# IESC Explanatory Notes Virtual Masterclass –

# Deriving site-specific guideline values for physico-chemical parameters and toxicants Video transcript

**Interviewer: So welcome everyone. As I said, it's a third in the series of our masterclasses. My name is Fiona Chandler. And during the day, I work with Alluvium Consulting. My background is in natural resource management in quite a variety of different disciplines. But my role here today really is as facilitator, your host moderator, and to make sure that you get the most out of this really unique opportunity to hear from both experts in this particular issue and the co-authors of the Explanatory Note, as well as the IESC and as well as that, those that support the IESC in the Department of Agriculture, Water and Environment. Before we get going, I'd like to acknowledge the traditional owners of all the lands that we're meeting on today here in Townsville and on the lands that we've been building Wulgurukaba people people. I wish to pay my respects to the elders, past, present, and emerging, and really recognise their connection to the land and water country that they've had such a strong connection to over time on this particular topic. I'd also like to extend that acknowledgement and respect to any Aboriginal and Torres Strait Islander people that are joining online with us today. Before we get going, I'd like to introduce a couple of the really important people online with us today. First of all, Andrew, would you like to say hi?**

Interviewee 1: Hi, I'm Andrew Boulton. I'm a member of the IESC. And I'm affiliated with University of New England. I'm an aquatic ecologist, filling in for Jenny Stauber, the IESC's ecotoxicologist who gives her apologies.

**Interviewer: Thanks, Andrew. Dustin.**

Interviewee 2: Good morning. Yeah, Dustin Hobbs. I work for a company called hydrobiology. I do a bit of ecotoxicology there and also in the technical lead on the environmental risk assessment group.

**Interviewer: Thanks, Dustin. Trang.**

Interviewee 3: Hi, good morning. My name is Trang Huynh. I am an environmental chemist. I am a technical analyst and then project manager at Hydrobiology Queensland. We based in Brisbane office.

**Interviewer: Thanks, Trang. And Peter.**

Interviewee 4: Good morning, everybody. My name is Peter Baker. I'm director of the Office for Water Science, and we support the Independent Expert Scientific Committee.

**Interviewer: Great. Thanks, everyone. And you'll be hearing lots more from each of them. But first of all, just a few tips on how you can participate in today's masterclass. And it really is a bit of an informal affair. We want to hear from you. So to do that, and to ask your questions and engage in any conversation, there's multiple ways you can do that. The first one is to use the Q&A icon and button. So if you just look at your menu bar, you'll see a little Q&A icon. Click on that. And it means that you cannot only submit a question to the panel, but others can actually see your questions and actually like it and bring it to the top of the list. So make sure that we see it and that we perhaps answer that over some of the other ones if they're more important to people. So you can use that at any time. And we've made sure there are particular points along the way for the next two hours where we'll stop. We'll have a look at that Q&A panel and then see what questions that we can answer.**

**At any time that you want to make a comment, say hi, or reflection or thought that you'd like us maybe to come back to, use that chat room at any time. I'll also be monitoring that all morning. The other way-- I realised that this is a pretty technical issue and topic. If you don't think it's a question that you can easily write out, we don't want-- expect you to be writing long essays. If you just kind of give me-- put up your hand, raise your hand, there's another little icon for that, I'll see you in the participant list. I'll unmute you and you can actually just ask your question verbally. So that might make it a lot easier for you to engage with the panel as well. I'm very happy to do that at any time.**

**Time permitting, we'll-- at the end of the kind of formal part of the slides, what we will do is I'm going to make everyone able to speak and turn your videos on and it's a really great way to share and to hear from some of your other peers in this area. I suspect we've got some other really experienced people in the room today. So that just gives us an opportunity to have a bit more of an open dialogue, learn from each other, and find out a little bit more about some other experiences and reflections on this topic. I'd also like to acknowledge we're recording this session, so that we can create some resources for other people to share in the future.**

**So let's quickly find out who is in the room. So what I'm going to do is just to put up a couple of poll questions. So this first one just allows us to find out a little bit more about each of you. There's only three questions, so just answer those for me, and then I'll share the results with you. The first one is just where you're joining us from. Which state-- if you're from international somewhere outside other than Australia, let us know in the chat room. We've had a few people from New Zealand and the United States, I think then join us over the last couple of masterclasses which is fantastic. If you're from Queensland, then you'll be maybe excited about the State of Origin, which is why I'm wearing red. I'm actually joining us in Townsville, so it's all a little bit mess here at the moment. We're also just interested how long and your-- some of your experience. Today is suited to both people who are new to this topic, as well as those that are looking for a little bit more detail. And then the third one is just about your use of this particular guideline note.**

**All right, I'm going to end that and quickly share that so you can see who else you're with. So most people from Queensland, yay, but a good smattering from across Australia. We've got people that are both new to that issue. So that's really great. And obviously, as I suspected some people that have been working also in this field for a little while. And looks like the majority of you have at least had some exposure to both this topic and the Information Guideline and Explanatory Notes developed by the IESC. So let's stop sharing that. What I'd like to do now is to reintroduce Dr. Andrew Boulton to give us a bit of a foundation for the IESC and the work that they do. So over to you, Andrew.**

Interviewee 1: Thanks, Fiona, and welcome everyone. Yes, before we get into the masterclass, I was just going to give you a little bit of background on the IESC. If I can get the next slide, please, Fiona. So the Independent Expert Scientific Committee was established in 2012 under the Commonwealth Environment Protection and Biodiversity Conservation Act. And our primary role is to provide scientific advice to the government on the water-related impacts of coal seam gas and large coal mining development. We also provide advice or scientific advice to the states that are members of the National Partnership Agreement. That's New South Wales, Queensland, South Australia, and Victoria. Our other roles include also contributing to the Bioregional Assessments. We often propose and through the Office of Water Science fund some research priorities investigating research and aspects of coal seam gas and large coal mining development. And the minister, either state or government under certain circumstances, can ask for our advice on other matters.

Next slide, please. So there's eight of us on the committee. From right-- from left to right, Craig Simmons, who's a hydrogeologist; Chris Pigram, who's our chair; Professor Wendy Timms, who's a geologist and hydrogeologist; Cath Moore, who sadly is headed back to New Zealand but has been replaced by Phil Hayes from Queensland who is a Groundwater scientist and geo-hydrogeologist; Dr. Jenny Stauber, who's an ecotoxicologist; Rory Nathan, who's a hydrologist; and Jenny Davis and myself, we're both freshwater ecologists.

Okay, so as I said, the primary role is providing advice on coal seam gas and large coal mining developments that might have an impact on water resources. And this is as a result of the water trigger. So basically, we've provided guidance on about 137 assessments so far. And this guidance and advice that we provide is on all potential impacts on water resources as defined by the Commonwealth Water Act 2000. And that includes not only effects on groundwater, surface water, water quality, quantity, ecosystems, and ecological processes, but also any of the general water resources including all the biota, all of the water quality and the sediments, and that's going to be part of the focus of today's presentation. Three things to note about our advice. The first is that it's scientific. So we're not making any regulatory decisions. But because the eight of us, are scientists with different backgrounds, different research disciplines, our advice is purely on the scientific pros and cons of the application, the environmental assessment. Our advice is also completely transparent. And so within 10 days of providing that advice to the regulator, we will publish that on our website so that anyone can see what we're recommending. And also, our advice is independent. None of us is affiliated or for this work we're all independent scientists, and none of us are bound to any government departments or companies or anything like that.

The next slide, please. Okay, so in 2013, we published these set of Information Guidelines. And these were really to help proponents prepare coal seam gas and large coal mining development proposals, primarily to help them improve the clarity and guidance that we as the committee were using to draw our scientific conclusions. And the guidelines in response to feedback from the users have been updated in 2015 and, again, in 2018. It's important to note that these guidelines are not prescriptive. They're not mandatory. And the main thing is really to try and assist proponents and their consultants on what information is needed to provide robust scientific advice.

There's been three sets-- sorry. Next slide, please. In 2018, these guidelines are supplemented by a set of Explanatory Notes. And these Explanatory Notes were introduced to provide further guidance on specific topics. They're more detailed than the actual Information Guidelines, again, they are guidance rather than being mandatory. And these guidelines, these Explanatory Notes for the guidelines produce the most up-to-date scientific methods, information, case study, some practical examples. There's been three sets of Explanatory Notes that have been published so far. And those of you-- I saw a couple of you had attended all three masterclasses, which is great. The first masterclass a couple of weeks ago was on the first Explanatory Note, and that was on uncertainty analysis in groundwater modelling. The second one was on assessing groundwater-dependent ecosystems last week. And then of course, this week on site-specific guidelines. There's a fourth one on modelling and characterising geological faults, which is currently out for public consultation. So we'd be very keen on any of your feedback on those on that draft, and indeed on any of the guidelines or the Explanatory Notes.

As I say, I hope you enjoy the masterclass and welcome. Thanks, Fiona.

**Interviewer: Thanks, Andrew. So this is just a good time to pause at this point. Are there any questions out there for Andrew with regards to the work and the role of the IESC? Now's a really good chance to find out some more. So use that Q&A box and the icon or the chat room. If not, Andrew is staying with us for the next couple of hours. So there are still more opportunity certainly to ask some more specific questions as we go. Looks like it's all quiet. You're off the hook, Andrew, for the time being.**

Interviewee 1: Thanks, Fiona. Cheers.

**Interviewer: So what I'd like to do now is to invite Dustin to kick us off on some of the content of this. So Dustin, over to you.**

Interviewee 2: Thanks, Fiona. Good morning to everyone again. Let's get into our masterclass. Okay. So the decisions framework that we have here on this first slide is pretty central to the derivation of scientific guideline values and we'll be referring to this throughout today's presentation. And I saw that the majority of you are familiar somewhat with the Explanatory Note. It's great to hear that someone has actually read the stuff that we put together. So very encouraging. So yeah. So we'll be referring back to this. And yeah, it's obviously central to everything that the Explanatory Note was about. Just to highlight quickly that there's a couple of different branches here. So we've got the physco-chemical on one side and the toxicant on the other side. And we'll be delving into those as part of case studies later on in the slideshow.

So just a quick outline. So just touch on, like a bit of a touch on the ANZG or the the Australia and New Zealand water quality guidelines and the updated 2018. We just go through some of the terminology that we use as part of the site-specific guideline value derivation. And then we get into what we're all here for, the why and the how to derive site-specific guidelines. And then we go through those. We've got three case studies to go through today. And then, as has been mentioned previously, we'll have some time for discussion. And also, as mentioned, we're going to have some polls, and there'll be a chance to answer questions, but just so you're on your toes, those snap polls will come up at some stage in the next few slides. And we'd really appreciate your participation in those. I think that gives us some good feedback especially live and for their further developments.

So, all right. Jumping slides already. Okay, so I just want to touch on the Australian and New Zealand guidelines. So they were last updated in 2018. A lot of the content in the 2018 was carried over from the previous version that was released in 2000. At Hydrobiology, we were involved with updating those guidelines, both the toxicant values, but also updating a lot of the content. And I say a some of it or lot of it was brought over but was actually updated as well. And there were a number of major improvements that were made to the overall documents and also updates to some of the default guideline values. But the biggest thing for me with the 2000 update-- 2018 update was the publishing of the documents on the web. So this ultimately makes it a live document and can be updated. You know, rather than waiting, what, 18 years for an update, these things can be updated fairly well live. So also, well, it means keeping an eye on this webpage, you can also subscribe to that to get updates when they've become available. So I'm sure all of you are subscribers, because you'd be very, very excited about those updates as they come up. But also, for me, it also brought a lot of the information that were in the 2000 guidelines into a much more user-friendly space. So you can go on there and you can get around on the tabs and click through a lot of things. And it's much easier to find things than it was in the old PDF version of the 2000 guidelines. And if you haven't been on there and checked it out, I do encourage you to get on there because I think it's a really good resource and especially in this space. So yeah, encourage you do that. So with this slide and in the next few slides, we're just touching on some of the terminology that we'll use throughout today's presentation and is used in the Explanatory Note. So here we're talking about stressors-- sorry, stressors. So, you know, we've got non-toxic stressors, such as nontoxic direct stressors, so toxic to the biota or alters their ecosystem, so nontoxic ones, such as nutrients or temperature and turbidity. And then we've also got toxic direct stressors such as metals and metalloids, organics, ammonia, selenium, pH, and B(OH). And then for indirect stressors, so these are the ones that affect other stressors, making them more or less toxic. So we're talking about potentially pH that can change the availability of metals in the environment or the presence of dissolved organic carbons and suspended particulate matter that can complex metals and potentially reduce the toxicity of those toxicants.

Okay, levels of protection. So we've touched on levels of protection throughout this talk. I'm sure you're all kind of familiar with that. I do note that some of the states actually have an extra level of protection within their water quality guidelines. But that is usually contained in between the high conservation value guidelines or level of protection and the highly disturbed system. So it's kind of a fourth one that sits in there in the middle. So just something to keep an eye out for when using the local guidelines or the state guidelines.

All right. Water quality guideline values. So this is obviously pretty important while we're here today. So we've got those default guideline values, which is the ANZG overarching kind of guidelines. If all else fails, we default back to there. We've got regional and local guideline values. In New Zealand, they have a river environment classification. In Australia, we have state jurisdictions and there's also-- within those states, there's further and amongst the states, like Murray-Darling Basin as well and the Great Barrier Reef have their own guideline values. And then site-specific guideline values have also been derived in some areas.

Water quality objectives. So site-specific guidelines and any other guidelines kind of feed into this. And so water quality objectives kind of there to guide the management of water bodies to protect the community values and also gives tangible targets to aim for in protecting the environment. So I'll probably don't go too much into the water quality objectives. But it's just good to understand that the water quality guidelines that we are using and are deriving needs to feed into these water quality objectives or you're looking to alter some of these water quality objectives for your development. We'll also look at-- touch on water quality and ecoregion. So we look at the default guideline values as they're separated into the different regions. At the moment, we're still defaulting to what was developed as part of the 2000 guidelines. And as I mentioned earlier, New Zealand have developed the River Environment Classification system. And we'll touch on those a little bit further later in the presentation.

All right, so one of the big changes to the updated water quality guidelines was the introduction of this management framework. What I like about it is it can be applied to a myriad of scenarios. So if you go onto the website, there is actually a whole bunch of different scenarios that this used as a generic type framework can be applied to a lot of different scenarios and I guess, for the most relevant to the current audience is the example of using the management framework when applying for a development approval. So there is actually an example on the ANZG website that goes into this. The framework is made up of the 10 steps. You can see in this lovely graphic that has been produced for the ANZG. But we are focused on step four today. So we're just determining our water and sediment quality guideline values and as part of that, you know, the step through of whether we need to derive site-specific guideline values or not. Just quickly touch on the hierarchy of guideline values. So it's not—it’salmost impossible to develop a universal set of physical and chemical stressor default guideline values, that’s a nice mouthful. And that applies equally to all the region. And as we've already mentioned, we have ecoregionbroken up into different regions because of that. And that was recognized in the 2000 edition of the water quality guidelines. And additional environmental factors such as local natural water quality can significantly alter the effects of PC stressors at a site. And these factors can vary considerably between sites. That's why water and sediment quality assessments that use more localised guideline values and advice targeted to the relevant local scale will always be more accurate than those using national or regional default guideline values. As a general rule of thumb, the greater the spatial resolution, the more accurate the assessment. So the closer we can get in, the better and more protective we are of that area. So therefore, there's a preferred hierarchy of the types of guideline value for PC stressors as shown in this slide. I think in my opinion that that arrow is going the wrong way. It should actually go that way. So from least preferred to most preferred. So we should always use the national default guideline values as a bit of a starting point. And then from there, we have a look to see whether we've got-- we can go down into that finer spatial scaling as mentioned earlier. So, you know, sometimes we may be able to find site-specific guideline values for where our application, our development may be.

Okay. So Fiona, is this where you are coming on?

**Interviewer: So thanks, Dustin. Let's take a little pause there for a moment. So again, you've got a couple of options to ask a question, provide your own thoughts. Do you agree with some of Dustin's comments just there? But while you're thinking, what we're just going to do is we've got a question for you from the panel. And so this one, if you just like to have a look at this now. Okay. So there's a question there that the panel have put to you. So this is-- there's more than one correct answer, potentially. So if you just like to have a look at those questions, but also, this is a time to ask anyone else a question as well. So we'll give you a couple of moments to have a think about that. There won't be a test afterwards. But this is pretty close. Dustin, while there, just look doing that poll, how often do those guidelines getting updated at the moment or is it on an as-needed basis?**

Interviewee 2: Good question. So given the long-- I guess the long time it took to update, there's quite a bit of data that was generated over that,that I think they started in about 2015 in the update. So there's a lot of data generated in that 15 years. Some new guidelines were developed over that time, and then some have been updated so that the-- a bunch of them were updated when they first released the guidelines. Now look, I'm not an expert in exactly what happened, but-- and then some more have been put out for public comment over the last couple of years and then have been ratified and brought in, I believe, and this is just going to be an ongoing kind of thing where there are pushes to update guidelines. But there's also been-- there is the ability for people to actually submit their own updates too. So as I say, you know, if you're interested in this thing, it's a really good idea to be subscribed because you get those updates emailed to you when things are actually happening, so. And also, it also gives you the chance to comment on any that have been put out to public comment. So yeah.

**Interviewer: Let's share the results then from that quick poll. And what does that look like to you, panel, Dustin and Trang?**

Interviewee 2: Yep, I'm glad every one-- well all of them have been ticked because they're all obviously relevant. Such a trick question put together. That's good. It's what would fit.

Interviewee 3: Indeed.

**Interviewer: Okay. So we do have a question for you, Dustin, to start with, so it's just there on the Q&A from Ashish. So this is basically providing the hierarchy. But, however, there is a general understanding that where the ANZG, DGV, lots of acronyms, are suitable, they should be adopted as triggers, although the SSGVs they might be more conservative. Any thoughts or comments on that?**

Interviewee 2: Yeah. Well, for mine, I probably wouldn't go down the road of developing a site-specific guideline values if your default guideline value is okay. So yeah, but you know, when you're developing your background data or your baseline data, it's fairly, fairly obvious which way you might need to go. So yeah, I think it kind of answers itself once you step through the framework, and hopefully, today's session will answer some of that for you as well. So, yeah.

**Interviewer: Okay. Anyone else want to add anything to that? Okay, then let's keep going. Dustin, over to you.**

Interviewee 2: Thanks. Okay. Just get rid of that. Okay. All right. So as mentioned earlier, we were talking about physico-chemical default guideline values and the geographical regions that were developed. And for inland waters in Australia at the moment, we have four geographical regions, so southeast Australia, southwest Australia, tropical Australia and south-central Australia. And these are still all based on the 2000 guidelines. For the marine waters, this has actually been updated. And I have to admit that I only have realised this in the last little bit. But for the marine waters, the 2018 water quality guideline introduced the six marine regions you can see represented by the different colours on the map on the right there in the top corner, top right corner. And then this was further broken down into mesoscale scale by regions, each with their own default guideline values with some of the bioregions having default guideline values at the surface and the depth in these areas and for all four seasons. So when I actually read that I was quite impressed. I thought that was actually pretty good to have broken it down into yeah, such a fine detail.

So for the marine area, the default guideline values have been set for chlorophyll a, dissolved oxygen, nitrate, phosphate, salinity, sea surface temperature, silicate, and turbidity. All right. In New Zealand, as I've mentioned a couple of times, they've updated their inland physico-chemical stressor default guideline values in line with what they call the River Environment Classification system or the REC. What they've done is they've gone in and all stretches of all the waterways within New Zealand have been classified into six distinct groups and managed according to those groups, regardless of their spatial location. I haven't actually used this very much. I've really done too much work in New Zealand. So if there's anyone on the workshop today or the masterclass today that has actually used it, I'd love to hear about that in the discussion section, because I find it seems to be a really good system and such fine detail as you delve down into the different levels that they've got there.

As you can see, on the slide, they start off with the climate and then getting closer with the source of the flow, the geology type, and then they get right in there with the valley landforms and these kinds of things. And looking at these different stretches of the actual river, we can see all these different colours. So that detail is just amazing to me. So I'd really love to hear if anyone's actually use that, ahead of the curve, I think, but, yeah, it's really good. Not to be out done Australia, the future. What we're trying to do here is what they're aiming to do. And in trying at the moment, we are still using the ecoregions, but they're developing physico-chemical default guideline values for 12 bioregions. As you can see here, all major catchment areas they've kind of been broken up into. And some of these bioregion default guideline values were to be released last year but had been delayed. And again, you know, watch this space. I'm sure those will be released in the coming future. And yeah, if you're a subscriber, you'll be one of the first to know.

All right. So the PC stressors or the physico-chemical stressors that are currently available are listed there on the right-- on the left, and these are carried over from the 2000 water quality guidelines and can be found in the 2000 guidelines in Section 3.3.2.5. If you know how to navigate there, congratulations. It's always a bit of a fun, fun, labyrinth. So these default guideline values were derived by using data from reference sites. And that was determined using the 80th and/or the 20th percentile as part of bell curve. So all the reference data was collected and then these percentiles were derived. And I mentioned 80th and 20th percentile. So for some parameters, an upper guideline value is derived because anything above that can be detrimental to the environment or the health of the species in that environment. And these potentially, you know, like for nutrients. Also, we have a lower bound one, which most of the guidelines have a 20th percentile. And this is mainly for dissolved oxygen, where we want to keep the dissolved oxygen above a certain level. And it's usually that 20th percentile is set as the guideline value. And then for those is also a couple of parameters. So pH and salinity or EC where we have an upper and a lower bound. And we'd like to-- well, we can see effects below and above these 20th and 80th percentiles. So it's quite important to set both of these. So yeah, we see effects at both of the extremes of those parameters.

All right, so back to our framework here. So the process of applying the framework will differ from site to site. While we do run through some case studies as examples, expect that each time we use it, the framework or going to looking at whether site-specific guideline values are something you need to do, there will always be sometimes major or minor differences between some of the projects that you've done. And one of those differences is that the development that you're putting an application together for could be a greenfield project with zero to very little data is available, or it could be a brownfield project such as an extension to an existing development where there may be quite a bit of data available. This decision framework is here to help guide when you might need to derive an SSGV for these different scenarios, or indeed, the default guideline value may be appropriate.

So as mentioned before, there are two branches of the framework. So on the left there, we've got the physico-chemical parameters. And on the right is when we're considering toxicants. The next few slides or the next section you will see us focusing on the physico-chemical side of things. So this is just an enlargement of that left branch of the framework, so we can see a little bit better. So when dealing with physico-chemical parameters, the main question we need to ask ourselves really is are local reference data available? If the answer is yes, then we can move on to deriving the, you know, doing the exciting stuff and deriving our site-specific guideline value. But if the answer is no, then we'll need to head down the road off looking at regional or national default guideline values until we have actually collected enough appropriate data to then go ahead and derive a site-specific guideline value.

And it is very important to ask the question at this point does the data that I have or the data that I'm going to collect meet the criteria to be considered reference data? That is, can the site that the information needs to be collected from be considered in reference condition in regards to where you are proposing your development?

**Interviewer: You've got another question for the audience I see. So let's bring up this quick one while you think again of other questions. So this one is really asking you what do you think about a reference site? What is it? What are the key attributes it should have? So I've just put up the poll questions for you now. And I'll just check the Q&A site in the chat room for any other thoughts or comments. This is also possibly while I give away the answers more than one possible response. So what should the third one be, Dustin?**

Interviewee 2: Flow of water regime.

**Interviewer: Not significantly--?**

Interviewee 2: Sentence not finished. Yeah. I can't remember what like it--

Interviewee 1: I think it means not significantly altered or not significantly changed.

Interviewee 2: Yeah. So anyway, leave that. That's fine.

**Interviewer: All right. I'll give you another couple of seconds to do that.**

Interviewee 2: I think they might be getting the hang of this trick questions type of stuff and should have made it a little more difficult but that's okay.

**Interviewer: I guess there's a question here. Are there other attributes that you haven't mentioned that are being considered? So I'll leave that poll there. And we'll just have a quick look. There's certainly a preference there. And there was a trick in the trick.**

Interviewee 2: Indeed. Indeed, and, again, you know, all these things do feed in and some are going to have more weight than others depending on your site. As mentioned previously, you know, each site is different. Each application is going to be different. Each development is going to be different. But having these in the back of your mind when you're talking about reference sites, you know, is pretty important. So, I just read out what ANZG 2018 consider in terms of reference sites. So a reference site is a site considered to be an unimpacted or minimally impacted condition that can serve as a suitable baseline on benchmark for the assessment and management of impacted sites and similar water bodies. The condition of the reference site is the reference condition. These values can encompass physico-chemical, biological, and habitat characteristics of an unimpacted or minimally impacted ecosystem. So, I mean, we're really just looking at the physico-chemical, and the chemistry side of things, really, but, you know, all these things need to feed into your-- what you consider a reference site. You know, the flow regime, again, is quite important, you know. If you've got an ephemeral stream, and you reference sites in the main river that it actually runs into, that's obviously not going to be very useful down the track. So it's important to take these factors into account when deciding if it's a reference site and that you have data for or will collect data from an appropriate reference site. This is something that's been brought up previously and is an important consideration for the IESC during their appraisal of development applications. I don't know of any specifics, but I do know that, you know, that's kind of been a bit of a sticking point previously, for some of your applications where reference sites, probably not quite reference sites but, yeah. So it's a pretty important part of the process. All right.

**Interviewer: Andrew, did you want to make any comment with regards to your experience in reviewing these submissions, talking about reference sites? Is there any other comments you'd like to add?**

Interviewee 1: Sure. A couple of points. I think, at the moment, we're talking about reference sites in the singular as if one site would do the job. And I think, occasionally the IESC when they're dealing with very variable areas, and Dustin raised a key point about ephemeral streams, you might need to have maybe more than one reference site. And so sometimes there's a tough decision as to whether you might have a couple of reference sites in the area. I think another key point to highlight that the IESC often looks at and that is that although it might be a good reference site when the development is being planned or beginning, it's also important to ensure that the development itself won't have an impact on the reference site. So because you can imagine that over, you know, 10, 20 years, you might have a situation where the reference site is no longer particularly reliable because there's been an expansion or development that has had some impact. So there's always this trade-off between having reference sites near enough to be relevant, but not so close that they might be even indirectly impacted by the development. So it's not a trivial decision. Sometimes there are no available reference sites. And you have to kind of try to infer what's going on. But the IESC considers the, you know, having a design with a reference-- one or more reference sites to be crucial in order to be able to disentangle the impacts of the given development from concurrent changes that might be associated with other activities, climate change, or both. Other than that, you know, those are the main considerations, but it's a key point. And it's really crucial that everyone has a very clear idea of what the key characteristics are of a reference site.

**Interviewer: Thanks, Andrew. Just a reminder, if you do want to ask a question verbally, that if that's easier for you, please just raise your hand, and I'll unmute you and you can engage with the panel yourself. So just check again on the questions, all right? So we might keep going then. Dustin?**

Interviewee 2: All right. All right. So I'll just point out that you've just stolen most of my thunder. Thanks, Andrew. You know, you might as well just give up now. It has kind of given the rest of my talk. But that's okay. We'll plow on. I'll try and make it a little bit different. All right. So yeah, reference sites. Very important. Good to hear that feedback from Andrew. And yeah, again, it's something worthwhile to check those kinds of things before diving in and design of your monitoring program. It's one of the major considerations.

All right. All right. Look at that. Designing water and sediment quality monitoring programs. So as we've just kind of touched on, this is a useful framework to refer to when designing monitoring program. It can be found in ANZG 2000. So on the website, I forgot to put the link on this one. And I challenged Trang to find that link to pop into the chat. I don't know whether she has or not. But if she could do that, that would be much appreciated. So by stepping through the framework and ensuring that you take all the factors that should be considered into account such as sampling design issues like the location of your sites as we've touched on reference sites, you know, capturing where the impact could be occurring, these kinds of things are pretty important. So the spatial variability, the frequency of sample collection, so usually it's monthly. Maybe it needs to be a little bit more. These kinds of things need to be taken into consideration, making sure you have precision and accuracy in your sampling, sampling design. And, you know, one of the biggest ones, obviously, you know, the parameters you're looking to measure. And then probably even bigger for our clients or the proponent is the cost effectiveness of that sampling program. There's no point doing things if you don't need to do them. And I know clients don't like spending money on things that they don't need to do. So all these factors are pretty important.

So obviously, in the next few steps within in that framework is looking at fairly important things like QA/QC and what other samples you may need to collect. So as I say, we're kind of looking here at sediment and water. But there are other things that can feed into this, especially biota, macro invertebrates, and fish and these kinds of things as extra lines of evidence. So these all should be considered as part of your monitoring program design. Well, thanks Trang, popped up. Very nice. Here we go. All right. Sorry about that. So this graphic was taken from I think it's Queensland document about 10 years ago, but it's a good little graphic that gives a bit of procedure for deriving guideline values from local reference data. So let's step through the questions that should be asked of the reference data. So suitable number of reference sites, the spatial coverage, these kinds of things that we've kind of touched on, then if we're happy with that, yes, we go on and calculate our ranges of 20th and 80th percentiles. Pretty important next step, step three, so we review the derived guideline values. It doesn't make sense. You know, there's no point going with something when it might not actually be that protective. So it really needs to make sense. And at some point throughout this, you know, you need to consult stakeholders and all those kinds of things to help you make that decision. And then when everyone's kind of happy with that, we will adopt our new GV. But that's kind of a just a quick step through. So if there are any questions at this point, I'm happy to answer them.

**Interviewer: Dustin, we've got one there from Claire. If you like, we will answer that one live. If you'd like to have a look. Trang, I'm just going to repost your comments into for all the attendees to see that. So I'm just going to do that now.**

Interviewee 3: Yeah, and I can answer, Claire, your question as well, so Dustin can continue with the talk.

Interviewee 2: Are you going to--

Interviewee 3: Do you want me to answer in--

**Interviewer: Yeah. Look, I just-- let's just stop now and we can answer this live. Trang, if you want to have a first go in answering that question for Claire?**

Interviewee 3: For Claire, so that question, so you would consider to do the toxicity site-specific guideline, and that's going to Dustin. We mentioned about the case study, number three. I've seen that it can expand your question as well. So you use toxicity to derive site-specific guideline when you don't have the suitable reference site. Is it correct, Dustin?

Interviewee 2: Let's ask Andrew.

Interviewee 1: Nice one. I figured you're probably going to cover that in your case study three. So mindful of have a time, so. And I think let's jump to the case study three. But then let's make sure we revisit this because this is a very common situation. And there are also grades, Claire. Sometimes things are moderately impacted. And it's sometimes making that decision as to whether you go with a moderately impacted site or not. Probably a broad point to make, and that is that if all the systems nearby are moderately impacted, then that's the reference condition. And so there's no point in having a completely pristine reference site or trying to make up a hypothetical one. You take what you've got, and so-- and I guess, you know, just seeing Brooke's comment here, you could use data from surrounding waterways, but you've got to make sure that those surrounding waterways are not near natural ones. And so therefore, they might not be particularly reliable reference points. As I say, I'm mindful of the overall time for the talk. And I think we need to come back to this point of reference sites, because it's really crucial.

**Interviewer: All right, so let's leave that one open, then. And let's-- Dustin, just keep going with the case study. And we'll, again, just pause on some of those, and then we'll eventually get to that case study three. So over to you, Dustin, and Tim, we'll hold your question there as well.**

Interviewee 2: Yeah, it’s a good question too. So all right. Thank you. All right. Let's get into our case studies. That's a good segue into it, I think. Hopefully, some of those questions will be answered as part of the case studies. But like I said, you know, earlier, every case is different, every site is different, every development application is different. And using the generic framework to kind of give you that step through is a great way to start. And then, you know, talking to experts, or regulators and those kinds of things to get feedback on stuff on your work before you actually get to that point is a great way to do it, if they're available. That's another thing, or, as I say, contacting experts or people who have a myriad of experience in this area.

So okay. So the case study. So this case study, we're deriving site-specific guideline values using baseline monitoring data. So this was a case study. It’s in the Explanatory Note. So you can go and get more detail out of there. But it was really looking at with a mine site that didn't tend to need to discharge but needed to derive guideline values or have a set of guideline values that it needed to meet for control discharges if they needed to. So the problem was the electrical conductivity was identified as a stressor of concern. But it was also known from reference site data that EC or electrical conductivity in the region exceeded the default guideline value. So the approach was to derive a suitable site-specific guideline value for EC using the reference site method. So in this example, a number of sites were identified as being in pre-mined condition. And these have been monitored as reference sites. And as baseline sites, a data review of those sites, I can't remember how many sites it was, it seemed it was about four or five or three or four sites that had baseline or reference site data. And the data review that only-- data review indicated that only one of the sites met criteria. So mainly the QA/QC criteria. And so the data from this site was used to derive the site-specific guideline value.

So, the data used was collected over a 10-year period. So we have quite a nice dataset to use there. It takes into account a lot of the variation that you might see through seasons or years or droughts and those kinds of things. The ecosystem at the discharge point was considered slightly to moderately disturbed. And so therefore, the 80th percentile of the reference data was calculated and proposed to be used as the guideline value. So you can see here our 80th percentile guideline value worked out at 3470 microsiemens of electrical conductivity. This is about 10 times the upper level of the default guideline value for that region. But after stakeholder consultation and consideration of all the factors of the area, obviously we're in a coal mining area where you have certain geology, it was accepted that this is not out of the realms of possibility and was adopted as the guideline value in this case. So yeah. A bit of an example of quite a shift from what would have been a very restrictive guideline value to something that could be met by the mine site if it did need to discharge.

Again, we come back to our participants. And I guess, are there any similar experiences or people done something different to the case study in these, that we've just shown? Again, we might-- if there's any quick questions, we might have a bit of time to answer it now. But otherwise, we'll just keep rolling on. I'm getting a shake of the head from Fiona. Okay, let's roll on. We don’t want to use up too much time. But again, you know, in the discussion, I'm happy to hear people's experiences because that opens up experiences that I might not have had throughout my professional experiences as well. So I'd be really happy to hear from people on that.

All right, so to kind of pass through. I’m having real trouble with this. All right. So we've looked at physico-chemical parameters. And now we will look at driving site-specific guideline values for toxicants. So we're going to start looking at this, the right hand branch of our generic framework. And within that, there are two sub branches to this toxicant side of the framework. One side deals with toxicants that do not have default guidelines. And one branch that deals with toxicants that do have default guideline values. So first up, we'll look at when we have a toxicant that does a default guideline value. And in this branch, I guess the main question that needs to be asked is are sufficient toxicity data available from literature to derive interim guideline values? So if toxicity data is available, then an interim guideline value can be derived? Happy days. If the answer is no, then toxicity data will need to be derived. So in terms of interim guideline values, what do we mean here? So in the ANZ water quality guidelines, there's a whole bunch of low reliability guideline values that have been derived. Now these are where there's not enough data to derive a moderate to high reliability. So the confidence in these guidelines is a little bit lower. So we can use those or we can search the literature for toxicity data and use that toxicity data to derive an interim guideline value. And a lot of the time both in ANZ water quality guidelines, and if your findings and toxicity data and assessment factor method will be used, the assessment factor is often, sorry-- the assessment factor method is where you take the lowest toxicity value for whatever species you are found and apply a factor. So this often leads to very conservative guideline values, which is probably not palatable to proponents. And so therefore, it is often recommended that further information be generated. And this can then shift onto that next dot point where if there's enough toxicity data being generated, and we'll touch on this in the next slide, species sensitivity distributions can be used. So this can often mean undertaking eco tox testing where a number of species will be exposed to the toxicant of interest to identify the concentration of the toxicant that will elicit an effect to each of those species. As I say, we'll look at this in the next slide. The recommended approach is to then take the toxicity data, be it from the literature or from the toxicity testing undertaken by the proponent and derive a site-specific guideline value using a species sensitivity distribution.

So here's our species sensitivity distribution. Now, being an ecotoxicologist, this is pretty fundamental to what I do. So I'll just run through what a species sensitivity distribution or an SSD is. So an SSD is generated using the results of the toxicity testing of your toxicant or if you've got enough values from the literature, you can actually do this with those values as well. And then you've fit it to a distribution. So you can see either a curve that goes through those results there. So this trickery is handled by a piece of software that was developed specifically for the Australian and New Zealand water quality guidelines. And it's called Burrlioz. It was first used for the 2000 guidelines. And they've updated it for the 2018 guidelines. And I won't bore you with the details. But what it does is generate this curve, as you can see here in the graph. And we can see on the Y axis, it's a cumulative percentage of species that are potentially affected by the toxicant that we're exploring, and then on the X axis, the concentration of the toxicant that has caused the effect to each of those species. And in this case, it's reported in milligrams per litre. So from this, we can then derive the protective concentration that we're interested in, or usually we will determine all four 'cause it kind of covers your range of protective concentrations. And then we can identify the corresponding toxicant concentration that should protect that percentage of species. So here, on this example, we've highlighted the five percentage of species that will potentially be affected. So you flip that and you say this is our 95% protection concentration, so we scooch across to our curve. And then we go down to our concentration. And this is actually part of the case study in the next few slides. But in this case, our 5% of species potentially affected will be when your concentration is over 776 milligrams per litre. So you can also look at the 20th. So your 80th percentile protective concentration, so we can come across and have a look at that. I think it's about 1200 or something like that. But we'll see that in the next slide. So sorry, if I laboured on this, it’s something which is part of what I do. I love it.

So yeah, so we'll go over this in this case study here. So, again, we were talking about the toxicant part of the framework, but we're looking at deriving site-specific guideline values that do not have default guideline value. So you don't have anything to come back to. There's no fallback in the national guidelines or the state guidelines. So in this case study, we want to establish concentration limits for discharge water. And this, again, is a coal mine-- what was done for a coal mine. And as we know, sulphate is often elevated in coal mine discharges. But we don't have a default guideline value for sulphide to protect freshwater ecosystems. So the approach here, as we mentioned, was to generate ecotoxicity data of local origin and then use an SSD to derive that site-specific guideline value. And as mentioned earlier, we will derive four levels of protection. And usually, that's the 80th-- 90th. So that's for your kind of highly disturbed systems, your 95th, which is your slightly disturbed systems, and then the 99th protective concentration, which is for your high ecological value systems or your pristine systems.

So in this case, a number of chronic toxicity tests were undertaken. And this was used as-- a chronic toxicity was used to reflect the continual discharge proposed from the mine. So this is kind of a looking at the long-term effects of the discharge. Eight locally relevant species were used. So all of these species are found or found in the area of the mine, so they're quite relevant to that part of the world. Local water was used as part of the laboratory exposures. So you are not introducing any potential variability. And also, the upstream or the local water was also used as control to ensure that the actual water that you're discharging into was not having an effect on the laboratory testing that was undertaken. One of the things behind that is that sometimes the species that you use were not read in that type of water. So sometimes there can be a little bit of an effect-- a background effect from the water that you're actually testing in. So the upstream water is generally used as a control.

So from that, we generated the data that we can see here. So this is that same SSD that we showed earlier. Again, we've got our percentage of species potentially affected and our concentration of sulphate along the bottom here and milligrams per litre. And then all of these dot points are where an effect was seen for these different species. So down the bottom here, we have a green hydra. In the middle, we've got, I thought, a macrophage-- a duckweed. And then at the top here, we've got our tough as old boots, rainbowfish and barramundi. And then in between, we've got a range of species that make up the different trophic levels that we need to use or take into consideration. So from this, we then derived our protective concentrations. And this is those protective concentrations. So from this, we could then set guideline values for the discharge of the water from the mine site. So what we're saying was as long as they were keeping their sulphate concentrations below 776 milligrams per litre, and I can hear you're saying, "Well, that's very specific." But, you know, that's the beauty of using actual data generated for a site. As long as they're keeping that below there, we should be protecting 95% of the species within the receiving environment. So this kind of-- this value was deemed kind of okay in terms of what it was. The mine site, we're okay with being able to get down to that level. And so it was deemed an acceptable guideline value. But there were kind of caveats around that in terms of kind of doing biological monitoring, you know, routine biological monitoring as another line of evidence to ensure that our guideline was actually protecting, you know, the stated 95% of species because we have really basis on eight species. You know, there's far more species that are going to be in that receiving environment. So that extra line of evidence is fairly important to ensure we are actually doing that.

All right, so that's our second case study. If anyone's got any, again, any quick questions about that case study, happy to answer them now. But if you want to, you know, get into the nuts and bolts a little bit more, probably best left for-- excuse me, the discussion area.

**Interviewer: So, yeah, take breaths, Dustin if the principal check that-- check the screen, and I think you're right. It sounds like the three are-- would go on to this third one. And then we can kind of open it up for some broader discussion. But we've got another one from Tim. We'll hold that one over, Tim, and we will answer that one live in a minute. We might come back to the issue of reference points after this, but--**

Interviewee 2: Yeah, yeah. That control versus reference question I'll leave to the end because we can have robust discussions about that, always a fun one.

**Interviewer: Okay. Looking forward to.**

Interviewee 2: And then with regard to that, are any of the criteria based on toxicity testing on Australian local species? I'm not 100% sure on that one. I can answer that fairly quickly now. I haven't really looked into the back end of it. But when I did see that the other day it did pique my interest and I can follow up on that and find out.

**Interviewer: Dustin, which question were you--**

Interviewee 2: Sorry, the one from Brooke. So it's for the 12 bioregion criteria being developed. Are any of the criteria based on toxicity testing on Australian local species? Now, the bioregions are based on physico-chemical data. So I believe most of it will be based on reference data. But don't quote me on that, and I can find out but I'm pretty sure it will be based on reference data. So good question. One I haven't followed up on but--

**Interviewer: Let's ask if Peter Baker's got any more thoughts on that one, on the bioregions. Peter, is that something in your area? No?**

Interviewee 4: No, Fiona.

**Interviewer: Okay. Well, let's hold that one cause someone else in the audience might have an answer as well, so.**

Interviewee 2: Yeah. And as I said, I could potentially follow that up--

**Interviewer: Sure.**

Interviewee 2: --and, you know, and let the attendees know one way or the other if they're interested or they could dig through the ANZG website and find it for themselves, you know. There's plenty of fun stuff in there.

**Interviewer: On that note, let's go into case study three.**

Interviewee 2: All right.

**Interviewer: And then we can come back to each of these questions, and we're going to have some good discussion.**

Interviewee 2: Sounds great. All right. Thanks, Fiona. All right. So as Fiona said, we'll come back. So I guess the final part of our framework is looking at toxicant that have default guideline values. And I did see that there's a question, I think, about-- no, that was our question about background information, you know, being higher than the default guideline value. So this is kind of that question, you know, where the reference data exceed default guideline values? You know, what do we do here? So I guess the question, again, you know, the question we ask ourselves, do background reference data exceed default guideline values? If we say, if, again, if it's no, we can use the most appropriate default guideline value. Hopefully, there's a regional one or a state one, and if not, we go back to the national one. But really, it's happy days because, you know, mostly our work is done for us and we're not worried about it. But if it is yes, then we need to move on to deriving site-specific guideline values for that toxicant. So just want to mention temporary waters. Now, this is something that's close to Andrew's heart. And I tell you if you've got any questions, please fire them at them, because I would be very interested to hear his answers too. But the temporary waters are an important and common consideration when dealing with coal mines and coal seam gas developments, a special problem is that there is sometimes no water to monitor or very little at certain times of the year. And we need to consider the wetting-drying cycle and that physico-chemical parameters can be influenced by a number of variables, both regional and local variables.

So this diagram runs through a number of the variables with the yellow boxes kind of representing the regional or catchment scale variables that you might need to consider and the green boxes representing the local scale. And these two levels of variables or that the two levels of variables can be important or become more important during the different seasons, with the regional or catchment scale being more important. So the yellow ones being more important during the wet season when there's much more connectivity throughout the catchment. In terms of water, potentially, you know, hopefully, you're going to have flowing water and all those kinds of things that you have to think about in a temporary water. And while the local scale variables will be more important during the dry season when there will be less conductivity and you're starting to see pool habitat and these kinds of things become more pronounced.

So with that in mind, yeah, there might be a need to derive two sets of guideline values. And hence why it's always preferable that two years of data is collected when you're looking at doing site-specific guideline values because you get that variation in there, you know. There's always going to be variation, but there can be extremes of it as well. And temporary waters can be one of those extremes. So, you know, there’s also kind of highlights the importance of your sediment monitoring as well. So that kind of leads us into our final case study. So, you know, this case study involves deriving a sediment site-specific guideline value. So as part of the new coal seam gas development, sediment quality objectives were to be developed for monitoring purposes during the dry season when some potentially affected creeks would actually be dry. So as part of the baseline data collection, zinc was found to be above the discharge-- the default guideline value. And therefore, a site-specific guideline value was to be developed using reference data.

So the approach to that was six comparable upstream reference sites were selected. Sediments were collected from each of those sites in triplicate. As mentioned before, the sampling was conducted over two years. And during those years, three sampling efforts were undertaken per year. So these samples were then sent off to the lab and analysed for the zinc content amongst other bits and pieces that are important when looking at sediment. So, this resulted in the condition of the water by the factors leading into this. The condition of the waterway was identified as highly disturbed system. And in some cases, if a system is identified as highly disturbed, you could potentially use different percentiles, but in this case, the 80th percentile was chosen to represent the site-specific guideline value after stakeholder consultation, so taking into account all those users of that area, that region, the farmers, the locals. So the 80th percentile was chosen. And as you can see here, the 350 milligrams per kilogram was the 80th percentile. Now, again, this is kind of a bit of a reality check on this, the guideline value that is, would be, they would like you to normally stay under is 200. But in this case, the background data is showing that 350 is kind of your median, your guideline value. And this is kind of-- this is acceptable, because the sediment quality guideline value is approximately 410 milligrams per kilogram. So 80th percentile is under that which is great because we do know that this is set, because it is most likely that there will be an effect on some of the species if this is exceeded. So we're under that. Everyone was happy with that. Stakeholders were happy. So this was actually set as the site-specific guideline value for this system.

Yeah. So this is kind of near the end of the talk. And we kind of skipped through fairly quickly. But I just wanted to highlight again, you know, the real importance of when you're designing a program, a monitoring program, be it water, sediment, non-biological, or really, you should be thinking about all three of these things when doing this kind of work, it's really important that you understand that this is where all the important decisions are made. So what you end up actually having to derive your site-specific guideline values or get your development application approved starts here. So it's really, really one of the most important things you will do as part of that project. But you've also got to remember when you're doing this, that you-- when you get into the miniature of, you know, where you're going to collect your water from, sediment, what parameters that we're going to be looking at, have we got our QA/QC, are we spending too much money, cause you've always got to step back, and, you know, never lose sight of the overall aim of the program, which is obviously the most, you know, you've got to answer that question. That's the most important thing. So again, this kind of framework is really useful to come back to and use when you're designing your programs. And, again, this is from ANZG. Go to the website. Have a bit of a look around. There's a whole bunch of really useful stuff that can guide not only your applications but a whole bunch of other things that you might be doing as either consultants or proponents. I was going to say something else really sage, but I forgot it. So yeah, so. Oh, and also, there's links to not only the Explanatory Note that Trang and I put together, but some other very useful papers. There's one by van Dam in there about site-specific guidelines and other bits and pieces. So yeah, it's a real treasure trove of useful information. And the more you get familiar with it, the easier it is to use. So, yeah, again, I recommend you go there and immerse yourself.

So that's pretty much the end of most of the actual formal slides. Just wanted to give you a few hints and tips. I know that some of the other masterclasses kind of did this at the end of the talk. So there's a couple here. I mean, this is, you know, I'm not giving away all my secrets. You'll have to you, yeah, you might have to contact me directly for that. But, you know, just a couple of quick ones. So always, always look for a regional or local guideline value. You just never know. There could be one there that, you know, is tucked away, or you talk to your local regulator, and they may be able to highlight something. And as you know, as a consultant, you know, why do the hard work if it has already been done? You know, it's, yeah. Don't reinvent the wheel.

In terms of toxicity data, a quick way that I've always used or what I've always done is to compile a toxicity dataset that I can then use to derive a guideline value using an SSD. It is using established databases such as the US EPA ECOTOX database that has changed over the years. And I don't know whether it's easier or harder to use, but, you know, if you, if you nut it out, you can actually get some really nice datasets out of that and it will save you a lot of time. And, yeah. There's also an Australian one, but I'm not sure how up to date that is, and I haven't actually seen it for a little while. So I might have to immerse myself in the ANZG website and see if I can find it. Also, the literature is always a good source of up-to-date toxicity information. So the US EPA ECOTOX database is updated fairly regularly. But it doesn't have all of the latest toxicity information. So if you're looking at something that might be a little bit new or novel, or hasn't ever had a lot of information, it's always wise to just go and do a quick literature search on that, as, you know, we potentially would be doing anyway. And, you know, the last one's probably the most important one here. You know, if in doubt, seek the advice of an expert, you know. It sometimes, again, can save you a lot of time. And also, you find, a lot of money to just touch base with someone who's done this kind of stuff before. So with that, that's pretty much the end of the slides. I'd like to thank you for-- I don't know whether you fell asleep or not but--

**Interviewer: We'll just stop there for a sec, Dustin. And I think we'll just get into some good questions coming through before we sort of do the wrap-up slides. So I'm just going to bring people's attention if you haven't already, just to bring out the Q&A box. And what I'll do is-- sorry, Paul, I'm just going to send you back into the room. It's just look at the QAs cause Trang's been busily answering some of the questions as well just during that session. So I just want to quickly go through those, Trang, of the answered ones first, and then we'll just come back and have a look at the ones that we still want to discuss. So there was another one from Chris there, Trang, that was around referring back to Claire's example where you've got upstream sites different from the base geology. Would you like to just make a further comment, Trang, on your response to Chris or anyone else in the panel?**

Interviewee 3: We see-- what question, sorry? I'm just--

**Interviewer: This was Chris' question on upstream sites being different. So you've already replied to it.**

Interviewee 3: Yes, yes. So basically, if you have a-- the different geology, so basically, you need to do the site-specific guidelines because the water chemistry will be different. The sediment will be different. So I think for that kind of condition, you may have to do the right site-specific guideline for that condition. And the toxicity will be the approach that people would go for it. And we all know toxicity is quite expensive approach. And now we have required SPC. So not many people are willing to do it. But if you don't have that, the default guideline, you don't have regional guideline, you don't have a suitable reference site. So this is the last resort you have to do. Yeah.

**Interviewer: Great. Thanks, Trang. If there's no other comments on that one from the panel, we'll go on to Nicole's question. So that was about the minimum number of data points required to derive the SSGVs for physico-chem. So thanks, Trang. You've, again, given a reference there and some further information. I mean, in fact, you've given that quite a bit of detail on that question for people to review.**

Interviewee 3: Yes, so in the document, we already explained how many sampling time we need to take and also depend on the weather condition, the climate condition, and the flow. So I think it's already mentioned in the chat room. And we, see provide instruction 3312, so yeah.

**Interviewer: Right. Very helpful.**

Interviewee 3: So, for example, like with the temporary water you have to capture complete the cycle, wet and dry, and stuff like that. So that variation, maybe Andrew, do you-- would you like to explain a little bit more in terms of the number of sampling? Some people will say oh, "Two years too long," but, you know, I think that's it to cover the variable of the data for during the sampling, so yeah.

Interviewee 1: Thanks, Trang. This is something the IESC often struggles with and, you know, understandably proponents are very keen for us to give them, you know, some hard and fast numbers. Of course, the two years is really just a guideline where we're trying to say, "Well look, you know, one year is unlikely to be enough, 5 to 10 years is probably unrealistic, you know, for a proponent to gather before anything happens. But I think there's three things that you have to bear in mind. The first Trang’s nailed and that is the amount of degree of variability that you're expecting. If you're expecting an awful lot of variability, and we often see that in temporary waters because of the fluctuations in water volumes and flow, then the more variability you're likely to need, you know, more data points. The other is the actual importance of the whole situation. If you've got an ecological asset or a valued asset, that is of particularly high, you know, cultural, natural, or heritage value, then you're likely to need more data points in order to be certain of your assessment of the risk. If, on the other hand, you know, it's not a particularly valued asset, then you can probably get away with fewer data points. So the amount of data you collect is really directly proportional to the importance of the issue. I think the third one that's not often touched on and that is the reliability and cost of the assessments. And because, you know, the IESC is well aware of the sort of cost balanced ratio or cost benefit ratio of gathering information beforehand, we're often, you know, suggesting that proponents look at new techniques that are coming onboard. Many involve remote sensing or new and cheaper analysis methods. And so, you know, this is partly what the guidelines and the Explanatory Notes are all about, trying to suggest ways in which proponents can gather more data in order to improve their assessments and provide more reliable information. That's probably more detail than you needed perhaps. But part of the reason we're reluctant to sort of say, "Well look, you can get by with just three data points," is in some cases, you might need a dozen. It might be a really important asset or highly variable system where you need a hell of a lot more.

Interviewee 3: Yeah. And also, I want to add in this because this is very common happen to some of the site we work on, like sometimes you got the one-year data, but the quality of the data is also important as well. You know, sometimes people collecting data but come back with something, the number very unusual. And that's why two year is give you the-- another opportunity to cover the data, you know, so the quality of data is also <inaudible>. That's why I consider two years at minimum. Yeah.

Interviewee 2: It just means that the proponent needs to be organised and start collecting the data as soon as I can, I guess, so.

Interviewee 3: Yeah. Yeah. Yeah.

Interviewee 1: I think another point to make on that further to Dustin's and that is quite often the IESC looks at expansions, you know, applications for expansion of mines or extensions of particular projects. And we're often a little bit disappointed that the proponent, all their consultants haven't made more use of available data that's been collected for, you know, monitoring programs beforehand, or if they have used that it's not very clear how they've used it in order to support their assessments of, you know, the degree of impact or risks likely. So, I think a real encouragement, and it really sort of, you know, comes back to Dustin's first hint and tip, make sure you do a really good search to see what information is out there already. And certainly, looking at previous EISs are sometimes really helpful to just finding, you know, troves of data or even, you know, checking that the proponent doesn't have any datasets collected for earlier assessments or continuous monitoring that could've been really useful.

Interviewee 2: That could happen. Especially when there's corporate turnover and those kinds of things--

Interviewee 1: Exactly.

Interviewee 2: --that data can be lost. So it's yeah, really, really important that you get them to really dig through and, you know, because it saves a lot of time and a lot of money and a lot of-- I wont say heartache. It's not quite that bad, but you know, it is important that anything that's available is made available as soon as you can, and you really need to, yeah, check on that, so.

Interviewee 3: Yeah, that's true because I worked on one project in New South Wales, Hunter Valley, so at the beginning, the people who handle the data. Say, we don't know where it is. But then you ask the question, and they go on, you know, I was like at the end, they gave us a whole set of data and monitor from the beginning of the mine. So this is good data. So we use that and going, reinvent the wheel and do the toxicity and stuff like that. So they have data. But sometimes people don't always use. It's very, very common for mining.

**Interviewer: I'm going to move you on to some more questions, so we can get through a few more. So let's go back to Claire's question, which was very early on. Claire, how are you feeling about some of the-- we've discussed a few more of those case studies now. So just going to check in with the panel for Claire's first question. Are there often no areas impacted by existing activities and not influenced by surrounding land uses in those areas? What approach would you take? Anything else that the panel wants to add to that, or in fact, again, from the participants in the webinar, any other tips and hints for Claire? Just raise your hand. Let me know in the chat room.**

Interviewee 1: Can I perhaps follow it up, Fiona? And I guess this is also addressing Brooke's comment about whether the point of the reference site is to act as a control or whether it's to demonstrate natural fluctuation over time. I think it's crucial that we get really clear in our mind, what a reference site is all about. A reference site is not a pristine site. We're not-- I mean, it might be a pristine site. But a reference site is really an idea of what the area would be like in the absence of the actual development. So in essence, if you've got a waterway, which is all the waterways in the area are contaminated or disturbed, then those are going to be appropriate reference sites, because it will obviously be unreasonable to be having a pristine reference site when most of your waterways are badly disturbed. Quite often people tend to confuse reference sites with what are called target sites. Now, target sites are those that are proposed when you're thinking about rehabilitation or restoration to some ideal or enhanced area. And I think it's really crucial that what we're-- you know, we're not trying to make the job easier or harder or whatever. We're really just trying to work out what impacts the development might have on the existing water resources.

**Interviewer: Awesome.**

Interviewee 1: Hopefully that answers the question a little bit more clearly. And I guess, coming back specifically to Claire's question, I'm just going to find it again, it just seems to have shuffled out.

**Interviewer: I've just put it into the answered--**

Interviewee 1: Oh, okay. Gotcha.

**Interviewer: I put it into the answered.**

Interviewee 1: If you've got an area that's impacted and highly developed, then, you know, the stream in that area are going to be your reference stream.

**Interviewer: Claire's happy.**

Interviewee 1: Excellent.

Interviewee 2: And it comes back to, I guess, making sure that that's fairly-- that's well understood within your application. I mean, you know, you can't just say, "Here it is." You got to say, "Well, you know, there's all this stuff around," which I'm sure they, you know, people do. I mean, we do. So, you know, if you've got that background information, it should be fairly straightforward.

Interviewee 1: And I think that's a good point, Dustin. I mean, I'm certain that the members of the IESC would be delighted if when proponents put together their descriptions of potential impacts and reference sites that they actually describe how and why the reference sites were chosen. And if there are any caveats in the reference sites, to be upfront about it. I mean, primarily what we're after our lines of evidence between the information being presented and the assertions of the proponents. And, you know, we're not expecting people to do anything with data they cannot get or don't have. We're really just after a line of sight, preferably multiple lines of evidence to support the assertions being made by the proponent about how much impact and how much risk there might be.

**Interviewer: Always pays to hang around to the ends of these masterclasses. It's where you get all the juicy bits. Let's keep going. There's another question there from Tim. Again, I think you've touched on this to some degree, Dustin, but do you want to just make any further comment?**

Interviewee 2: Yeah, so I think-- so when you're doing the 20th and 90th percentiles, you are taking the whole dataset. You're not to get-- you're not-- unless you, you know, maybe you've got a huge outlier or something like that, and it just doesn't make sense. Okay. You'd probably get rid of that datapoint, but the dataset that you could collect over a certain amount of time and in this case, you know, to be-- to make Andrew happy two years, you know, minimum, and you include all of that data within your percentile distribution, and then your 80th percentile will include where that any of those high or low values that are there, so you're not really-- you are including all of your low and high concentrations. So, yeah, there's -- other than, as I say, an anomaly in your dataset it should, you know, if it's outside of two standard deviations from the rest of the data, you'd probably get rid of it. But other than that, you include everything.

**Interviewer: Okay, Tim, are you happy with that response? If not, raise your hand and I'll unmute you where you can continue the debate. Otherwise, there's Brooke, we've kind of talked a little bit more about some of your original questions. I'll just get the panel to have another read of your questions, Brooke, and just see if I want to add anything else to that or if you want to ask a bit more, again, I can unmute you. So that was all about the pristine. So I think we've kind of covered off on some of that and Trang has given you some references there. So Brooke, you've also-- going back in history, so once upon a time, 30 was the magical number of minimum datapoints per parameter.**

Interviewee 2: I think that's kind of covered in that two years, you know, like, I think, if you want to use a number, you can say 24, because we would expect to collect at least a sample every month, if not more. So. you know, I think that's just kind of built on having those potential two seasonal cycles. So you get that-- you can catch that variability. Obviously, two years is a small timeframe in terms of what happened in the environment in the first place. But, you know, it's, again, I think, as Andrew touched on earlier, it's that trade-off between, you know, economics and, you know, the science. So, yeah.

**Interviewer: So just drawing your attention, Dustin, so if you have less, do you just have it there as triggers?**

Interviewee 2: Oh yeah.

**Interviewer: Is that--**

Interviewee 2: So if-- well actually that's an interesting one, because I was actually going to ask Andrew these questions before. So if you've got less, you know, if-- or you want to move on to doing some stuff, and you haven't quite got all the data, can you submit something that say, two-thirds or three quarters of the dataset and say, "Look, this is what it looks like, you know, can we start thinking about doing stuff because we're time crunched," blah, blah, blah or, you know, is it-- can you like--

Interviewee 1: I'll let I'll let Peter talk a little bit more about the sort of administrative details, but from a scientific perspective, we are assessing what we've got in front of us. And so if a proponent decides for whatever reason to put in an application based on a year's data or, you know, information where they are not-- or their consultants are not convinced that there's enough information to make a very strong case, then it's up to the consultant and the proponents to be very open about that degree of uncertainty. You know, it sort of comes back to the fact that quite often the IESC do something of a bit of a pub test and say, "Well, look, you know, these are data that were collected, you know, during a drought." That drought is broken, we've now got a whole lot of rain coming through the system. And the proponents claiming this situation when we expect, you know, this is going on. As long as the proponent and the consultants are upfront about the degree of uncertainty and temper their conclusions accordingly, then we take what we’re given, but there are very often situations where there are just simply too few data to support the assertion. And very often a proponent will say, "Well, we don't think there's going to be a significant impact." And it's just not convincing enough to be able to demonstrate that. Quite often you need a lot more data to claim there won't be a significant impact, because you're trying to cover, you know, the amount of natural variability there is in the system. But let me throw to Peter to see firstly, whether that seems like a reasonable thing and secondly, what would be the situation where you get, you know, and I'll work carefully but, you know, perhaps a half-baked EIS. There's really not enough data to support an assertion. What would the Office of Water Science do in those situations?

**Interviewer: So I'm going to do a bit of a shout out now to Ashish, because you've actually given everyone in the chat room the name of the CSIRO software. And I don't know how to say this right, Dustin, but Burrlioz?**

Interviewee 2: Burrlioz.

**Interviewer: Burrlioz?**

Interviewee 2: Yeah.

**Interviewer: So thanks for that, Ashish, but you've also asked a question. So is it okay that while two years of data is being collected, an interim guideline value can be used for the first few observations, so say 8 to 10?**

Interviewee 2: No. I would say no. That's where in that framework, it says you default back to your local or regional guideline value if it's available or the national one. As was just discussed, you know, it's just not enough to base a decision on. So, I mean, I'm coming from the consultant side. I probably wouldn't myself. I don't think that's enough information just scientifically. Andrew has kind of answered that and said, you know, the pub test-- does it pass the pub test? Probably not. I don't think it would. I mean, that's only eight to 10 months of one year. So well, I guess it could be-- it could be 8 to 10 observations every two months over a year-and-a-half. I don't know. But, you know, from mine, probably not. But again, it comes back to what, you know, what is the system that you're looking at. Is there a huge variability? All those kinds of things. So I think, you know, that's probably more, you know, something that Andrew has already kind of answered that, you know, do you think it would, you know, you got to ask yourself does that really cover the variability? And if you're going to submit that, or ask for it to be an interim guideline value, you need to give all that background data to adequately argue your point, I guess, so.

Interviewee 1: I think also to add to that, sometimes we'll see, again, coming back to the temporary waters, you'll have temporary streams where, you know, particularly ephemeral streams, where there might not have-- or there might have been only one or two flow events in two years. And under those circumstances, we often suggest that you're actually after event-based data. So you might set up some sort of data logger or water collector that will actually grab a series of water samples when it flows and, you know, refrigerate or curate those samples appropriately. That's fine for the physico-chem staff. It's probably a little bit more challenging for the ecotox work, where you might end up having to leach sediments and then doing ecotox on the leachates or something like that. But--

Interviewee 2: All the concentration--

Interviewee 1: --all of those come back to, you know, your initial point about the aim of the project, the aim of the sampling program and what you're actually trying to answer. And that, again, comes back to why we're so reluctant to sort of pluck numbers from the sky and say 30 will do it or two years will do it. It's as long as a ball of string.

**Interviewer: Okay, so--**

Interviewee 2: So Fiona, I was just going to say Brooke's kind of commented in the chat there that most of her work has been in the ephemeral streams, and, you know, limited data were collected over 10 years. So, you know, I mean, she might have some useful information as part of that when we have a discussion, so.

**Interviewer: Exactly. And I'm going to open everyone up to have that discussion in a couple of minutes. So while you're thinking of some other questions, what I just like to do is invite you to give us a little bit of feedback. So I'm just about to launch a poll again. Last one, there are no trick questions on this one. We do just value your feedback from today's session. We are also planning to seek some more feedback from each of you not only on this series of master classes, but your other ideas of other topics and conversations that are relevant to the work of the IESC in the Explanatory Notes and possibly your feedback on some of the existing material as well as they go through their various review processes. So keep an eye out for your inbox to provide that feedback. But if you wouldn't mind just giving us some immediate thoughts on today's session that would be really appreciated for the team. And once we finish this poll, what I'm going to do is just open up everyone. We'd love to get you to turn your videos on and unmute yourself. And we can have some further discussion for the next 30 minutes or so or as long as you can hang around. But while we're doing that, I probably would just like to take this moment to thank the authors for your work in preparing the material and participating today, Andrew for you and Jenny Stauber. I know you did a lot of work behind the scenes to prep for these. So thank you both, and to the secretariat for organising the sessions. If you can hang on a little bit longer, that would be wonderful. But that probably does bring us to the end of the formal part of the masterclass content. And just before you go, I'll give you another minute just to finish that poll for us. And so I'm going to end that now. Looks like we've got everyone. And I'll just share those results with everyone at the moment. So great. Looks like we've hit the mark in terms of this. It's always challenging doing it in virtual format. But hopefully it meant a broader cross-section from across Australia were able to participate. I think a lot of us are getting more comfortable with the virtual format. But certainly, I know there's an intent to keep some of the in-person work and opportunities heading in the future, as COVID permits.**

END OF TRANSCRIPT