AUSCRIPT AUSTRALASIA PTY LIMITED
ACN 110 028 825

T: 1800 AUSCRIPT (1800 287 274)
E: clientservices@auscript.com.au
W: www.auscript.com.au

TRANSCRIPT OF PROCEEDINGS

TRANSCRIPT IN CONFIDENCE

O/N H-1247451

INDEPENDENT PLANNING COMMISSION

MEETING WITH WATER EXPERT PANEL

RE: NARRABRI GAS PROJECT

PANEL:	**STEPHEN O'CONNOR (CHAIR)** **JOHN HANN** **PROF SNOW BARLOW**
SENIOR COUNSEL ASSISTING:	**RICHARD BEASLEY SC**
OFFICE OF IPC:	**STEPHEN BARRY** **CASEY JOSHUA**
WATER EXPERT PANEL:	**PROF PETER COOK (WEP CHAIR)** **PROF CHRIS FELL** **PROF JOHN CARTER** **MICHAEL WILLIAMS**
DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT:	**MIKE YOUNG** **DAVID KITTO** **STEPHEN O'DONOGHUE**
LOCATION:	**VIDEOCONFERENCE**
DATE:	**9.02 AM, TUESDAY, 28 JULY 2020**

MR S. O'CONNOR: I think we've got a pretty good rollup there. We just note that Richard Beasley, the counsel assisting, is having some problems logging in, so - - -

MS C. JOSHUA: He's here now. On his way.

MR O'CONNOR: Yes. Great. Okay. Welcome, everybody. We have a full complement now, do we? Yes? Okay. Terrific. So I just want to make everyone aware that – that proceedings will be transcripted. We have Auscript online and that transcript will be uploaded to our website. I have a short introductory statement I'm going to read prior to commencing, and then as per the agenda, we will go through the various items that we've listed. But just let me thank you all for your time this morning. The panel very much appreciates the opportunity to discuss this particular project with the Water Expert Panel. I would like to acknowledge the traditional owners of the land on which we meet and I would also pay my respects to their elders, past, present and emerging.

Welcome to the video conference today to discuss the proposed Narrabri Gas Project in the Narrabri Local Government area. My name is Stephen O'Connor. I am the chair of this commission panel. Joining me are my fellow commissioners, John Hann and Professor Snow Barlow. Also in attendance is counsel assisting, Richard Beasley SC; Stephen Barry; And Casey Joshua from the office of the commission. In the interests of openness and transparency and to ensure the full capture of information, today's video conference is being recorded and a full transcript will be produced and made available on the commission's website.

The video conferencing is one of the commission's decision-making processes. It is taking place at the preliminary stage of those process and will form one of several sources of information upon which the commission will base its decision. It is important for the commission to ask questions of attendees and to clarify issues whenever we consider it appropriate. If you're asked a question and are not in a position to answer, please feel free to take the question on notice and provide any additional information in writing, which we will then place on our website. To ensure the accuracy of the transcript, I request that all persons present today introduce themselves each time before they speak and for all members to ensure that they do not speak over the top of each other.

We will now begin. As per our program, we're looking to – and I assume it's David, but – it's David Kitto, but someone to kick us off and just give us an overview of the role that the Water Expert Panel has played in the assessment process through this project. So, David, am I – can I hand to you.

MR D. KITTO: Thank you, Steve. So David Kitto from the Department of Planning, Industry and Environment. Due to the significant public interest in the project and significant concerns about the water impacts of the Narrabri Gas Project, the department formed an independent panel to assist with the assessment. In

forming that panel, we were keen to keep the continuity with the work that was done by the chief scientist and engineer during the review of coal seam gas in New South Wales. The Water Expert Panel that we've formed as four members: Professor Peter Cook, from the University of Melbourne; Professor John Carter from the University of Newcastle; Professor Chris Fell from the University of New South Wales; and Michael Williams, who for many years was the principal hydrogeologist for New South Wales Government and has a lot of experience in working with groundwater across New South Wales.

So the expertise of the panel covers all key aspects of the Narrabri Gas Project from geology through geomechanics, reduced water treatment and also hydrogeology. Three of the members, Professor Cook, Carter and Fell, all worked on the chief scientist's review of coal seam gas in New South Wales. And they've been involved in reviewing all aspects of the Narrabri Project for over the last three years. I don't think any of them expected to be involved for so long, but they've been involved from the beginning and they have reviewed all the critical documents. They've undertaken consultation with the community and experts within government and also experts – the experts of some of the opponents of the project.

And they have produced a detailed report, which has been one of the key inputs to the department's assessment of the merits of the Narrabri Gas Project. I would just like to stress that they're not working for the department. They are independent experts and they have given independent advice to the department. And the department has considered that advice fully and factored it in to all its recommendations to the Independent Planning Commission.

MR O'CONNOR: Thank you, David, for that introduction. So I might commence with just a couple of questions that we'll be keen to hear from the panel in terms of a response. The first question, I'll just refer to page 4 of the executive summary of the Water Expert Panel's report. And there's one sentence there that says:

> *The prospect of subsidence or induced seismic activity is low given the considerable depth from which the gas is to be extracted.*

That question relates to that word "low." Just what does that mean? Does it mean, for example, there's a one per cent probability of the occurrence of some sort of seismic activity in any given year or, you know, just how do we interpret that word "low"?

PROF COOK: Maybe I could – it's Peter Cook, and maybe I could start off, but I'll then pass it on to John Carter for any further comment. I think the – the word "low" could be interpreted as "very unlikely." And certainly very unlikely in terms of any seismic activity that would affect anybody or anything. It's a low seismicity area and, in addition to that, the sort of activities that are proposed for the project do not involve, for instance, any injection of produced water, which has been a source of earthquakes in other areas. I should call this "seismic activity," because earthquakes really is – is just not the sort of thing that's happening for the most part.

These are things that can be detected through various instruments. They're not damaging events. We do not believe that there's a high likelihood. In fact, we – as we said, a very low likelihood of any such events in the Narrabri area, not least because the methane is being drawn from great depths; over a kilometre in depth for the most part. And the nature of the rocks is such that it's unlikely that there will be any induced seismicity. So, John, would – Professor John Carter, would you like to add to that to comment?

PROF CARTER: Sorry. I was – John Carter. I was muted. I apologise. I've got very little to add to that, Peter. The subsidence would be very low, because, as you said, the depth and the – effectively the overlying strata will bridge over any compression of the coal seams.

MR O'CONNOR: So do I take it then that the – if you're saying "low" means "very unlikely," is that less than a one per cent probability in any given year?

PROF COOK: It's very hard to put a precise number on it. I suspect that that's – that's probably a reasonable indicative number, but let – again, let me ask John to see if he's got any further comment on that.

MR BEASLEY: Yes. Sorry to interrupt. Richard Beasley speaking. These things wouldn't conventionally be dealt with, though, in terms of numerical percentages, would they?

PROF COOK: Well, anything can be dealt with numerically if you really want to. It's a matter for .....

MR BEASLEY: If you're discussing something – if you're making – expressing an opinion about low risk of seismic activity or seismic risk, I – I understand that meaning highly unlikely. I wouldn't understand it, though, if you said it's 1.6 per cent or it's 0.4 per cent. I wouldn't – I would view that as bizarre.

PROF COOK: Well, I would agree with you. I would much prefer to – to say highly unlikely.

MR BEASLEY: Yes. Yes.

PROF CARTER: I would agree with that.

MR BEASLEY: Yes.

PROF CARTER: Sorry. John Carter.

MR BEASLEY: Sorry to interrupt.

MR O'CONNOR: Thank you, Richard and John and Peter. The next question I have relates to another statement. This one's on page 5 of the executive summary. And it says:

> *Nonetheless, there is a small risk of impacts for connected water sources, which can potentially have cumulative significant local impacts.*

I just would like to know a bit more about what you mean by "cumulative significant local impacts."

PROF COOK: Can you just give me a moment while I look – while I look at – right. Okay:

> *Nonetheless … small … impacts … connected water sources … cumulative –*

that – by "cumulative," we're talking about obviously the cumulative – the effect of – of more than one activity in that area, which collectively could produce a small impact in a local area. That's really what we're saying there, so we see no prospect of a regional cumulative impact from these proposed activities. But you can never exclude the possibility of a very localised impact on a bore or one or two bores. That's the way that I would interpret - - -

MR O'CONNOR: And what does "impact" mean? Does it mean that the bore ceases to function in the way that it was previously?

PROF COOK: It may be a drawdown of the water table. The water table may decrease by one, two, three metres, whatever the number is, but we're not talking about drastic impacts. These are minor impacts, very minor impacts for the most part .....

MR BEASLEY: ..... just on that – Richard Beasley. Just on that issue of just to cover it off while it's in my mind, that issue of a local impact as distinct from a regional impact, it would be the same – there's some concern amongst the objectors to this proposal of spills of – you know, for example, produced water at a well site or spills of some other contaminant. That would likely also to be something that would result in a very localised problem as distinct from a regional problem; correct?

PROF COOK: That's – that's correct.

MR BEASLEY: Yes. Unless it was a spill that just went on and on undetected for a – a – an extraordinary long period of time.

PROF COOK: That's – that's correct. The sort of spill you're talking about at a wellhead would be a very localised sort of thing.

MR BEASLEY: Yes.

PROF COOK: If on the other hand a holding pond suddenly failed, then that obviously would have a more significant impact .....

PROF BARLOW: Peter, it's Snow Barlow here. You say "local." What are we talking about? Are we talking about 100 hectares or 1000 hectares or - - -

PROF COOK: I would say nothing like that sort of area, quite frankly, but I will call upon my colleagues to check on that, but I would say we're talking about one or two hectares or less than that. Very often, less than that. I mean, if we're talking about one bore, maybe there's a – an envelope around that bore of 50 metres, something like that. But let me see if, for instance, Michael, has any comments on that.

MR WILLIAMS: ..... you're right there. There's a - - -

MR O'CONNOR: Michael, can you just say who you are for giving - - -

MR WILLIAMS: Sorry. Michael Williams – and the areas that are – will be involved will be small in comparison, so of the area – of the water, a couple of hectares max.

MR O'CONNOR: And, John Carter, did you have anything further to add to that?

PROF CARTER: I would agree with the aerial impact would be limited to the sort of numbers you're talking about, one or a few hectares at the most. And any migration of any pollutants would be very slow, if you believe the research done by CSIRO on this matter.

MR O'CONNOR: And, John, can I just ask, when you say "very slow," can you actually tell us what - - -

PROF CARTER: Well, it might only – yes. It might only move a matter of metres in years, you know?

MR HANN: If I could just – it's John Hann here with the IPC. Just in regard – to help us try and characterise the risk and coming back to what would be acceptable and unacceptable, because there are a number of different terms used in the Water Expert Panel's various chapters, for example, there's the term "small." Now, I presume that's different to "low," but trying of the understand ultimately what's acceptable and what's unacceptable and particularly what might have potential to be irreversible, would you care to make – I know this is generalities, but it would assist us. Would you care to make some comments about that to assist us?

MR BEASLEY: Just before anyone answers that – Richard Beasley. Just before anyone answers that question, John, I think it's important that we identify risk of what, because it may – I don't know. I'm not the expert, but it may – may alter the – the – the – the answer given by – by the experts if – if we actually identify - - -

PROF CARTER: Yes.

MR BEASLEY: - - - what is – what is the risk you're concerned of and then what's the scale of that risk?

MR O'CONNOR: No. I appreciate that, and so if we take an example that might be the unintended groundwater movement, and in this particular case, it concludes – the panel concludes that the risk of unintended groundwater movement is small. So how do we – given that that can relate to methane and the occurrence of methane moving upwards to the high-quality aquifers at the surface, how do we interpret small?

PROF COOK: I guess you could – Peter Cook. Small obviously has a quantitative connotation to it, and as a matter of saying, "Really, we think it's small, so small that it's unlikely to have any significant impact," I mean, that's really the way that I think the use of the term "small" can be interpreted. In other words, we're not saying it's – you can say it's different to low, because of the nature of the impact. But what we're saying is that if ..... said it's a pollutant, there would be a small amount of pollutant that would have a very small consequence. I mean, that's – that's the way that I would interpret that, but – so, Chris, would you like to comment?

PROF FELL: Yes. So I think on a risk versus likelihood graph, we would say - - -

MR O'CONNOR: Could you please introduce yourself.

PROF FELL: I'm sorry. I'm terribly sorry, Steve. Chris Fell. And on a risk versus likelihood graph, we would say the spill imposes a fairly low likelihood. They've been successful in three years in not having any in this Queensland operations, and the likelihood of doing major damage is very small. And, in fact, the impact of one spill that was had by Eastern Gas some years back, was only – knockout maybe an acre or two of growth, which they successfully retrieved. There was no impact on the lower aquifers below. Thank you, Chris. Richard, I know you had a few questions. Would you like to pose some of your questions to the panel.

MR BEASLEY: I think the panel may have – the commissioners may have their own matters they wish to explore that relate to a range of things. I would just like to get your view – the views of the panel in relation to what I think have emerged of the main concern of the objectors. Now, they've got – there's more reasons raised by the objectors than this, so please don't think I – no one when they read the transcript should think I'm trying to assert there's only one reason people are opposed to this mine of those that are opposed. But I think what seems to be the main concern from the submissions and also the report that was – I only saw and I think was sent to the commission last night from Dr Currell, although it does come from the evidence he gave last Monday, I – sorry – last Thursday.

And this gets to page 42 in particular, I think, of the panel's report. I think in your report – and I'm addressing all panel members, you've said that you're not confident that the information provided in the ES on the structural setting of the gas project

meets the threshold of being adequately characterised. And then in 42, you've said with the possible exception of information about faulting – and I will come back to that and I'm sorry for how long I'm taking to ask a question, but I'm just trying to give you some context – with the possible exception of information about faulting, there is sufficient geological information available on which to base a high-level assessment of the proposed development.

Just to clarify one issue for me, what do you mean by high level assessment? What should the commissioners take that to mean? You would think I would know what it means, but I would rather hear it from you.

PROF COOK: Yes. It's Peter Cook. I will start that off. It's a matter of the resolution that you're talking about. Are you talking about the resolution of 10 metres in the sedimentary column and are you talking then about 10 metres as being your minimum groundwater unit or are you talking about one metre or 50 centimetres? That's what we're really talking about. And obviously the finer the resolution, the more confidence you have in your groundwater model. But let me ask Michael to come in and add to that.

MR WILLIAMS: Yes. The EIS model has – is – is fit for purpose as CSIRO have said. It is – it's predictive capacity, because it is – it's based on a steady state model, its predicative capacity isn't particularly good. And – but the conditions of consent say that – and set out really quite strictly what a new model will look like. There EIS model, we need to also remember that there are management rules there in each of the water sources, so there is – there's a safety net there. One of the things that – in the report that did come up was that we talked about stress. And when talk about stress, we talked about really the level of use against the extraction limit.

So when the aquifer became highly stressed, the extraction – the amount of use started to approach the extraction limit and the rules in the plan or the thresholds then started to kick in. And so you have that boundary. The trouble is that a steady state model won't allow you to – isn't a very good predicator. The model that's – IES model has data – has taken data from each of the layers that's available and it's – there is available for nearly all of the layers, all of the aquifer layers; not for all the aquitard layers. And that has been ..... and then they said, "Look, we haven't got enough data, so we'll – we'll do a few things." And – and what they did was – was – was quite – quite okay.

So the new – the other thing was with the EIS model, it was unfortunate that they predicted the year 2000 and that – the unfortunate part there was that the – the gaps that we – the GAB had been running a – a water saving project or a bore rehabilitation project. And that really only started – it had been going for some time. It really only started kicking in a bit before 2000. And so the pressure level in the GAB has actually been going up, but the EIS model doesn't show that. And the – so the prediction of the impact of water – the water impact across each of those layers and into the Namoi Alluvium or the Lower Namoi Alluvium is going to be impacted by the pressurisation of the – of the GAB in that period.

So the transient model will allow you to take account of all of these – all of this data that's – of measured data that's available and make better predictors of what – what – what might happen. Yes. I'll – I'll leave it at that.

MR BEASLEY: All right. I think if I can drill down to what I see as the real heart of the expert evidence that the objectors have provided to the commission in relation to both the risk of methane contamination into the freshwater aquifers and also cross-contamination between the freshwater aquifers and the coal seam water is I think they're saying there's not enough information in relation to faulting and in the most recent material sent last night from Dr Currell, they're saying that there's some new peer reviewed research conducted by University of New South Wales and ANSTO and this research indicates, and I'm reading now:

> *…the presence of major geological structures in the Gunnedah Basin and overlying sequences that are likely to enhance connectivity between deep and shallow geological units within and to the north of the project area.*

What I just read, I think, is the nub of what the concern is from the objectors, that there's not enough known about potential faulting. There's this other evidence and there really needs to be more research done in relation to the geological structures which may indicate enhanced connectivity between the two layers of aquifers and – and it's taking a risk to approve the project and have it go ahead in those circumstances. Can any or all of you respond to that?

PROF COOK: Let me start by responding to it, but I'll get others to respond it. I think it's a matter of – Michael said – used the term "fit for purpose" and the purpose at the moment is to provide an overall plan for the Narrabri Gas Project. Do you we have the information that's suitable for citing all 850 of the proposed wells? Well, of course not. Nothing like that. What we have is enough information to say that this is the stage to which the project can proceed. And nobody is saying that that should proceed to 850 wells. The process of collecting data is an ongoing process. I think it's a – maybe there's a – a misunderstanding amongst people that they think you have all of the information you need, every piece of information you need in order to start a project.

Well, of course, that's just not possible, because if you wanted all the information you would need, you would actually have to drill 850 wells right now before you started doing anything. And, of course, that's – that's just not feasible for this project or any other project of this sort. So collecting data is an ongoing process. It's a staged process. And it obviously is going to impact upon the future of the – the project. You might initially have a plan to put a well here and you decide you're not going to pull a well there. You're going to put it somewhere else. So that – it's an ongoing process that we go through with any sort of project like this. Maybe, John Carter, you'd like to come in.

MR BEASLEY: Just before you do, John, just so that I understand – so what you're saying, Peter, is that in your view, analysing all the risks, the stage has been reached

where there's certainly sufficient certainty of low risk in relation to matters that might be important for the project to proceed, but proceed being to commence with site number 1, not drilling 850 wells simultaneously at the same time, but rather a progressive project whereby knowledge will be gathered through the course of the project that adds to the knowledge from the time of approval. Is that generally what you're saying?

PROF COOK: Absolutely. That's a – the only way that it could proceed is the sensible way that it should proceed.

MR BEASLEY: Thanks.

PROF BARLOW: Snow Barlow here.

MR BEASLEY: Sorry. I – sorry, Snow. I think Peter was flicking over to whether John had a view to add about this first. Sorry.

PROF CARTER: Yes. John Carter here. Thank you. I think there are a couple of issues in – tied up in what – in your question. One is the situation now is there much connectivity between the aquifers? And as we indicated in our report, there is some evidence to suggest if it is, it's not a very strong hydraulic connection. And those two main pieces of evidence are the very different levels of concentration of salts in the different aquifers. If the – if the aquifers were connected through these structural features and these faults and so on, over – over the passage of long time, you'd expect equalisation or – or – of the salt concentration. So that's one bit of evidence that suggests things are probably not very well connected at the present. The other bit of evidence is that – the different pressure gradients in the different aquifers. So that gives me, at least, some confidence that there's not a great hydraulic conductivity between the different aquifers at the moment

MR BEASLEY: Sorry to interrupt. Can I just clarify one thing that you said there? Do you mean that your confidence of – that there not being a great deal of connectivity is partly based on the fact that the – we know how good the quality of the water is from the alluvium and we know how saline the water in the coal seam is and the fact that the water quality is so good and the alluvium is an indication of – that there's not much connectivity between the two or have I misunderstood that?

PROF CARTER: No, that's exactly what I meant. I mean, just - - -

MR BEASLEY: Okay.

PROF CARTER: - - - osmotic pressure would see some equalisation over - - -

MR BEASLEY: Yes.

PROF CARTER: - - - millions of years and that, it would appear, has not happened.

MR O'CONNOR: It's Steve O'Connor here - - -

PROF CARTER: The other issue is .....

MR O'CONNOR: - - - ..... but just to be clear on that point - - -

MR BEASLEY: Steve, I don't think John had finished. Sorry.

PROF CARTER: No, I had finished. I was going to move on to - - -

MR BEASLEY: Sorry. Go on.

MR O'CONNOR: Okay. So my point relates to the issue just raised about the different pressures. So do I understand that there are different pressures in the different seams or aquifers, et cetera, that lead you to believe they are connected, otherwise the pressure would be the same in all .....

PROF CARTER: Well, pressure gradience with depth are different in the different aquifers and don't align, as if it's just hydrostatic. I mean obviously the pressure gradient – the pressures in the GOB are higher otherwise you wouldn't have artesian water supply. So that's what I – that's what I – I mean – I think Santos pointed that out in their EIS.

The other thing I was going to go on to say is, you know, if the issue is migration of pollutants during the production phase, what needs to be recognised is the hydraulic gradient is downwards. The flow will be downwards because the pressures at depth will be reduced below those above them. So any transmission of pollutants is most likely to curve downwards rather than upwards into the fresh water aquifers.

MR HANN: It's John Hann here. Would that apply to methane, though?

PROF CARTER: Not necessarily. It would apply to any methane – there are two ways pollutants can move around in groundwater. They can go with the flow, which is called infection, or they can defuse by molecular diffusion and in that case they can actually go against the hydraulic gradient. So methane may still come to the surface.

MR HANN: And just to follow-up on that, John Hann here, is that this most recent material that Dr Currell has provided to the IPC, talks about data – it does refer to publications that are post your report, I think late 2019, but it refers to the reliance on data that's been available for quite some time and it's really talking about particularly the detection of methane and suggesting that that methane in these upper higher quality aquifers is due to some connectivity from the much lower GAB.

PROF CARTER: I'll have a crack at this first, if you don't mind, it's John Carter, and then Chris perhaps may enlarge on it. You could – it is feasible that the

migration of methane, if it is coming from below the GAB as suggested in that – I think it's the Iverach paper - - -

MR HANN: That's right.

PROF CARTER: - - - that could be explained by diffusion, molecular diffusion, rather than flow of groundwater. I mean, there may also be flow of some groundwater from – obviously from the GAB into the upper alluviums, which could carry some of the methane. Chris?

PROF FELL: Sorry. Yes. The paper by Iverach was brought to our attention. We've had a look at that and one has to draw the conclusion that if the overlying aquifer is not being tapped, then diffusional processes could bring the higher level of methane and a gradient in methane could be established and that, of course, is the upper layer where biological processes are present and break the methane down. So one can understand. I apologise. I'll have to go offline. There's a jackhammer behind .....

MR BEASLEY: Michael, I think you had a comment you wanted to make.

MR WILLIAMS: Yes. In the Iverach paper, she points out in the graphical abstract, she points that she specifically says there's no water movement out of the – out of the – out of the coal seams and moving up, but there is a movement of methane and you need to understand – yes?

PROF COOK: Could I perhaps come in. Yes, we've looked at the Iverach paper in some detail in recent days because of the fact that it was being cited by a number of people. Look, it's a fine piece of science. But it's focused on a particular thing. It doesn't say anything about the flux, it doesn't say anything about the time scale. It's not a criticism of the paper. The paper was focused on something else. Is there or is there not any methane and what is the potential source of it.

The important thing is if it takes X million years, and sometimes it can take millions of years for these things to come to the surface, then that's one thing. If it takes a day or two, then that's clearly another thing. In this case, there's no indication this is a rapid process, nor is there an indication this is volumetrically a very significant process. That would need, you know, a different study, if you like. So Iverach wasn't commenting on that.

Those are two really important things, you know, the speed at which these things occur. We suspect it might be quite low. And the volumetrics which again we don't really have a handle on those but we've no intimation that we're talking here large volumes. So it's – look, it would be very surprising if you didn't get some methane in the system. That would be a real surprise. But you do get some and that's fine, that's what we'd expect.

PROF BARLOW: So, Snow Barlow here. A couple of questions. The first one to John Carter. John, you've just spoken about you would expect if there's depressurisation for the spills to go down, rather than up, does that mean they're going to end up in the Great Artesian Basin because one of the, you know, major source of objections that we've had in the public hearing has been the absolute dependence of agriculture over a quarter of Australia, on the Great Artesian Basin, but in this small regional area, particularly the area to the west of Narrabri and would that apply to the salt but also any extraneous compounds from the drilling fluids? Are they likely to get into the Great Artesian Basin?

PROF CARTER: John Carter. Again it would depend on the magnitude of the spill and with the events that – the typical scenarios we've been talking about it's surface spills, it would be very unlikely to get down that far simply because of the depth and it would be, you know, it would be attenuation as the – whatever the pollutant was, flowed down with the groundwater. If it's a sub-surface leak or something from a well, perhaps, but as long as the well integrity measures are invoked, I think there's very little likelihood of that.

PROF COOK: Could I suggest that perhaps Michael could also comment, Mr Chair?

MR O'CONNOR: Certainly.

MR WILLIAMS: I'm terribly sorry. I've forgotten what the question was.

PROF COOK: The question related to the extent to which there could be pollution of the Great Artesian Basin or an impact on the Great Artesian Basin from, for example, a spill.

MR WILLIAMS: The spill or pollutant would have to be very large because of the large volume that's involved in the Great Artesian Basin in toto. But care would have to be taken that there weren't polluting activities that could be avoided. But any spill would be diluted. I mean, it would go diluted out both in time and space.

PROF COOK: Peter Cook again. If I could just make one other comment. By and large, when we're talking about spills, we're talking about spills of 44-gallon drums and that sort of magnitude. Now, it doesn't obviously go beyond that to the holding ponds. That's something that is detectable quite quickly and one would assume, one has to assume, that there is a good regulatory resume in place that would take immediate action on something of that sort. So again its volumetrics are quite modest with these sorts of activity as.

The sort of thing that you sometimes see depicted on film and so on or read about sometimes from, you know, activities from decades ago in West Texas or something like that are just highly unlikely to happen. We do not have the regulatory resume that would allow that sort of thing to happen and nor is the sort of activities that are proposed likely to produce that sort of thing. You know, this is a great – this is a not

– it's not highly pressured. It's a coal seam gas activity. It's not an oil or a conventional gas activity, if you like, nor is it Shell gas activity.

MR O'CONNOR: Thank you, Peter. Can I just follow-up with a question to John. You mentioned well integrity. It's been put to us during the public hearing that some wells are likely to fail, you know, early in their life, but ultimately all wells eventually fail because you're talking about such a long time frame. Can you please comment on that?

PROF CARTER: Yes. John Carter. Well, I think the history is shown we've got much better at avoiding well integrity problems and the data clearly shows that, that – and CSIRO have compiled data on that, as have others. So that's the first point I would make. We're not in the early 1900s. We're in the early 2000s and technology's greatly improved.

I – there are – the point I would simply make is if there are well integrity problems during production, they can be dealt with. There are technologies to ..... wells at that point. The other issue, I think, that's probably on people's minds is, well, what happens in the future when the response – Santos no longer has responsibility for abandoned wells. The – the New South Wales Code of Conduct that the chief scientist was responsible for was very – has one provision in it which gives me some confidence that the long – there shouldn't be long-term problems and that is that the well – an abandoned well must be filled with cement right from the coal seam to the surface. So you've got 900 metres of tubing full of cement paste, I think, which – well, it's hard to see – yes, the steel may corrode. The cement may be attacked over time. But I think you've got such a long length of this sealed well, I don't – I think the risks of any minor problems are low, very low.

PROF BARLOW: Snow Barlow here, John. But, you know, ultimately it is going to break down. You know, what's the sort of decay rate of a well down to, you know, down to zero?

PROF CARTER: I don't know.

PROF BARLOW: Yes. Does anyone know?

PROF CARTER: I don't think anyone's been around a thousand years to observe.

MR BEASLEY: Richard Beasley. Can I ask a very general question because it's come up in the hearings, but one of the things that many of the objectors have said is that there's a failure by the department to either properly take into account or take into account at all the precautionary principle. Do I understand – please don't let me put words in your mouth. You say something different if I haven't got this right. But do I understand that the panel's view is that based on the level of risks you've identified for the key areas of risk in your report, that a proportional response to those risks and a precautionary response to those risks are the proposed conditions for this project in relation to fill development protocol, groundwater, et cetera, the

bare – that an approval subject to those conditions is a proportional and precautionary response to the risks of the level you've identified, is that generally correct?

PROF COOK: I'd say yes, you've expressed it very well. That's exactly the situation we find ourselves in, yes.

PROF CARTER: Can I make one more addition - - -

MR O'CONNOR: It's John Carter.

PROF CARTER: - - - to my previous answer? I mean, if the material – let's say the steel rusts. Where's it going to go? It's going to sit there as either a – an oxide of iron or something and in the – in our report we did a calculation to show how long it would take for migration of any pollutant up a very thin – let's assume there's a continuous needle hole all the way to the surface. It could take – the quantities that would move up along that pathway would be very, very small and easily diluted by the much greater volumes of water in the aquifers. So you can't, sort of – yes, the material might break down, but it will break down to something else and still block the hole, if I can put it in those terms.

MR BEASLEY: Richard Beasley again. I have one or two questions on solid waste and salt but that's moving away from groundwater, so I'll hold off on that in case any members of the Commission have got any further questions on the groundwater issues.

MR HANN: Richard, it's John Hann here. Look, I've got one further question that relates to groundwater and it goes to your key observation number 7, which – and then on page 52 of the – of your report, and it's to do with the discrepancy between the model predicted flows between the GAB and the Lower Namoi aquifer and between what was predicted in the EIS model and I think it's New South Wales water or the New South Wales government's data and you acknowledge that. And this is something that Dr Currell has raised with us again because we've heard through the days of the hearing the concerns of the farmers and the ability to access water. So it goes to entitlement and allocations of water where one would assume you need a reasonably accurate means to predict what the predictive flows would be, to then be able to come up and calculate the level of entitlement that the applicant should apply for and then it goes to, well, they're fully allocated as I think is mentioned. So, look, I just wonder whether you've got any comment on that?

PROF CARTER: I think that's one for Michael, who's looked at this issue of entitlement in his previous role as well as his current role. Michael.

MR WILLIAMS: Yes. You're correct. The observation of the EIS model doesn't adequately predict the quantum of water moving from the GAB into the Lower Namoi is a concern. But remember that that is being driven by relatively small ..... and the impact of the – impact of the coal seam gas, or proposed coal seam gas, is

relatively small. So what – the model – the EIS model, as we said earlier, is a steady static model. It has single values for each of the layers and therefore you would reasonably predict – it reasonably stated – and it's all uniform. So you'd reasonably say that it wasn't going to be able to predict it very well.

The new – the proposal and the condition of consent is for a transient model. There's miles enough data there to be able to adequately assess that – assess what that flux is and predict what the impacts are going to be and, yes, and so the other one that you mentioned is – so the new model will get over that problem. Each transient model will get over that problem. The other one you mentioned was about entitlement and, yes, that model will inform what the entitlement arrangements might be, what entitlement Santos or the – Santos may need to get and that it will also tell you what the timing of that entitlement – when they will need it and when they may wish to pass it back into the water trading.

In terms of the system being fully allocated, it is fully allocated, there's no doubt. But there is a robust water trading mark. What we pointed out was that we were – the amount of water they'd require may – would be large in comparison to what had been traded previously and so it was a question of what was the depth of the market. But, I mean, you've seen in the press recently that there is a depth of market in this area and that they would be able to get their entitlement at a price and that would be subject to negotiation. So I don't think – while I acknowledge that the EIS model has the problems, we then move on to what the next – what the next will be under condition of consent and that does cover this issue. It signs off on that issue and actually demonstrates that you can, within the current arrangements, you can cover any problems.

PROF CARTER: Thank you, Michael.

MR O'CONNOR: Michael, I've just got a follow-up question. This is Steve O'Connor here. That movement from the static model to the transient model you've just outlined, can you give us an idea of the time frame? How long is it? Is it just a matter of drilling these extra 25 wells to be able to build that transient model or does it take much longer than that?

MR WILLIAMS: It's Michael Williams. The – it can be done – if – what you're looking for is the transfer of water from the GAB into the Lower Namoi, that can be done now. The data's there. The GAB bores have been monitored. It depends – there's at least once every four years the bores are monitored but some are monitored more closely than that. The Lower Namoi alluvium has been monitored since the early '60s but let's say it was fully there by the mid '70s. There's monthly – in most cases there's monthly or automatic water levels in there and so – and there is a robust groundwater flow model for the Lower Namoi.

So it can be done – that part of it can be done very quickly. There will need to be – you spoke about monitoring and the report does point out that there needs to be – there needs to be ..... about what the monitoring network for the coal seam gas might

look like and that monitoring will need to be both company and government monitoring, both inside and outside the lease so that all of these water balance aspects are covered.

MR O'CONNOR: Thank you, Michael. We might move back to you, Richard, just given the time, I want to make sure we do cover those issues of waste disposal and salt, in particular, so can you please - - -

MR BEASLEY: Sure. Sure. Just before I – sorry, Richard Beasley again. Just before I ask a question about salt waste, can I – this is a very general question but I'll ask it because it's been a matter raised by a number of people that have made submissions to the Commissioners objecting to the mine. One of – one of – a consistent complaint is that the chief scientist's recommendations from her review back in 2014, not all of her recommendations have been acted on or put in place.

My – and please tell me whether you agree or that I'm hopelessly wrong, but my reading of those recommendations, it's one issue as to whether they should all have been acted on or put in place by now but having looked at those recommendations, I couldn't see any that prevented the assessment of this project, that any had to be – of the chief's scientist's recommendations, had to be put in place before you could conduct a thorough assessment of this particular project. Do any of you have a view in relation to that?

PROF COOK: Let me kick it off and so first we were uniformly supportive of the recommendations coming out of the chief scientist's report. I suppose you could say we were all of us involved in it to varying degrees but I think still we were able to look at it comprehensively and say it's a good report and, yes, we'd like to see all the recommendations acted on in some way. Now, we're not saying – I think it's one for the department to comment on whether things have or have not been accepted and - - -

MR BEASLEY: Sure.

PROF COOK: - - - what role is seen in the future. But you're absolutely right in what you say. There's nothing there that prevents us from reaching the conclusion we already have that this project can proceed provided a number of steps are taken and that's what we've said. I mean, we've not said, look, everything's perfect, nothing to see here. Move on. What we've said is, look, it has the potential to move on. These are the conditions that we believe should be placed upon it in moving ahead. What we're saying is we don't have to stop here and do everything before we do the next thing in terms of the process.

MR BEASLEY: Sure. Richard Beasley again. I suppose to be slightly more specific, one of the chief scientist's recommendations is that drilling should only occur in regions where the geology and hydrogeology are well characterised. But they have been part of the assessment for this project, the geology and the hydrogeology are part of the assessment for this project so at least my reading of it,

that recommendation may be an excellent piece of advice from the chief scientist but it doesn't prevent and hasn't prevented that issue being considered for this project, whether or not that recommendation has been fully put in place separately.

PROF COOK: Well – Peter Cook again. We did make the recommendation that there should be more work done - - -

MR BEASLEY: Yes.

PROF COOK: - - - and that seismic survey should be undertaken before wells are drilled to ensure there are no major faults in the area. So that's totally consistent with the O'Kane report.

MR BEASLEY: All right. Richard Beasley again. Unless anyone has a follow-up on that, I just had a couple of brief - - -

PROF BARLOW: I just have one follow-up.

MR BEASLEY: Yes. Go on, Snow.

PROF BARLOW: If I might. Back on the groundwater levels or – I think you just answered – firstly to Peter Cook. No, you stated quite a while back that you wouldn't know the full geology until we drill the 850 wells. But could you fill in that geology with seismic surveys before you began? It wouldn't be as detailed as the drilling but it would provide more information than you currently have.

PROF COOK: Everything you do will – Peter Cook. Everything you do will provide more information and yes, more detailed seismic surveys would actually provide you with that. There's a limitation to seismic surveys. You can only detect down to a certain thickness of sediment, for example. You mightn't be able to detect below 10 metres, whereas a well can obviously sample material down to a few ..... which you can't do with seismic. So there are limitations with seismic. But, yes, you're absolutely correct. You get more information out of more seismic surveys and certainly that's why the WEP felt there was benefit in undertaking more seismic surveys.

Do you need to take those – undertake those seismic surveys before you can move to the next phase of the project? Well, what we are suggesting is that it could be undertaken at the same time as you're moving ahead, that it's part and parcel of the appraisal process and my understanding is the appraisal process could take two or three years. That being the case, you can do a lot of this extra work during that time, would be our view.

MR BEASLEY: Thank you. One just quick question, sorry, Richard, to Michael Williams. With regard to – you mention there's sort of a double barrel question here, Michael. With regard to the bore monitoring network, this is more the surface bores, will – when will – is it proposed for both government and the company to fill in the

groundwater network to be more complete than it is, and is there any proposal to include some farmers bores in that that basically in the project area?

MR WILLIAMS: It's covered in the – what's proposed – Michael Williams. It's – what's covered in the conditions of consent and it – at that point the monitoring network will be sorted out. In terms of the farmers bores being monitored, in the alluvium, the farmer bores, the usage is monitored and it – measuring drawdown is all very well and good but it's actually the usage, the volume's moved that are the thing that you really want to know about. And so in the GAB as well, they take a pressure level and a flow from those bores. I believe it's the conditions of consent to sort out what's practical or not and you've got user groups in that – in the – they're ..... up a water management group or a water advisory group and that has uses in there. So there's a wide enough range of groups to be able to come up with something that's fit for purpose.

MR BEASLEY: Thank you.

MR O'CONNOR: We might move on, now, to that waste issue, thank you.

MR BEASLEY: Yes. Sure. Richard Beasley again. Please don't hesitate to tell me that you think this is more a matter to explore with the EPA than any of you on the water expert panel. But one of the recommendations you made, I think it's recommendation 21, is that the EPA should get some sort of confirmation from a waste disposal operator that it has the capacity to take the salt waste and I assume that means take it and be able to store it safely or dispose of it safely. And that hasn't happened. There's more of a plan for a plan and in the approval and that's a matter for the Commissioners,.

But the question I really wanted to explore is one that's come through from the submission that Professor Kahn from UNSW gave on Thursday and that is contained in the document that I think the Commission received yesterday and that is that this is the issue of the EPA guidelines for solid waste. His view is that if you look at those guidelines, solid waste includes things like glass, plastic, rubber, et cetera, that it's all very well for Santos to give the chemical composition of the salt waste as a means of saying this will be general solid waste, but I think Professor Kahn's view is that the guidelines just weren't set up to deal with something like the huge amount of salt waste that will be generated from something like a CSG mine. Do any of you have a view on that or is it a matter to explore with the EPA?

PROF COOK: I'd like to pass it on, if I may, to Chris Fell for his initial comments.

PROF FELL: Chris Fell speaking. Can you hear me?

MR O'CONNOR: Yes, I can, Chris.

PROF FELL: Thank you. Essentially, the waste will pass the solid waste requirement, but a licensed operator would not accept it unless they were willing to

put it into cells or the risk of leachate is handled. Now, bear in mind that solid waste can include putrescibles and they drain equally, and you'll have to have specially constructed licensed premises. So it really is in the EPA's hands regarding the licence. But the owner of the deposit area would have to liaise with the EPA. The EPA would not allow such disposal. Can I make a point that in Queensland they very successfully handle solid waste by putting it into cell-based storage and they're talking about quantities that are eight or 10 times those we're talking about.

MR BEASLEY: Sorry, is that salt solid waste from mine?

PROF FELL: Solid crystal salt.

MR BEASLEY: Yes. Okay.

PROF FELL: And the big thing to recognise is we're not talking about sodium chloride, we're talking principally about sodium carbonate.

MR BEASLEY: Yes.

PROF FELL: And the water, the produce water is about six or 10 times more concentrated in sodium bicarbonate at Santos than it is in the Surat Basin in Queensland. And the process to go from produce water through to crystal solids is a well-established one and been operating very successfully. I would see no process difficulties regarding the storage. By far the best option is for Santos to explore the possibility of a market sodium carbonate in Australia. We currently import 400,000 tons a year. So it's quite possible as an industry could be started. We had one some years back in South Australia, making sodium carbonate from sea water, which is a very expensive process. To make it from this material, which is high in bicarbonate, so much cheaper and in fact I understand that Santos is talking with a Californian soda producer about this very possibility.

MR BEASLEY: I think – Richard again. I think Professor Kahn wants it a mandatory condition of a project involving .....

PROF FELL: I know. Well, then you must talk to the EPA.

MR BEASLEY: Yes.

PROF FELL: But my understanding of the situation is you don't get a licence or continue licence unless you meet the requirements for safety in handling the leachate. It's not alone a problem for this particular solid.

MR O'CONNOR: Chris, it's Steve O'Connor here. Can I just ask a follow-up question because the water expert panel did look at the volumes of salt and come to quite a different conclusion about how much salt might be accumulated over the 25-year life of the project. Do you just want to comment on that, the very different figures that you've produced as opposed to Santos?

PROF FELL: Yes. We in fact commented on that in our WEP report. The key thing is that over patches of a holding, you will get different produced water contents, depending on how far the water has flowed through the rock structure. So I – well, WEP report actually looked at three independent produced water concentration samples and came up with three different answers. The real answer is we don't quite know at the moment but the department looked at figures and came up with, I think it was 800,000 tons over the life of the project and in fact that was different than that in the original EIS and I'm inclined to believe the department's figures.

PROF BARLOW: Snow Barlow here. Can I just ask Chris a supplementary on that, Steve? Chris, now, if it is to be marketed commercially to the, you know, soda ash and soda bicarbonate market in Australia, one of the – now, this comes out of coal so presumably it's going to have heavy metals and it's going to have some organics in it. Do you know what the extent of that is and are they relatively easily removed?

PROF FELL: So, thank you. Yes. We do know. In fact there are surprisingly low concentrations. But the most important thing is the reverse osmosis plan whips those out quite effectively.

PROF BARLOW: So you can - - -

PROF FELL: So you can – the permeate figures, the operating reverse osmosis plant, Leewood treatment plant, are available and they show very low COPCs, that's chemicals of potential concern.

PROF BARLOW: Thank you.

MR O'CONNOR: I've got a question. Sorry, Richard, do you have anything further in relation to waste?

MR BEASLEY: No, no.

MR O'CONNOR: No. I've got a question that relates to stygofauna. Let me just refer again to page 5 of the executive summary where it says:

> *Concerns have also been expressed about potential impacts on stygofauna. But given the extent to which the aquifers in the region have been utilised over many years, there are unlikely to be any significant natural fauna remaining and in any case, their recognition would be quite problematic.*

I just would like to know what evidence you base that finding on that there's likely to be very little stygofauna.

PROF COOK: If I could just initiate the comment – it's Peter Cook. It's one based upon the volumes of water and the fact we're saying it's unlikely that given the

amount of water that's been moved around the system, we've got anything remotely resembling a natural system still prevailing. But, Michael, do you have any comments that you'd like to follow-up with?

MR WILLIAMS: Michael Williams. The water movement in the alluvium, the Namoi alluvium, has been such – I mean, that – the volumes of water that are moving there and you can actually track them, are large and so any stygofauna would have been moved around. There may have been fauna induced from the river in the alluvium, but that's doubtful. I'm sure you've spoken to experts, Peter Serov, I notice, was on the list there. So the alluvium, yes, had been moved around. The GAB, you'd have to wonder whether there was any natural stygofauna there or whether they'd been induced, but for the deeper aquifers that haven't been pumped, there may be something there or not, who knows.

PROF COOK: If I could just make one further comment there. I mean, you certainly find stygofauna in the extreme western districts of the Great Artesian Basin where the water is a million or two million years old. I mean, you've got no contamination or no significant contamination in those areas. So certainly in the western GAB you'd have it. But the Namoi area is a very different area to what we're talking about with the GAB, with mountain springs and so on. So we don't pretend that we reached an expert opinion on stygofaunas, we don't have a stygofauna expert in the WEP but all we're saying is that just based upon the likely volumetrics, that it's unlikely we will have some indigenous stygofauna there. That's all we're saying.

MR O'CONNOR: Okay. Thank you, Peter. I'm conscious of the time and we're just about out of time. So are there any last questions from any of the panel members, that's the IPC panel.

MR HANN: Steve, I have – it's John Hann. Just a quick question. We have heard in the course of the hearings in this past week, reference to drill cuttings and the potential for contamination regarding their handling and disposal. I just wondered whether you might have a comment on that.

PROF COOK: The – my understanding is that quite a few of the cuttings will actually be used in the vicinity of the wells for wells site work and so on. The coals, which are the most likely parts of the cuttings to have contaminants, natural contaminants, if you like, are going to be disposed of separately as part of a waste disposal facility. Let me see. John, did you look at that particular issue or was it Chris who looked at that particular one?

PROF FELL: I thought it was you, Peter.

PROF COOK: Was it me, was it? Right. Okay. You're quite right. I did. I just thought that maybe somebody else had also looked at it. We – for the most part the cuttings are not going to be heavily contaminated – naturally contaminated in the Great Artesian Basin or in the Namoi because of the nature of the sediments there.

They're fairly caught so there's not going to be much in the way of heavy metals or anything like that. It's really only once you get into the GOB, then to the coals, you have to take care with them and that is proposed as part of the – as part of the project, that they will be separately disposed of.

MR O'CONNOR: Thank you, Peter.

PROF COOK: In an appropriate facility.

MR O'CONNOR: Thanks, Peter.

PROF COOK: Yes.

MR O'CONNOR: Anything from you, Snow, before we wrap up?

PROF BARLOW: Yes. One last question to Michael Williams. Back to the groundwater bore monitoring network. Once you put that in place and you put the transient model in place, you know, the chief scientist report made it clear that, you know, baselines should be established. How many years data does it take to get a baseline for a groundwater monitoring network?

MR WILLIAMS: That's a – Michael Williams. That's a very difficult question to answer. The real answer is for as long as you can get because of changes in climate are going to make those changes. The reality is if you can get a couple of years, up to three years, it's probably sufficient because once you've got the model in place and your baseline established, you're then able to avoid – your model level there allow you to avoid going outside the – any target you set. So, yes, three years.

MR O'CONNOR: Does that satisfy you, Snow, or have you got a further question?

PROF BARLOW: Yes. I guess it will be a sliding baseline with climate changing. So I guess you build on it, but you think three years would be adequate to get an approximate – you know, given - - -

MR WILLIAMS: That's what's currently being used and it's adequate. Remember that what – I'd leave it to the water advisory group to determine what they want to do but it would be – make sense to get some broad baseline data over the whole leased area as soon as possible. Of course you won't be able to get it all at once but if you do it progressively and as a priority would be my – would be my hope as to what that group says.

PROF BARLOW: Yes, that's what I was – it would need to be over the whole area, and it needs to begin pretty quickly.

MR WILLIAMS: From community – yes, yes.

MR O'CONNOR: Okay. We might call an end to the discussion now. I'd just like to put on record our thanks, that's the IPC panel's thanks, to the WEP for their time this morning to answer your questions and I'd also like to thank the department for facilitating that process it's much appreciated. I'll call an end to this transcript now. Thank you very much.

RECORDING CONCLUDED [10.18 am]