to attach and biofilms to form.

I've been involved several times in my career in problems with Pseudomonas contamination of these outlets, but the one that came to the foremost was the outbreak in Belfast, which resulted in the deaths of some babies, and there was an investigation carried out by a former colleague, Jimmy Walker at Porton Down, that showed that these aerators were heavily contaminated, over millions of Pseudomonas aeruginosa in one of these aerators at the end of a tap.

Q So, what did you think when you discovered that these items were present at the hospital?

A I was horrified. There'd been such a lot of press involvement of the Belfast outbreak. There'd been new

guidance from the Department of Health that raised this issue and advised about how to reduce the risk and not having these flow straighteners was in that-- and aerators was in that guidance.

Q Yes, thank you. Page 64 please, two pages further on. At the bottom of that page, we've got "e. Point-of-use filters." Now, you've discussed those and described those already, so thank you for those, but I'm interested in the-- Just give me a moment-- an issue relating to baby baths. Now, did you see any examples-- You mentioned the reduction of space and so on that may be caused by having the filters, and you've also mentioned elsewhere the issue of baby baths being unfillable, are those two issues linked?

A Sorry, can you repeat that----

Q Are those linked? Was the baby baths being unfillable anything to do with the presence of point-of-use filters on the taps that might be used for them?

A No-- Well, that didn't help, that made the situation worse, but the sinks weren't big enough to get a point-of-use filter. It was difficult to fill them without splashing water onto yourself when you'd filled them anyway. If you can imagine a bathroom basin and trying to fill a baby bath with a bathroom basin, it would be very difficult to do that without getting water all over yourself at the same time.

Q Thank you. So, that's a design flaw, but it's not a design flaw----

A It's not taking account of the intended user and uses of the water, yes.

Q Now, you may recall this without me having to take you to it, but the point-of-use filters informed 14 recommendations that were in your report, was that correct? Towards the end of your statement page-- it's only three pages further on, 67. No, it's not, sorry, it's question 67, page 82. The second half of that page relates to an action plan and you're saying at 66 that you hadn't seen the document previously, but 67-- that the action plan-- the question is if the action plan was an accurate reflection of your recommendations, and you've said "Yes."

I'll take you to look at Bundle 12, page 930, please. We see here a document that's headed, "Action plan from Susanne Lee report – attributed to Teresa Inkster/Ian Powrie May 2018." See that?

A Yes.

Q If we look here, recommendation 1 is-- something corresponds to what----

A What we talked about earlier, yes.

Q We won't go through all of them, but if you look at recommendation 2, does that also correspond to one of

your recommendations from your report?

A Yes.

Q So, on the face of it, that's an action plan dating from May 2018 and, in actual fact, if we go one page further on, then we see-- at the bottom right corner of that page in relation to recommendation 3, we see a recording that the next meeting that is due on this particular "disinfection of tools" topic is due on 4 May 2018. So, on the face of it, this action plan has been drawn up quite soon after your visit.

A Yes.

Q If it's based upon your recommendations which are in your report, that rather suggests that your recommendations must have come out within a week or so of your visit rather than two or three weeks as you estimated earlier.

A Yes, some-- Yes, yes, okay. I think so.

Q Could we look, now, at bundle 27, volume 3, page 465, and this is headed, "Action Plan from Susanne Lee Report." You see the recommendations in the first column are the same as we looked at a moment ago. If we look at the last column-- There are five columns in this version, and the last one is "status" column, and it's recording in these two boxes the status of these particular actions at 17 August 2018. If we go on to the next page, we should see something similar in the last column. Do you take it, then, on the face of it, that your recommendations were being considered or being put into effect in August?

A Yes.

Q One final specific issue that I'd like to ask you about which is about water outlets within the hospital because this was a concern of yours. If we go back to your statement at page number 57, the heading of this page is "over-provision of water outlets," and you'd stated that it was felt it was over-provision of water outlets, how is this communicated to you by whom, etc., and you've said in your answer there:

> "This is a common design problem in that the calculation for the provision of water outlets guidance is out of date and all hospitals have too many outlets. "

Can you comment on your views on the outlets at the Queen Elizabeth Hospital please?

A Yes. This is really based on work that's been done in in Holland, but where you've got very high-risk patients who are extremely vulnerable to water-borne infections, you should consider removing outlets where the patients might be exposed. It's been shown that splashes from outlets can reach up to two

meters from that outlet. So, if you've got one in a patient bedroom, for example, there is a high risk, unless you have a screen or some other means of preventing splashes from the outlets and the drains from reaching the patient, that it's better to remove those so that you're not putting those patients at risk. The evidence that removing them from the proximity to the patients has reduced both waterborne infections, the use of antimicrobials, reduced patient stays, and overall costs of treatment of those patients because you're removing that source of infection from their proximity.

Q Is this something specific to high-risk patients?

A Yes. Well, it's more important for high-risk patients, but generally, if you walk around a hospital, you'll find that there are lots of outlets that are never used. In outbreak investigations, I've stood in neonatal units, for example, where there are two wash-hand basins side by side and if you a watch nurse is queuing up to use one and completely ignoring the other, because they have to sort of step around other people. So, you need to be aware of staff behaviour as well when designing. In other outbreak investigations, I've noticed-- well, observed, if you have a row of wash-hand basins in a toilet, for example, people don't come out and do an acute turn.

They tend to come out in a flow, so they won't use the wash-hand basin that's closest to the toilet, for example. They will come where it's a nice gentle flow. So, the one next to the toilet-- the wall won't very rarely get used, whereas the ones where it's a more natural movement will.

Q So, things like that would be things that you say ought to be taken into account when considering how many, and presumably where.

A And where to put them, yes.

Q If we go over the page to page 58, at this point there's a list set at the middle of the page and here, don't get me wrong, but I think you're describing what you consider to be the "true costs," as you've put them, or the true factors that should be taken into account when considering whether or not to have a particular number of outlets. Is that correct?

A It is.

Q You've mentioned things like initial cost of fitting, cost of maintaining, environmental costs, and so on. I mean, just to be clear, are these-- is this general observations about water outlets, or is this something specific to the Queen Elizabeth Hospital?

A No, it is because there is this policy generally of making the hospital experience more of a hotel-type experience. Talking to colleagues, there

is a growing body of thought that we should be concentrating on reducing the risks rather than improving patient experience.

Q You may or may not be aware that the approach throughout the Queen Elizabeth was generally in favour of single occupancy rooms. Can you comment on that from the perspective of outlets that you've just been talking about?

A It's a big debate that is ongoing as to which is the greater risk. If you have patients in single rooms, then you reduce the risk of patient-to-patient transmission, but that ignores the fact that if you've got an en-suite in a hospital room, they very rarely get used, particularly where you've got people who are far too ill to get out of bed and use them. There's some work being-- which I was made aware of recently, which I can't remember the percentages now, but a very low percentage of outlets in en-suites actually get used on a regular basis.

Q What's the specific risk that comes about from unused en-suites?

A The risk from that is stagnation increases the risk of Legionellosis, but also other infections from other waterborne pathogens, such as Pseudomonas, for example, and any other gram-negative. So, when the patient is able to use the shower, if it's been sitting there for a long period of time, then they're more at risk because of the period of growth when the outlet hasn't been used. It costs a lot more to the Estates who have to make sure that the flushing is carried out of those outlets, more disinfection, more hot water, waste of water because you're flushing water that you've treated, you've heated. The risk from waterborne pathogens is much more increased where you've got water outlets that aren't used.

Q This Inquiry has heard some time ago some evidence about patients' experience of using en-suite bathrooms at the hospital. We've heard accounts of things like blocked drains, water pooling, patients having to stand in pooled water while showering, water failing to flow properly into the drains, water redirecting away from the showers, even to the extent of flowing into the bedroom area of the single occupancy rooms, even into the corridor in at least one case. Can you comment upon the risks that are being posed by that sort of scenario?

A Well, again, if the patient is in contact with water that has been in contact with the drains, then in effect they're paddling in drain water and it means that they are then exposed to all the bugs that are in that drain water, so direct risk of infection if they happen to have any cuts but also cross-

contamination from those areas to others, including the floor in their rooms and in their beds and wherever you walk. If you've been paddling in contaminated water, you're going to transfer that wherever you go, and that is a result of blocked drains, of drains not being designed within a fall, or people putting things down the drains that they shouldn't, such as paper towels and wipes which cause blockages, and then the water to back up.

Q Now, the first question I have about that is an obvious one, but drain water is worse than other water. Is that correct?

A Yes.

Q Secondly, I think I picked you up in saying that there were two specific problems that you encounter: blockage in drains and insufficient fall, I think was the way you put it. Drain blockage, I think, you've explained a lot about. Can you explain what you meant by "insufficient fall," please?

A So, I don't know whether this was applicable to the hospital or not, but I've been involved in others where what you want is for the water-- the drains to fall down into the main drain so that you've got good flow that's going to take any particulates, tissue, etc., faeces, down into the main drain. If that fall isn't far enough, then you will get blockages

because the water isn't able to flow fast enough to take down the particulates, sewage, etc.

Q It is as simple as gravity doing the work?

A It's as simple as gravity helping to do the work, yes.

Q The bigger the slope, the more gravity does the work.

A Yes.

Q Okay, thank you. Just a couple more questions for you. They arise out of the BBC documentary that I understand you took part in. It's Disclosure: Secrets of Scotland's Superhospital, it's called, and it came out in the middle of 2020. Does that ring a bell with you?

A Just before Covid, yes.

Q Now, specifically what I wanted to ask you about is your appearance in that documentary and you're introduced there with the following blurb for you:

> "To understand things better, [it was said] we commissioned an independent expert in water safety."

Would you accept that having already been advising the hospital by that point that that was not a proper description, you shouldn't have been introduced as an independent expert?

A I was independent in that I wasn't involved in any of the building

process, the construction process or the management of the hospital up to that stage. It hadn't occurred to me, the question you're asking me, at that time, I have to say.

Q How did it come about that you got that description in the programme?

A I don't think it was my description. I think it was one that the BBC came up with. I don't think I described it. I don't-- I can't tell you. It's too long ago.

Q To put it maybe a slightly different way, when they came to you to ask you to participate, did they ask you to participate in a particular capacity, or was it not like that?

A No, it wasn't like that, it was just to look at the data and give my opinion.

Q They didn't say to you, "We're looking for an independent expert on Queen Elizabeth. Are you an independent expert on Queen Elizabeth?"

A No.

Q I don't know if you watched your own appearance back, but do you recall what you were doing when you were on screen?

A I think I was sitting in a laboratory somewhere answering the questions.

Q I happened to watch it last night and you were pictured looking through some documents, and I recognised the logo on one of the documents as being DMA Canyon.

A Yes.

Q Now, you mentioned in your statement at page 86, question 74, you're asked about a report published by DMA Canyon in 2015. Now, do you recall that particular report?

A Yes, but I hadn't seen it when I went to the hospital.

Q You have seen it since?

A Yes.

Q And I think perhaps other reports by DMA Canyon as well.

A Yes.

Q And indeed, over the page at question 75, you say that you were impressed by these risk assessments.

A I was, and that's quite rare.

Q Can you explain why?

A The risk assessments were quite comprehensive. They were logical. They'd worked from the incoming water supply, they considered the factors that I would have looked for in a risk assessment, as far as Legionella is concerned. I think they did quite a good job. They looked at the management and communication structure, which is often omitted in this type of risk assessment. So, overall, it was better than most risk assessments that I see when doing investigations.

Q In your view, what ought to have happened with them once they were received?

A The 2015 one was-- so, identified really dangerous aspects of the water system. The fact that they found E coli, that there had been Legionella found earlier, should all have been escalated up to board level to make a decision on whether it was safe to put patients into that hospital.

Q When you discovered that that hadn't happened, what was your reaction?

A My action?

Q Your reaction.

A Oh, my reaction, sorry. Again, I found it incomprehensible that that wouldn't have been escalated. Something like finding Legionella at commissioning stage, but also E coli, which is an indication of fecal or sewage contamination of potable water supply, it means that that water wasn't safe to drink, to use in a hospital environment.

Q And once you had had the opportunity to read the 2015 report, what conclusion did you reach?

A That that hospital wasn't safe for the intended patient group. We've got the highest risk patients, bone marrow transplant patients, neutropenic patients who have no ability to fight infection using water that potentially could cause their death.

Q I don't have any further questions for the witness, my Lord.

THE CHAIR: Dr Lee, what I propose to do now is break for about 10 minutes just to check with the rest of the room as to whether there's any further questions to be asked. So, could I ask you to return to the witness room and I hope to be able to have you back here in 10 minutes.

THE WITNESS: Thank you, my Lord.

THE CHAIR: We'll take 10 minutes to see if there's any more questions. Thank you.

(<u>Short break</u>)

THE CHAIR: Mr Maciver?

MR MACIVER: There are no additional questions for the witness, my Lord.

THE CHAIR: Thank you. Dr Lee, I understand there's no more questions, and that means you're free to go, but before you go, can I thank you for your attendance here today and also the considerable amount of work which will have been involved in preparing your written statement, both your oral testimony and the written statement are very useful and I'm grateful for them but, as I've said, you're now free to go. Thank

you.

THE WITNESS: Thank you very much, my Lord. Thank you.

(The witness withdrew)

THE CHAIR: My understanding is that we will resume tomorrow with Dr Peters as the witness and Mr Connal asking the questions.

MR MACIVER: Yes, my Lord.

THE CHAIR: Well, can I wish you a good afternoon and we'll see each other all being well tomorrow at 10.

(Session ends)