ENVIRONMENT, NATURAL RESOURCES AND REGIONAL DEVELOPMENT COMMITTEE

Inquiry into the management, governance and use of environmental water

Melbourne — 5 December 2017

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Professor Ewen Silvester, deputy director, Murray-Darling Freshwater Research Centre *(via videoconference)*.

The DEPUTY CHAIR — Welcome to the Environment, Natural Resources and Regional Development Committee's public hearing in relation to the inquiry into the management, governance and use of environmental water. The evidence is being recorded. The hearings are also being filmed and broadcast live via the Parliament's website. All evidence taken today is protected by parliamentary privilege. Therefore you are protected for what you say here today, but if you go outside and repeat the same things, those comments may not be protected by this privilege.

We welcome you, Professor Ewen Silvester, deputy director, Murray-Darling Freshwater Research Centre. Today's evidence that you give will be recorded. You will be provided with a proof version of the transcript at the earliest opportunity. Transcripts will ultimately be made public and posted on the committee's website. We invite you to a make short 5-minute presentation, and then the committee would like to ask you a range of questions.

Prof. SILVESTER — Thank you. I thought it might be appropriate, given that I did not make the original submission, to say who I am and what my background is. Nick Bond, who is director of the centre, made the submission. He is not available at the moment, so I have been asked to do that, and I am quite happy to do it. My background is a little different to Nick's, though. I am trained in physical chemistry, University of Melbourne. I worked in the French CNRS system, which is equivalent to our CSIRO, for some years, and then in our CSIRO system for 10 years after that. About 12 years ago I moved to La Trobe University in Wodonga, and I have been there since. Recently, as you mentioned, I have been appointed deputy director of the MDFRC. Just in case you are not aware, the MDFRC is a centre within La Trobe University and has research labs on the Wodonga and Mildura campuses.

I am not a specialist, if you like, in blackwater. I am a chemist and I am well around the chemistry of it. My research interests are more in upland and alpine systems, but I have also worked in lowland wetlands, including acidification of wetlands as far down the system as Mildura. So, as I say, I am well across the chemical aspects of this issue. I am also an editor of the *International Journal of Hydrology*, so I have some awareness of what this field is doing in the international context.

I am just going to summarise the submission made by the centre. It was specifically around the causes of the hypoxic blackwater events that occurred in 2010 and 2016 and our view that these were caused due to the mobilisation of accumulated carbon from flood plains and were particularly bad because of two major reasons, two factors. One is the time since the last flood, the last time it had been inundated. You will recall of course that 2010 was at the end of the millennium drought, and so the system certainly had not seen water for that time and probably a long time before that, and similarly in 2016 it had been five years of lower flows. Time since flood allows carbon to accumulate on the flood plain, so that when they do get inundated there is a lot of material to move.

The other effect was timing. These high-flow events occurred in summer, which has two effects. One is that the water is warmer, so the decomposition of carbon is faster and the depletion of oxygen is more rapid. The other is a purely little chemistry thing: in summer when the water is warmer there is less oxygen in the water, and so getting to zero is easier in summer than it is in winter.

Our view is there is no evidence that environmental water contributed to these particular events at peak flow. At peak flow the dominant factor was a natural flow event. There were e-flows later in the hydrograph, but they are not part of the major flow event. In addition it is unpublished so far but e-flows have been demonstrated to have been of benefit in the management of the effect of hypoxic blackwater, allowing some high-quality water from the upper catchments to be released and provide refuge for some fish.

We would like to stress that the mobilisation of carbon from flood plains to rivers is a natural process. It is a good process and underpins aquatic food webs. The aquatic systems in the river depend upon the carbon that is provided from wetlands and ultimately supports fish and bird populations. The issue is only around the amount of carbon in one of the wetlands and then the quality, and quality has a particular meaning in water science. It is a molecular term about the type of carbon and how biodegradable it is, but in short if we have long periods between inundation, then we will have accumulation of carbon and the potential for oxygen depletion when we do mobilise that carbon.

From a scientific point of view, ignoring all other constraints, the best management response would be to ensure that flood plains are inundated regularly — not necessarily every year, but regularly — to avoid the

accumulation of carbon. So when there are large flow events that you cannot control, the amount of material that moves into the river is not as great as what it was in 2010 and 2016.

The management challenge of course is that we do not live outside the context of people. So to enable the exchange between river and flood plain in reverse and support the ecosystems, we need to also not adversely affect the other users of the river. This is going to become increasingly more challenging in the future. We live in a world where climate is changing. The run-off and inflows are likely to decrease and rainfall is likely to become more episodic as we may see more of these sorts of events in the future.

I will finish on two points. The MDFRC is currently engaged in two large adaptive management projects to assist in understanding how flows affect and can be manipulated to produce our desired ecological outcomes and potentially with less water. Those projects include the long-term intervention monitoring program, specifically directed towards understanding the role of environmental water in the implementation of the Murray-Darling Basin plan. The second one is the environmental water knowledge and research project, which aims to understand the ecological response to different water regimes.

It is true to say there is still a great deal of science to be done around this, particularly in developing predictive models of how ecosystems respond to flow, and this is going to become even more challenging. It is particularly challenging in the Australian context because our flows are, in any case, irregular and are now superimposed upon changing climate. There we go.

The DEPUTY CHAIR — Thank you. You finished very quickly.

Prof. SILVESTER — Was that too fast? I am so sorry.

The DEPUTY CHAIR — That is all right. That is fine. Thank you very much.

Mr RICHARDSON — Thank you, Professor Silvester, for joining us today. Some of the submitters have talked about the natural benefits that environmental flows can have on creating blackwater events — that the major, severe blackwater events are the greatest challenge. In terms of maximising the benefit of environmental flows, we have heard from submitters to this inquiry about barriers to using environmental flows in water and the need for greater flexibility and adaptability in their management. Can you take us through some of those challenges and, as a Victorian example, what we might be able to do to better manage those environmental flows?

Prof. SILVESTER — Okay, I will do my best. There are some legal issues that I am not fully around. I think I understand them, but probably not as well as I could. Firstly, to reiterate, the movement of carbon from flood plains is important for the ecosystem's in-channel. Provision of carbon effectively supports microbial communities and ultimately all other trophic levels and ultimately fish and birds and whatever. So that is fine.

Distinguishing between carbon movement from flood plains and blackwater is shades of grey. Frequent or every few year inundation and mobilisation of carbon provides a more balanced way to deliver carbon into rivers as opposed to long periods of without inundation and then massive movement of carbon. The difference of course is the amount of materials being moved and the ability of the river system to use that carbon in a useful way. When we have hypoxic blackwater events, effectively the river cannot cope with that amount of carbon in a good way.

My understanding — and you may correct me on this — is that over-bank events are hard to achieve in Victoria due to legal reasons. This is partly my personal view, but the challenge in managing inundation in flood plains is also to not impose necessarily on private landholders. Having said that, I think every person who farms on flood plains would recognise that the value of the flood plain is largely due to the fact they get inundated and they get a refresh of carbon and nutrients on that land. It is possible to have a win-win, but it is a huge engineering challenge, I think, to deliver that water to both natural flood plain ecosystems and private landholders and still look after the infrastructure.

Mr O'SULLIVAN — A question I would like to ask, Professor, is: in relation to the 2010 and 2016 floods, what could have been done to either prevent those blackwater events from occurring or at least minimise them?

Prof. SILVESTER — Okay, I think you are fighting nature. As I said, 2010 particularly was the end of the millennium drought. The flows were particularly low for nearly all of that period. I doubt we could have

achieved flood plain inundation with the flows that were there, even with the environmental flows on top. That really is the challenge. This is slightly outside my knowledge area, but there is some work in deliberately delivering water to at least limit it past the flood plains to try and minimise the amount of accumulation. But widespread accumulation under those conditions is probably difficult to achieve.

Mr O'SULLIVAN — Yes. That is probably part of the question I was asking, or what I was alluding to: 2010 was probably unavoidable because there had been that millennium drought, which meant that there was that build-up of carbon over six or seven years and when that flood water did come down it was always going to bring in an extra load of carbon. I did actually expect that you might say that that was probably going to be difficult.

But in terms of the 2016 flow, I guess that was slightly different because there had not been the same amount of build-up, because obviously it would have been cleared in the 2010 flood. I guess my question from here is: we have heard today that we probably should have a better system of real-time monitoring in terms of the river flows themselves. If we had a much more sophisticated river flow monitoring system, would that be a better way of being able to manage the system to minimise the impacts of blackwater events in the future?

Prof. SILVESTER — There are two parts to that. Again it is slightly outside my knowledge area, but my understanding is that the 2016 flood mobilised carbon from different flood plains than those in the 2010 event. So effectively we are looking at carbon that had been there for longer than five years. That was largely the cause of that. As for real-time monitoring of the system, I am a big advocate. There is a lot we can do with remote sensing and with a whole range of different ways of understanding how the system is behaving. That is the way the world is going. In fact in terms of environmental science, environmental chemistry in the aquatic area we have enormous capacity to understand where the flow levels are at and what the water quality is at any point in time. We are not doing it yet, and I think we have lost our way a little bit on water quality in that respect. In fact my reading of the situation is that we have almost given up on routine monitoring and water quality in a large part of Victoria because we have not known how to use the data particularly effectively. But we could do a lot more. We could do a lot better.

Mr O'SULLIVAN — In terms of having that real-time monitoring, it is all very well to monitor but then you need to be able to manage and act as a result of the data that you receive. What do we need to be doing in the next 12 months, two years or five years for that real-time monitoring to become a normal part of river management systems?

Prof. SILVESTER — The time frame is difficult to really respond to. I will tell you what I think we can do. We can definitely real-time monitor things like organic carbon levels in water. That is possible. People do it now; it can be done. Through telemetry you could have those numbers instantly. You could also respond through environmental flows if you have the water available to create refugia. If you find the organic carbon levels are going high and the oxygen levels are going low and you think you need to respond, you could do it. You could do it from a river management point of view. Certainly it is theoretically possible. I am sure there is a whole range of engineering constraints around that, but there is no scientific reason why you could not achieve that. How long it would take to implement, well, that technology already exists for doing those sorts of measurements, so you could do that rather rapidly. But whether we could respond from a management point of view in the same timescale, I am not sure.

Mr O'SULLIVAN — What are the barriers for real-time management not happening now?

Prof. SILVESTER — That is getting beyond my knowledge area, I am sorry.

Mr O'SULLIVAN — Who should we ask that question of then?

Prof. SILVESTER — You have had lots of people. I am sure someone must know a lot more than me about river management.

Ms HALFPENNY — Just continuing with technology, do you have any suggestions in terms of further infrastructure that is required to make more efficient use of environmental water or to mitigate blackwater that can be implemented in the Murray Darling Basin or elsewhere?

Prof. SILVESTER — Again, in a slightly vague way I can answer that. There will be key points where flood plain water re-enters the channel, and it would make sense that if we were to measure water quality parameters in those locations, we would know very rapidly whether we are getting an effect on channel water. That would make sense to me as a strategy towards understanding the water quality implications of the connection between the flood plain and the channel. Does that answer your question, or only in part?

Ms HALFPENNY — I suppose one of our jobs is to get the evidence but also look at what solutions and ways that we might be able to improve the situation. If you have only got so much water, is there infrastructure that could be invested in, or are there other jurisdictions overseas or in other states that we can compare ourselves with or look at the way they are doing things and maybe do things better. That is the broad idea I am asking about.

Prof. SILVESTER — My view is that in the international context not many countries have the problem that we do. Most places are dealing with regular flow regimes and they have quite predictable flows. That is not true of all places, but Australia has a particular issue with irregularity in-flow so it makes our task of river management more challenging.

Ms HALFPENNY — Is that due to irrigation or to the natural environment?

Prof. SILVESTER — That is natural variation. That is our climate. That is just the nature of the world we live in. But I have not quite answered your question and I will do my best to answer it. The chemist in me would say if you measure it at least you have got some target, some number to work with or some sets of numbers to work with in terms of water quality, and you have some way of developing a strategy to respond. If you do not measure the water quality where we have interaction between flood plain and channel, then we really are working without knowledge, and I think that is a difficult place to be if you want to manage the system.

Mr RIORDAN — There is a lot of talk of blackwater and hypoxic blackwater. These events of course are naturally occurring. Do we have much information on how quickly the systems recover from it, and like all problems in life is the amount of effort and time we put into it warranted given the problem we are trying to solve? Do you have comments on that? Is it something that we just have to learn to live with?

Prof. SILVESTER — I could not tell you precisely how long it takes for the system to recover, and 'recover' is a mixed thing. Recovering from oxygen depletion will probably happen within a few weeks, because it is the flow system and of course higher quality water from upper catchment is always being delivered. But, as you will know, the effects of hypoxic blackwater in 2010 and 2016 were highly detrimental to fish and invertebrate life and so that recovery time would be substantially greater. I guess one of our points is that recovery is something we should really think about, because this will happen again. How do we maximise the chance of the system recovering rapidly? That is to make sure that there is refugia, that there are places fish can be and will survive and be able to breed when the conditions are good again, and we provide the right conditions to support the ecosystem so the carbon that is delivered to the system can drive the dynamics of the aquatic ecosystem.

The DEPUTY CHAIR — I was actually going to follow on from that question with Nick Bond's submission, in that he talks about longer term there being perhaps less flooding events that would occur due to climate change, if you take that view, and that the natural flush or flood of the nutrients is more unlikely through those events, and then you have got other options, which are the environmental water flows that could be used or other things. I am interested in what the other things could be.

Prof. SILVESTER — I am not quite sure I know what was on his mind when he said that. I am afraid I cannot answer the question.

The DEPUTY CHAIR — I can read you the passage because we have got a couple of minutes. He said:

> While there are potentially beneficial approaches to using environmental water to try and reduce the risk of hypoxic blackwater events —

which you have just spoken about —

> the projected long-term reductions in run-off from climate change coupled with current river regulation practices to manage land and water will likely mean that the frequency of more regular small-scale floods remains low.

Then he goes on to say:

> To this extent, the risks from such events will continue in the future. Further work is thus required to identify those areas of the flood plain that are likely to make the greatest contribution to organic matter loads —

and it goes on. His view is we need to look at further work in relation to how we can displace normal flooding of those areas, but I was wondering did you have in mind what other further work that might show to replace —

Prof. SILVESTER — I think what he is referring to is that the delivery of water to flood plain under a future flow, as in where flows are more generally low, will have to be more targeted. So areas where there are higher levels of carbon accumulation will be the ones you would choose to go for, so you effectively are trying to minimise the risk by targeting the areas where there is not the highest risk.

The DEPUTY CHAIR — Which sort of lead, to my mind, potentially to some water diversion, but maybe that is not what he was thinking. It would not happen naturally and you would actually divert flush water to flush that system.

Prof. SILVESTER — Yes, or it might be that you can deliver water through flood runs rather than onto the flood plain itself, where there is also a high accumulation of carbon, and that in itself may be enough to mitigate the high-flow event when it does actually happen.

The DEPUTY CHAIR — Yes. I think you have satisfied us. Thank you very much for your time, Professor Silvester. We appreciate it.

Prof. SILVESTER — Thank you for the opportunity.

The DEPUTY CHAIR — And thank Mr Bond for his submission too.

Prof. SILVESTER — I will do.

Witness withdrew.