the second thing is really, I think what we are doing in every small way, in every development we're making around our properties.

And that's a property, when you pave over your grass area, your lawn, that that increases the risk of flooding. When in your communities, you decide to go for hard infrastructure versus green infrastructure, that will increase the risk of flooding. Anything that we can do as a society to slow down the speed of runoff of water when it rains or snow melts and the like, that's a good thing, because that slows down the risk of flooding. Now the challenge of the future is that the way or when it rains or when there's a snow melt is much more uncertain, it's much more difficult. And invariably it's becoming much more extreme as well.

So making sure that at a personal level, how are you prepared for that event, which might challenge yourself in your family, and I started emergency preparedness that all of us need to have. Now, those communities that live in those high risk flood zones, those hurricane zones, I'm sure are well used to preparing for emergencies, albeit not one that anyone really wants to think about, but even those communities that are not in those traditional zones, I think now needs to start thinking, what's that plan B, what would we do in that emergency situation and what can we do and advice to help prevent, mitigate that situation developing.

Steven Ludwig: Floods have seemed to been increasing in the amount of frequency and level of power, for lack of a better word recently, do you think communities and the public, no matter where they are around the world are becoming more aware of how challenging that can be?

Brian Harvey: I think so. I think we as flood professionals are also getting better at communicating, because I think people...

Steven Ludwig: By having you on podcasts.

Brian Harvey: Yeah. Maybe, absolutely. I'm a great power believer that people, once they're empowered and have the knowledge, then they will do the right thing for their families, their communities, their society. No one wants to be in a difficult situation. So I believe it's, again, another example of partnership, the partnership between the governments, the private sector such as ours, really engaging with the community so that collectively we can start to be ready, respond and just understand what's a good citizen mean, how do we become that citizen which helps us prepare.

Steven Ludwig: It sounds like if we don't engage in partnership, I can do, my family can do, your family can do, our own emergency preparedness. A government entity can do whatever it requires and the for-profit sector can do what it requires. But it sounds like you've been very clear that if we don't work together, we're going to be missing something important.

Brian Harvey: Absolutely right. And another example of that partnership perhaps, is that we as professionals now have got some fantastic tools, domain knowledge techniques that we use in predicting how things could develop into the future. So we've got that in abundance. I think there's a societal awareness now, which is starting to make people appreciate that something different is required in the future. But the thing which is, we all need to embrace now is that idea of courage. To think that a little bit harder than we have done in the past in developing the solutions for flood resilience and drought resilience for making that little bit of extra investment now which will make our society much more resilient in the future.we've been experiencing as a world, these issues of floods and droughts for centuries, in thousands of years, and there's nothing new yet there.

But what I'm noticing is the challenge of population growth in cities, a degree of change with our climate and weather events and that sort of thing, it's becoming a bit more unpredictable, and a bit more risky therefore in certain areas. When you add all tho, inqpd p10(edi3(n5(halo h isneed5(n5(5h i@5 g0w ye(4no5(5(n5(5

Steven Ludwig: You mentioned coastal flooding and how that's increasing. One of the projects you worked on was The Major UK 10 Year TEAM2100. What was that project about?

Brian Harvey: So working in partnership with the environment agency, the UK government client who are responsible for strategic flood management in the UK, TEAM2100 is all around protecting London from flooding or putting it in a more appropriate way, helping to mitigate the risk of flooding in London over years. So that's just looking at the Thames Barrier and working in partnership with the...

Steven Ludwig: So the River Thames goes right into the heart of London.

Brian Harvey: Exactly. Right through the heart of London. And going back to some of those earlier comments, London was set up in a location by the Romans. So it's one that many thousands plus years of history there incredible waterfront along the River Thames which is enjoyed by many. But that's also a flood defense asset, that wall does protect London. Fortunately, those walls and the excellent work in the environment agency and other parties there have kept London dry since 1953, which was the last big flood there. Many thousands of people enjoy the city because of that high level of standard provided by Thames Barrier and the embankments and the like.

Steven Ludwig: What do you learn that other communities could take away from that project?

Brian Harvey: I think there's probably two or three key lessons for me. Lesson number one is long term thinking. The TEAM2100 linked to the Thame's Estuary strategy, which the environment agency led on is a look forward to the year 2100. And by looking that far ahead, we can start to predict, develop and understand how that river or that river estuary is going to change over time. So I think that's the first thing, long term planning. The second one is that reinforcement, so that idea of partnership. We've got to embrace the energy, the investment and the commitment of so many parties, the private sector, the public sector, the communities to really live with that River Thames in a really sustainable and resilient way.

And I think probably the third one is that, don't just assume that partnership applies externally. For me, the big power of TEAM2100 was the project 13 style approach. And project 13 is a UK contracting methodology which brings together consultants, contractors, the client to really focus on the outcomes that are required of a project. So in the TEAM2100's sends true efficiency, longer term thinking, and asset management led approach to really getting the best for the citizens of London.

Steven Ludwig: How could you take those three things that you'd just mentioned, long term thinking partnership and focusing on the outcomes beforo0

Brian Harvey: Yeah. So droughts are again a challenge of now.

Steven Ludwig: But as you said, we've been living with them since humanity began, right? However, they're becoming more frequent.

Brian Harvey: Yeah. And the challenge of old is that we've, we've used more traditional methods to deal with a standard water supply pipeline which goes for many hundreds of kilometers say. But now we've got a lot more tools and techniques in our tool chest, as it were to deal with droughts. So we can use water, recycling, desalination, water transfer schemes, and the list carries on. And we can do that at a macro level, very big national level, regional level, or we can do it at a very micro level and use those techniques to help alleviate some of the challenges of drought. But going back to those three things, again, that those three points. First of all, long term thinking, we can predict an increasing challenge of weather. We can predict population growth in cities, so we can predict therefore the likely gap using current techniques of supply and demand.

Secondly, that the idea of partnership. So partnership applies, as I say to maintaining water quality. It applies to considering those new techniques. So don't be so set on a traditional way of solving or providing water. Look at those other techniques, the desalination, the water reuse and communities, I've engaged with over, across the world are starting to embrace those other techniques of water supply ones that weren't available to our fellow professionals of many years ago. And then lastly, the outcome. So outcome for me, in terms of drought is when you turn your tap in your house, you have water. That's the ultimate outcome. And for me, therefore, that's gives us a really strong connection with the community, which then unlocks that partnership. So if everyone is focused on keeping that water flowing to a tap, we come up with new techniques.

We really unlock the power of efficient delivery techniques, maybe even connect in there some of the digital elements of which has the ultimate way of connecting communities to future drought challenges, where's your water coming from today? For example. Then there may be together. We can start to solve this, but I think that the challenge of resilience in terms of water, be it flood, drought or any other big storm events. Any singular party, I think is really going to be stress and challenge in solving this on their own. Now is the time for true partnerships.

Steven Ludwig: So I think when people think of drought. We get pictures of these dried cake beds that look like the desert, and then you see the agriculture failing. But in the last few years, we've seen it in major developed cities in South Africa, and then big cities in India. And the continent of Aust otie-5((a(ha)4v Bu)B(v3(di9(o(h(n(49(der)c)-9(ar)-3(na710

Brian Harvey: And I think there are some great examples around world, cities that we've been involved with around the world. And I think they're certainly an inspiration to me. And I think every city that hasn't gone through that resiliency planning yet, and I think there are inspirations there as well.

Steven Ludwig: What do you mean by, when you say resiliency planning? Just, can you define that for us?

Brian Harvey: Yeah. So, and maybe put it in a really practical way. So a city, which has always impressed me is Singapore. And that nation is one we are really proud to work with for many years now. But that nation was very much at the forefront of looking long term. They knew looking forward that they were going to have a water challenge if they did nothing different. And therefore they've invested in flexibility and their water supply for the future. So they've invested in water reuse, desalination and some elements of rainwater harvesting, so it capture the rain that falls from the sky. So they've got multiple taps as they call it three taps and there's a fourth one of water transfer as well. But that city has looked way into the future. There is other examples that other cities that have learnt from Singapore.

So Bangalore at the moment almost going through master planning. Other cities around the [inaudible] water resource and planning. City of London, looking at water resource planning. And then obviously Australia, these is examples there as well, some great work in the United States as well, there's some fantastic long term planning projects underway. But the critical thing is that we are thinking longterm. And thinking almost the unthinkable in some of those plan so that those cities continue to operate. One statistic which really struck me, which was published by the UK government a while back would be, what would be the cost of operating a city without a natural water supply?

Steven Ludwig: Even though these weather events are therand I9ng. A-2(0)8bW*nBTF2 11 Tf1 0 0 1 130.0s.0832 62

trigger points in terms of water levels, flood events, and so forth, but thinking what those trigger points could be and at what point you need to start investing, that's the really powerful thing of now the tools and techniques we've got, is that we can start saying, okay, we're not really sure, is it going to be this type of flood or that type of flood, but in the round, it's going to be a challenge at some point.

To respond to that challenge, there are these types of events and probably with this predicted climate change level, be it temperature or rainfall. Then at some point in the future, we need to invest in this sort of infrastructure,

Steven Ludwig: Since 2000, just to pick a year, the technology and our computing power has gone through the roof, right? And now we're talking about our artificial intelligence and machine learning and using big data to help us. How do you see technology progressing in the next, let's say 10 years, no one can see really beyond that in helping us prepare and plan for these sort of events.

Brian Harvey: I think the power of technology now is enabling us to consider more scenarios and consider those most scenarios in a very fast and rapid way. And I think that's the power of technology. It enables us to consider many thousands of scenarios, where in the past, we might have considered two or three. And if you put a thousand scenarios or many, many different extreme options in front of an engineer, an environmental professional that exists within Jacobs, then you can start to consider bigger bolder solutions to some of these challenges. And I think that's since 2000, the computing power, some of the tools and techniques we've got, that transformation's enabled us to put in place more robust solutions and really increased the power of the professionals engage within our industry, as opposed to just, as we've had to do in the past, just consider a few options. So really now it's that range and breadth of solution is that's the thing which has dramatically changed since the year 2000.

Steven Ludwig: You also mentioned technology as a tool to enable us to adapt quickly. You mentioned monitoring, and I'm sort of switching. How do you see technology and maybe called the internet of thing? I don't like that phrase, but it's common, right? The internet of things, helping us become more resilient. Do you see that the connectivity of our response system is helping us?

Brian Harvey: Yeah. I think short answer is yes.

Steven Ludwig: We have that covered.[crosstalk]

Brian Harvey: But I think to the internet of things will be unlocked when there's really strong fiber connectivity to really embed those sensors within everything. And the internet thing gives us that power to find out challenges and problems with any of the infrastructure assets very much more quickly. And if we're able to find those problems more quickly or challenges more quickly, we can sort start solve them more quickly. And so I think one of the advances which will come in

technology therefore is that, when it comes back to outcomes, is how quickly we can respond to a challenge. And actually, can we even get to the stage of predicting that challenge before it even happens by monitoring different things? So for example, a water pump, maybe in the past, is it working or not working? That's probably the sophistication.

Now we can manage or monitor the electricity use, some of the vibrations in the pumps, which will actually predicts before failure happens, and so when you combine an internet things with a really sophisticated asset management system, then you can come up with really robust way of monitoring, managing, and really, I guess unlocking the full power of technology, to bring those much stronger outcomes of the future.

Steven Ludwig: Brian, this has been a fascinating conversation. Is there anything I've for forgot to ask that you want to mention?

Brian Harvey: I think nothing you've forgotten to ask, but one point I'm not going to miss the opportunity to just reinforce, and that's the power of partnership. This is a really exciting time for the world, in many instances. It's also a really exciting time in that we can start to look at what is the right types of solutions for society in the future, but to unlock those societal challenge and change, unlock those solutions to the future. We all need to work together, be it the communities, the government's, private sector, and hopefully professionals within Jacobs will be a proud part of that future of societye iturher, be it t5(-)5] TJE36 ts ts ts ts tH51NreW*nBTF2 11