CENTRE for LiveableCities SINGAPORE

SUBJECT: **Water – Holland's "Frenemy"**

SPEAKER: **Ms Tracy Metz**

MODERATOR: **Mr Tan Nguan Sen**

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Note:

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Malevan (M) 00:00:01	A very good afternoon and welcome to today's CLC lecture series, the second in the 2016 of lectures. My name is Malevan, I work at the Centre for Liveable Cities and I will be your MC for this afternoon. The Centre was jointly established by the Ministry of National Development and the Ministry of Environment and Water Resources in 2008 to distil, create and share knowledge on liveable and sustainable cities. The CLC Lecture Series is one of the platforms through which urban thought leaders share best practices and exchange ideas and experiences. For today's session, we're honoured to have with us, Ms Tracy Metz, Director of the John Adams Institute. She'll share with us the Netherlands' forward thinking, long term solutions of working with nature to protect the manmade land and how engineers, urban designers and landscape architects are working together to redesign cities and the countryside to create more space for water. The presentation will be followed by a moderated panel discussion and a Q&A session with the audience, which will be moderated by Mr Tan Nguan Sen, Chief Sustainability Officer of PUB, Singapore's national water agency. Let us now begin the lecture by inviting Tracy on stage. Tracy please.
Tracy Metz (TM) 00:01:42	My batteries' not running low. I'm all ready to go. I'd want to thank the Centre for Liveable Cities for inviting me to this illustrious podium to tell you what I've learned about how the Netherlands are approaching water, looking into the future. I am indeed the Director of the John Adams Institute, which is an independent podium for American culture in the Netherlands. I've lived in the Netherlands now for 35 years. I am a dual national, originally from California and now also a Dutch national. And, you really can't not be interested in water issues living in the Netherlands. Especially now as conditions are changing, the climate is changing, the Dutch are also becoming confronted with consequences of intervening in the natural system for the past several centuries. Water is an urgent issue all over the world and especially in the Netherlands and I want to tell you some of what I've seen about how the Dutch are changing their approach to water. So, my book – Sweet and Salt, Water and the Dutch is not about

00:03:47	the history of Dutch water management, there are libraries full of that. Nobody needs an American to tell them about the history of what they've been doing so well for centuries. But perhaps it is my view as an outsider, my fresh look at the Netherlands that helps bring across this story about how the Dutch approach is changing and what that will mean for us in the future. Sweet and Salt, there's a copy of the book outside on the publications table. Sweet and Salt is a 2-part project, consisted of an exhibition of about 125 artworks by artists from the last one and a half centuries, curated by my colleague Maarrtje van den Heuvel in… ahmmm… yes… [Figures out the projector control]. That's volume. Which one is…? Forward? Ok, yes. Thank you. Sweet and Salt was an exhibition of artworks, curated my colleague Maarrtje van den Heuvel. And my part of the project, which was the story of the redesign of the landscape to accommodate a new relationship to water. And I call this talk… Yes? [Figures out the projector control]. Is my battery running low? At the computer, thank you. Ok. Have we... ? Ok, thank you. And I give it the title "Water – Holland's 'Frenemy'". Of course for centuries Holland regarded water really very simply as the enemy, the country would not survive without keeping the water out. But now, as I said, now that conditions are changing, we're all looking for a new relationship to water and water can now sometimes be our friend. So this uneasy new marriage I've called Holl…"Water is Holland's Frenemy". We see that… before I go… actually we'll get to the image… I want to tell you I've divided my talk into a number of parts to make it easier to get a grip on this. First I'll show you a number of images that set the stage worldwide. And then some that will show you the situation in my adopted country, the Netherlands. And then I'll show you some design solutions engineers and landscape architects are working increasingly together as Mr Tan and I were discussing beforehand. Working together to find new ways to redesign both our cities and the countryside. I'll show you some examples of that. I'll also mention briefly a couple of solutions here in Singapore which I find very forward looking. I think Singapore's really an example to the

00:06:03	world in many ways. And then I'll finish off with two sessions called "Do it Ourselves". We're trying to get citizens more involved. And citizens are indeed stepping up and coming up with new ideas about how to use water in novel fashions and I think those are really worthwhile investigating. And the final chapter is perhaps the most visionary of all, about using our imagination to create utopian, floating cities, all sorts of new ideas, some of which are completely crazy and some of which are really interesting and worthwhile. Drought. We all know that the water situation in the world is becoming more and more extreme. Too often, there is not enough water. I read yesterday in Cloud Forest that by 2050, we expect to have a shortage of drinking water worldwide. That really gets me thinking, how old will I be in 2050? Will I be alive? Will our children still have drinking water? Will life on our planet be possible? The issue is becoming more and more urgent and we all see that. This is an image from Brazil. Where also tremendous, in spite of the rain forest, many parts of Brazil are suffering from great water shortages. People are having to buy water. And the people who have to buy the water generally are the poorest people who have the least money to buy the water. So you see, water shortages are increasingly becoming a class issue also, all over the world. This is where I come from. This is southern California. You really cannot help but wonder, what possessed anyone to build here. Who would want to live here? Who could possibly survive here? But you see that nevertheless, people have built here and the pressure on our precious earth to live and to colonize is so huge, that we're in a huge mental shift, trying to adapt our desires to our possibilities. And this is one place I think that the earth shows us that our desires were probably not very sensible. It's very sensitive, I'll go back. Just slight touch. [Referring to slide control]. The opposite of drought is flooding. And we've seen in the last ten years, a huge increase in the amount of flooding and the severity of flooding also. This was just a few months ago in the Indian city of Chennai. I think this image says so much about what this could do to a human life, how

	destructive this can be. And this is an image that I'm sure all of us remember well from Hurricane Sandy. Who would have thought that Wall Street, who in America could have thought that Wall Street could be paralysed by a storm. I don't think, before this happened, it would ever have occurred to anyone as a serious possibility. We all know now that of course it did. And I think this has become an iconic image of the damage done by Hurricane Sandy to one of the powerhouses of the American economy and perhaps also given the stock exchange, the world economy. So the simple magnitude of the issue we're talking about is really huge. The Netherlands have done very well in flood control with a whole series of measures, technological landscape measures, to control flooding in the past, but I wanted to show you these images just to make that a little more relative. To show you that the Dutch really do not have everything completely under control yet. There was very heavy rain and flooding through the rivers in 1993 and 1995. These are images of both. So, I just want you to realise that this is something that the Netherlands are still working on in a very proactive fashion. How can we redesign our cities and our landscape to make them more flexible, more resilient so that when flooding does happen, either we can prevent the flooding, or when it does happen, we don't suffer so much and suffer so much damage? This is an urgent question for the Netherlands because as you can see by these two maps, at least a third of this country is flood prone, if the Dutch didn't have this extensive system of dikes. And keeping the water out is of essential importance for a country where 60 to 70 percent of the Gross National Product is earned below sea level, where over half the nation's population live, in this western area along the coast, with the four major cities, including Amsterdam and Rotterdam. So if, without this tremendously sophisticated and long developed system, the Netherlands would not be habitable. So perhaps it's no surprise that the Netherlands are now also more forward thinking than many countries in the world, including my own native country of America, about how to deal with these challenges and find a new path. Just a couple images to show you how

	important water is for the Netherlands. How much it shapes the landscape, and how intimate the relationship between the Dutch and water is. Some of these landscapes are extremely beautiful. I'll show you another river landscape in a moment. Now, this is a typical Dutch landscape in the west of the country, near the coast where in the middle ages, the inhabitants of this very soggy delta, started digging up peat as fuel. And would lay the peat along the narrow strips of land left here. Lay the peat out to dry and then come back and pick it up later with boats. And this, we all know now how much energy landscapes influence the way our countries and our surroundings look. And this I think is a beautiful example of how the Netherlands and its economy have been shaped by that relationship to energy and to water. One of the ways in which the Dutch have been dealing with water right from the start has been by building dikes. Built with traditionally the ways we did it. We build the dikes to keep the water out. We build the dikes to reclaim land and then pumped and pumped and pumped to get the water out. And I think this is one of the interesting correlations between the Netherlands and Singapore is that there is a tradition of reclaiming land and using it to expand the country and expand the economy. And also in Singapore, for expanding water catchment area now. Another Dutch tradition has been storm surge barriers. This one was built after a major flood in 1953. This is the biggest storm surge barrier in the country. And I think you can see now how the mentality was developing towards more and more manmade, hard, concrete infrastructure. This is an absolutely beautiful place to visit to see Dutch water management. But it's also in a way, old school. Would we still build this now, if we were looking to an answer to major flood? I don't know how it would look, but I think it would look different. And here we also see, perhaps even more highly evolved engineering. There are sluices to separate sweet and salt. I think it's a, it's a beautiful image but it really shows mentality too. This shows the enemy mentality. The mentality of hard-nosed infrastructure to keep the water out and there's very little of the softness and the interaction that we're working on now towards in Dutch

00:13:08	water management. Bringing water back into the city. I want to show you some design solutions for this that I think are really interesting and are showing us the way forward. Some of them haven't been realised, some of them may ultimately not be a good idea. But it's the idea of the mentality change that we're going through now and the new way of building and working. This is a street that used to be a canal in 17th century Amsterdam. It's actually just around the corner from my house. And the idea is that we have paved over so much of the city, made the ground so hard and the water is running off so quickly. We need to make the city softer, greener, and hold on to the water rather than letting it flow straight away into the sewer. And of course now, instead of water, we now have parked cars. I think this is a rather old fashioned way of looking at the city and we're trying to change this. The idea is, and this is just one of the series of designs, that you bring the water back into the centre of what used to be the canal and then put the parked cars underneath. Of course it's expensive, it's hard to realise and it will take a long time. But just a simple fact that we're working in this direction, I think shows us one of the many improvements that we can make in the city. This is I think a very well-known project in Seoul, in Korea. Cheonggyecheon. I knew I wasn't going to say it right. Mr Tan, how do I pronounce it?
Tan Nguan Sen (TNS) 00:15:51	Cheonggyecheon.
TM 00:13:27	Cheonggyecheon. Thank you. I think it's a very hard name. A very optimistic project actually because this was what it used to look like. Good heavens. And the river was underneath all these cars it had completely disappeared. And now we're moving the cars out and restoring the water in the city centre. They brought back, not only water safety but also made this into a much more attractive place. And perhaps that is what we're

00:15:40	really looking for now is new water solutions that will make life, make the cities more attractive, and safer at the same time. This is an image of a water square in the city of Hamburg in Germany, still one of Europe's major ports and we have with us today Kees Christiaanse, who was the supervisor of this urban plan. He is associated with the ETH in Zurich and also with the ETH here in Singapore. So, perhaps later Kees, you can say something about this plan. And the idea is resilience. The Elbe, the river that Hamburg is located on, still is one of the rivers with one of the highest tide in Europe. Sometimes as much as 7 or 8 metres. That's at least 2 floors of this building. So, how do you build in a way that the city can deal with that tide, without suffering damage or having to be repaired every time there's some sort of flooding. And the idea is that this square is designed in a way that when the tide does rise, the water can just flow in. Later it flows out again, and all you have to do is come in and send in the cleaning crews from the city with their hoses to clean up the mud and the sticks and you're back in business. This is modern day resilience. Here too, the buildings all have higher floors. There's parking behind these walls. And the buildings can also have cafes or day care centres. The only requirement is that nobody sleeps in these buildings because otherwise you could be surprised by the flood in your sleep and they want to prevent that. But all sorts of new uses in the new design of the city making it possible for the water to come and go without creating any serious damage. This is an image of the town just north of Amsterdam which I really like because it's such an ugly place. It was a very ugly place under a freeway overpass. There was no reason, ever, for anyone to go there. Someone had the brilliant idea of bringing in water here and making this into a fun place. A place to have a ballgame. Or, there also now supermarkets and flower shops under the overpass. They've redesigned the pillars. And now this freeway overpass is a place that actually draws people and also water is one of the big draws. The polo game. That you can play water polo under a freeway overpass, I think that's such a wonderful idea and I think the person who thought of this really deserves a

	prize. It may not be a serious contribution to resilience. It may not be a water catchment area. But just the fact that it brings people in and people want to be here, I think it's a tremendous contribution to the city scape. An example from the city of Rotterdam. This too is about resilience. You can see, this is the high sidewalk. And when it hasn't rained so hard and there isn't so much water, here along the benches, there's another of these sidewalks. But it's a resilient place. It's a place where the city can change character. Sometimes it's dry and sometimes it's wet. And this takes, also and change in mentality in all of us, we're not used to places changing character in the meantime, they're either one way or the other. And I think this bridge is a great symbol of how this place could change character. I asked the designer of Rotterdam, I said, "Uh oh, I think something went wrong." And he said, "No, no. On the contrary. We did this purposely." The city of Rotterdam purposely designed this bridge to disappear into the water, thinking that this will help people realise that yes, this place can change character. Sometimes it's wet. Sometimes it's dry. And when the water recedes, no problem. I think it's… since we're all trying to get people more aware of water issues and what this can mean for their own cities and their own lives, I thought that this was such a simple thing but still really significant. You see that more and more water is being brought into the built environment. On the right, this is the image that you saw on the poster. This is a housing development in Amsterdam that, where the houses go straight into the water where people have their own docks behind the houses and can have their own boats. And on the left you see a planned development. This is a rendering of a new development also in Amsterdam, where you see the housing and the water are even more closely connected. And I understood from Mr Tan that in a project here in Singapore, Bishan Park, that the for sale private housing next to this park has now increased since the park was realised, in value by 100%. The houses become twice as valuable because they have green and water outside. So this is also a financial incentive to make our cities safer and more beautiful. This was an important project in the city of Rotterdam

00:20:04	which was realised, just last December it opened. And these are called the water squares. This too is again about making the city resilient and flexible when sometimes there is water and sometimes there isn't. These basins here, are actually, when they're not full of water, just places to sit, to chat. Students from the schools around them come out to play basketball. And people just hang around and sit in the sun. When it rains, these basins fill up and of course nobody sits there. Then gradually the water seeps back into the ground water or into the sewer and all you have to do again is clean up and that's all there is to it. I think these are a very interesting project in Rotterdam because they show us much about what urban design could mean for us. But there is also an interesting question - What is climate change going to bring us in the increased amount of water? How many of these water squares will a city like Rotterdam need? And how much do they cost? So, I think looking forward, Rotterdam will be looking at the question - Is this a solution that brings us enough capacity for water storage? And do we have enough places in the city to build these? So the issue of urban design for water is really becoming the forefront I think of urban design in general. Moving out of the city, into the countryside, I promised you another image of one of Holland's rivers. This is the river Waal which is the most important shipping artery down from Europe, towards the north sea. And as the climates starts change, the glaciers are melting in the alps, there is more water coming down the rivers through the Netherlands towards the north sea. And the Netherlands are having, are getting water from every direction now. Through the rivers, the sea is rising, more and more rain, and the salt water from the sea is pushing up under the dunes. So it's becoming more urgent issue to find more space for water. Especially along the rivers. The Netherlands has a national project called Room for the River, a 2 billion euro project with 39 different projects, of which this is one of the biggest. And they have not only given more space for water but they've also redesigned the river scape in a way that will bring people to the water and give them a new public space. And this was… there've been

00:22:25	four new bridges built, a new event space, the edges of the river have been redesigned to really make a welcoming public space. This was a project, just this one project of 350 million euros. And this amount became very, was really in the public mind when recently David Cameron of the UK announced that after the terrible floods in Yorkshire in northern England, the British government was going to give 40 million pounds to new water measures. And this really made the Dutch laugh, realising that just one project like this had already cost 350 million euros. What was England going to do with 40 million pounds? And I think there's some awareness creating still to be done there. This is another project also in the same place along the river Waal. This is another project that has this wonderful, magical, flexibility. This is a bicycle bridge, this one. And to get there, sometimes, you can just walk over the path. But sometimes when the river water is high, the path will be subdued and then perhaps you can use the stepping stones to cross. So, there're all sorts of new design tools being used to create awareness of what water means to us and how it changes our environment. Another new project which was just opened a couple of months ago, is on the coast of the Netherlands where of course the dunes are the main defence against the North Sea and this is actually a parking garage. They inserted the parking garage into the dunes as a way of solidifying the dunes, making them stronger to defend this town against the sea. And it's not an urban design but I think it's a way of designing for water that makes people and more aware and makes the surroundings more beautiful. And for the beach town itself it was a great blessing because the town was always suffocated by too many parked cars and now the town has… itself is becoming more habitable and more beautiful. And all the cars go into the garage and also help support the dunes in this fashion. The last image I wanted to show you, because this is also a social process, this is a project in agricultural part of the Netherlands, where the water is sometimes threatening to flood the agricultural areas as the rivers get higher. So the government had said, "Ok. We're going to take this area and let it flood."

00:25:00	And the farmers who lived there on these farms said, "Wait a minute, we don't know anything about this. What do you mean you're gonna just let our area flood? We'd like to have some say in this." And this is an interesting social process, this is the only project I know in the Netherlands where people actually, were up in arms against the government process not just because they wanted more money, because they were going to be evicted, but no, because they said, "We want to think along with you. We want to think what could be the best solution for us here with our farms. We farmed here for generations, we want to give a proposal and think about what the best way would be to deal with water in this area." And they came up with a proposal together with a Dutch landscape firm – [unknown foreign name]. And they decided to move the farms out of the agricultural area. This dike along the river has been lowered. This dike is still in place and the forests have been moved to mounds along the lower dike. And of course mounds, higher ground, were the first way ever that the Dutch defended themselves against water. So I think it's really interesting to see how in a social process of government working together with citizens we're finding new ways, which were actually very old ways. Sometimes the old ways are actually the best aren't they? Putting existing functions like agriculture back on top of mounds and then, as you'll see from this image, keep an eye on these farms. And on the next image you'll see what this will look like when the river does flood. The agricultural land will flood but the farmers will be up on their mounds and they will suffer no damage. When the water recedes and they go back to growing their crops. This is resilience. This is flexibility. Just a couple ideas from here, you don't need me to tell you about Singapore. You all know much more about Singapore than I do. But I wanted to mention a couple of things that really struck me here as forward looking and that also the Dutch and everyone else in the world who is looking for new ways of dealing with water could learn from. Sorry, it's a rather grainy image but I have been very charmed here by the term "interim green". I think that's a wonderful idea. By planning ahead

	and you save land for development but you're not developing yet so in the meantime you make interim green. And that means that there's water catchment area. That means there's an improvement of public space. For example here in this golf course. And when time does come to develop, there is already space set aside. I think this concept of interim green is something that we should adopt in the Netherlands immediately. This of course is the Park Royal Hotel which is here, just around the corner. I had an interview yesterday with the architects – WOHA, Wong and Hassell. And I was really intrigued about hearing their ideas about densifying, not only densifying the city, but also densifying the green. Making sky gardens. Making multilevel green and thereby increasing the capacity of the building to absorb toxic chemicals, to clean the air, to cool the air. The intensification of green along with the intensification of our building programme, I thought was a really interesting and revolutionary way of looking at intensifying the city which is of course something Singapore has been very good at for… ever since it was founded. Yes. Innovation is really what this is about. It's about how to treat used water, as it's called and make that into NEWater. I've understood that about 30% of Singapore's water resources in 2050, if I'm not mistaken, will come from reused water - NEWater. The water situation isn't that urgent yet that people find it easy to drink this, if I'm not mistaken. There is a psychological barrier here. If the situation becomes really urgent of course we'll learn that. And it's also interesting because Singapore's trying to become independent of water supplies from Malaysia. I find it interesting that all Singapore's food is imported. But there's more effort going into becoming independent of the neighbours for the water supply than for the food supply. I guess because you can only get your water supply from one supply. Food you can get from anywhere. But I thought it's a politically interesting statement and also in water technology innovation and an important moment to see that we're moving in New Water. And it's not only happening here. The Dutch are also working on it. But not just the Dutch. Do you recognize this guy? He's probably one of

00:28:18	the best known people in the world. Bill Gates from Microsoft. And he is making a statement here. He is drinking a glass of recycled water. Good for him. Marina Barrage of course. I thought this was a beautiful example of designing for water. It's a storm surge barrier and also a separation between sweet and salt at Marina Bay. But it's not just been designed as an engineering facility. It's been designed as a welcoming public place. And I think a beautiful job has been done here and I understand that this is a very popular place for people to come to have a picnic and be close to the water. And, I don't have an image here but we'll show one later of Bishan Park. Which of course is one of Singapore's prime examples of redesigning what was just a functional concrete channel to become a place that could absorb more water, higher water, lower water. And to bring people back to engage with water. It's no surprise that Singapore's water project is called ABC – Active, Beautiful and Clean. And I think particularly the A of active is something that the Dutch can learn from Singapore. The Dutch are trying very hard to get their citizens engaged again in water issues but I think for the last 50, 60 years, the Dutch feel that government should take care of that. Engineers are taking care of that. It's not our responsibility as citizens and I'm convinced that the Dutch can learn a lot from the way Singapore is bringing citizens in to be engaged and bring them back to the water. This was the storm surge barrier which of course is an engineering facility. But to combine this with the beautiful building of the barrage I think has been really well done, congratulations. So, what can we do? What can we do as citizens? What's our responsibility and how much room is there for us within the existing legislation? This I think is the way we should not do it. This is an image from the Mississippi River, near New Orleans, in the town of Vicksburg. And this is a farmer who has seen the water rising and thought, "I'm not going to wait for government to come down here and build me a dike and protect my farm." He's probably right. It wouldn't have happened. So what has he done? He's gotten out his bulldozer and he built his own dike. You can't blame him, but at the same time I think this

00:31:40	is not the system that any of us really want. I think the strength of Singapore, the strength of the Netherlands certainly is working together and that citizens can rely on government to protect them. So, this is the one image I want to show you of the way I think we should not do things. This is an interesting citizen initiative in Amsterdam. It's very messy. It's very improvised. But I think it's really interesting because here, people have taken things into their own hands. This was a group of kids, young people, who thought, "We want to create our own place to work." And they took a disused shipyard and they took some disused houseboats. And they picked the houseboats up as you can see. And they put them onto the land and then built a walkway in between them. So it's a whole colony of former houseboats that are now used as offices because the land is too contaminated to use as a housing development. People are not allowed to live there. But these are all modern day offices. And it's become s real hotspot in Amsterdam. They also have a café, which has been completely built from discarded materials and recycled wood and everything recycled and they built it themselves. And the only thing the city did to facilitate this, was to give permits. And I think this is a wonderful heartening example of what people can do if they're eager and if government will give them the leeway to do this. Regulations sometimes are tight. But with some creative legislating and a lot of creativity in the building and the designing of this place, really, a lot can be achieved. This is a guy who had taken his toilet to the main square in Amsterdam. On a recent manifestation of Amsterdam called Rainproof. You know that we're, all over the world weather's becoming more extreme, more and more rainfall. And Amsterdam has a programme called Rainproof, to try and deal with this excess rainfall. And so they had a manifestation on dam square, and this guy came to the square with his toilet and a barrel of water, and he showed everyone who would listen to him, how he had, is now flushing his toilet at home with the rainwater. And it was just one person with a good idea. There was no structure, no permit, no government, anything about this. This was just one guy who was out to convince people that

there were other ways of doing things and he was gonna show you how to do it. So, for everyone who can by, he would connect the hose to the barrel and then fill the… And it was… It was absolutely charming and I really had to admire his spirit and his dedication to the idea that this was a much better way to deal with water than as we do now, which is flush our toilets with expensive drinking water. What a waste. And he has the answer. So he's out there, on his soapbox, telling us what this answer should be.

And as we all know, this is a former school in Amsterdam. And the school has decided, it's no longer a school. It's now used as a collection of artist studios. And the artists together have decided that this hard pavement in the back, there are no cars there anymore. You know what, let's get rid of the pavement. Let's tear this up and make this into an urban garden. And they've done it. And it was just their simple idea and they didn't need a permit. It was in their parking lot. They just went out and did it. And I think it's so admirable to see these people who really think about these issues, who don't wait for people to give them an idea, or to give them permission. They just say, "This is the right thing to do and we're going to do it."

I want to finish up by showing you some perhaps slightly more utopian images of what water life could look like in the future. This is a project by a young architect who just got his degree last December. Eric Geboers is his name. He said so much of the world is getting its water now from desalination. And we all know that also Singapore, desalination is expensive, it's very high energy consuming. And he thought well, then we have the water but we're just throwing salt back in the sea, this is ridiculous. His idea was to keep the water but also keep the salt. And use the salt for architecture of a new Sea Salts City. And this is his design for a Sea Salt City and he'd like to build this, I believe in Dubai or Qatar, where of course so much of their water comes from desalination. And then he's designed a building procedure to use this salt and harden it with a binding material and then you can, you can also, as long as you build in domes,

00:34:00	this building material is strong enough to actually stand up and stay. This is him. He tried his first samples… he baked he first samples in the oven at home. And then decided that it was work and has gotten bigger and bigger. And I love the idea that with just existing materials and existing technology with a very simple addition to making the salt into building material, that you can do this. And his idea about the city is that you build the city from salt and then you have fish. And the fish poo, you feed to the goats. And then you have meat. He has a whole circular economy based on existing materials. And he says that with his sea salts that he can build city where he can house 125,000 people. I don't know if it's true, but just the fact that he's thought his through and that there are people out there thinking of how to relate urbanity to water issues. And the circular economy, I find very optimistic. Huge solar gardens. Solar greenhouses in the desert. This is a project designed for, I believe Australia. This is interesting also for Singapore because you don't grow your own food. It might be interesting to see if you couldn't use some of this vast land surface which is devoted to military functions for actually growing your own food. Then it would not just be a reserve but also be productive. A solar greenhouse. Speaking of growing food, the Netherlands are of course also very land scarce and have developed hi-tech solutions for growing food in warehouses, in empty office buildings, in all sorts of spaces that because of the technology, you don't need land for it. You can do it on all sorts of material, you can also do it in hanging pods. There's all sorts of new technology, some of which of course not completely market ready. But there's a lot of new thinking about how you can use disused space. And we have a lot of empty offices in the Netherlands to do something more functional for the country than just let them stand empty. This was a design by a young firm from the town of Delft, from the Technical University town for a floating city. You see the floating cities are very popular now among designers and the more utopian thinkers about the future of water. I myself… This firm, [sic: Delta Sink] has really gone very far in the thinking through of what life in a
00:35:37	

00:37:15	floating city could be like. I myself am not yet convinced. I'll be interested to hear in our Q&A what you think of this. Is this really the direction we want to go? I'm not sure. But I love the fact that a new relationship to water is producing all this exciting new ideas. And these are also new ideas but a little scary. This is from a project called sea-steading. Does sea-steading mean anything to you? There are several multi billionaires in Silicon Valley in California, who feel that in spite of the fact that the tech industry has had billions in support from the government that they do not want to be limited by government anymore. They don't want to pay taxes for example. So all these rich people are thinking, "Where can we move to that we don't have to pay taxes? We're going to move to outside territorial limits." So, sea-steading is a new idea by some very rich people to build floating cities out in the oceans so that they don't have to pay taxes. To my mind, this is a terrible abuse of the whole new idea of a new way of living with water. But it's happening and I wanted to share these ideas with you. Sea-steading actually held a competition and they have a very interesting website with all these new ideas for living not only with water but on water. These are 2 of them and this is another one. Actually, this could be Singapore. And finally, after having visit the Cloud Forest yesterday, I was really struck, I knew by this image, this is by a Dutch designer who designs for living on water. And he says, well if we can design to live on water, can we also design to have nature on water. Floating nature. Not just floating cities but also floating nature. And this was his idea. Looks a little bit like Cloud Forest on its head doesn't it? And that you could actually move nature out to sea and in that way increase the amount of nature available for all of us. And finally, my final image I wanted to share with you today. Artists are also increasingly getting interested in water issues. And one of the most interesting Dutch technology artist, if I can call him that. He calls himself a technology poet. Dan Rosenheim is his name. He designed a project for the Netherlands called Waterlicht. And it's really a very simple project. It's just light and smoke. And the blue light reflecting off the smoke here,

	shows you where the water level above your head would be, at that moment. So, he could do this project anywhere, depending on how high the water level is. He makes a layer of smoke and then sends these light beams through the smoke to show you actually where you are and I think it's wonderful that artists are getting involved in our relationship to our built environment to this extent now. Showing us with a project like this. Where we are and what water really means to us. Not just as a functionality. Not just as an engineering issue. But it's something which is really just essential to the life we lead and the place that we lead that life. Thank you very much.
M 00:39:30	Thank you Tracy for that insightful lecture. We will now proceed to the question and answer session. Ladies and gentleman, during the Q&A, we ask that you please state your name and organization before asking questions or making comments. You may raise your hand and our staff will walk to you with microphones. We would now like to invite Mr Tan Nguan Sen to join Tracy on the stage for the moderated discussion and Q&A. Mr Tan, please.
TNS 00:40:22	Hi, good afternoon everyone. Thank you Tracy, for that very interesting presentation. And we had a very interesting conversation actually before the lecture. And I found out actually there are a lot of commonalities between the Netherlands and Singapore, in the way we look at water. And especially some of the pictures, they are quite striking, especially the one with the bridge sticking into the water. We are in Singapore, trying to do some of these things. To make people more aware of water through our ABC waters programme. And especially Bishan Park – Kallang River project. That one, unfortunately Tracy has not seen it. But I'm sure that when she comes back to Singapore, we'll bring her to see it. And first, maybe I'll just start off with a question which struck me, is that – like the Netherlands, we are very good in engineering solutions right? So, we engineers like to make sure that things will work as designed and as efficient as possible. And especially in terms of drainage infrastructure,

	water infrastructure. So like the Dutch, you build all your storm surge barriers and all that, and all the hard structures to keep the sea out. So, in the same way in Singapore over the past 20, 30 years, we have built a lot of drainage canals to take away all the storm waters that will cause flooding. And the interesting thing is that now in the Netherlands, there is this paradigm shift where you're thinking of how to bring water back into the city. And that requires engineers to change their mindset. And for us also in Singapore, when we first did the Kallang River – Bishan project, it was the first time where we wanted to change a concrete canal into a naturalized river. And for engineers, that is a scary thing because we won't know how the river is going to function. Will it be able to take all the storm water? And of course the rainfall in Singapore and in Holland is very different. In Holland the rain that falls in a day, in Singapore, it can fall within an hour. So the issue is really, how do you… what is your experience in Holland, the Netherlands? Or how did this change in the mindset of the engineers from thinking of water as something that is, like you said, as an enemy, to something that you want to actually welcome into the city. And are there any lessons we can learn from Dutch experience?
TM 00:43:32	It's a huge mind shift for engineers in particular because the main concern was always safety and there was one way to attain that goal was to keep the water out. And now the idea that maybe lowering the dikes, letting the water in, that that might be a safer way, is a really difficult way to approach this. And also, the engineers were used to having the only say in all these matters and now the engineers don't have the only say. They have to work with landscape architects. They have to work together, good heavens, with citizens, who might also have an opinion about this. It becomes much more complicated and many of these processes are very, very, long. Because there's a long period of negotiation and design and consultation. But ultimately, the engineers I think, as the water issues become more urgent all over the world, engineers are understanding that they have to work together with other disciplines. And landscape

	architects are also stepping up to the plate to take part in that discussions. And finding a new empowerment. So, but in the beginning, things are maturing. But in the beginning, you could really see that these disciplines did not speak the same language at all. They have different priorities, different approaches. And getting this round stake into this square hole has really been a lengthy and laborious process. But since the outcome is now being seen as a Dutch approach and being exported all over the world, I think now people are starting to realise that this really could be worthwhile.
TNS 00:45:42	Thank you. Ok, so I'll open up to the floor for questions. Gentleman. Please pass the microphone to the gentleman in the blue shirt.
Audience 1 00:46:32	Good afternoon. Good afternoon and thank you Ms Tracy Metz, Mr Tan. My name is Lim Soon Heng. I used to work for a shipyard, Keppel Shipyard for many years and I recently formed a company called Floating Solutions, so you know which direction I'm heading. You mentioned just now, you asked if anybody is familiar with sea-steading. Yes, in fact I've met the people who organize sea-steading. Joe Quirk and Randy Hanson. The idea actually came from Patrick Freeman, who is the grandson of Milton Freeman. So, the idea is crazy. I told them, I met them, I told them, it's a crazy idea. There are better thing to do with floating structures. I'm completely in agreement with this idea that floating structures are more sustainable because you know, when you have a floating city, you don't build roads. You don't pollute the roads. You don't pollute the city. It is also more sustainable than our previous solution, which was to reclaim land. And our reclamation has actually become sort of a… it's on the radar screen of United Nations, NEP, NEDP. Because everytime we bring in a barge load of sand, someone is going to make some noise. I'm just sharing this with you, I'm not asking questions. We are just sharing knowledge right? I recently delivered a paper at the University at the Ho Chi Minh City, it's called Mega Floats for a Sustainable Future. So from there, you can see many problems with our pollution can be actually resolved by

	having floating structures. Here in Singapore, I'm beating the grass to get attention on floating structures. I've met up with people in URA. I in fact written to Prime Minister to try to draw attention for a need to consider the sea as a space solution for Singapore. Singapore is 700 square kilometre, give or take a few. And we have just about as much territorial waters, and we should pay more attention to developing that space. We are now working with one of your Dutch companies, [unknown foreign name]. Have you heard of him? We're trying to develop something on those lines and hopefully convince the authorities here that the space, the sea, is a space solution for Singapore. Because right now, we are concentrating too much on underground cities, reclaimed land or building higher buildings. So very little is… So very little attention is focussed on the sea space that we have. Thank you.
TM 00:50:46	If this was such a good solution, why hasn't it taken off yet? Maybe we should have this conversation over beer afterwards.
TNS 00:51:05	Is there another question? Yes.
Audience 2 00:51:12	Hi, good afternoon. My name's Ken Chin. I'm from the Civil Service College. I actually have a number of questions so, maybe I'll just run through all of them first and we can see how best and maybe if anyone wants to jump in as well. So, I came in a little late, apologies for that. I just want… You mentioned that with the storm surge walls, you think that the current solution probably wouldn't look like that and I wasn't sure if there was any discussion before that, that led you to have that say as to why the storm surge walls wouldn't look like that right now. So I was just wondering if you could elaborate on that. And also to add on to Mr Tan's question regarding the engineering mindset, it's also the citizen mindset change. What was the evolution of citizens' mindsets? Particularly when it comes to redundancy because in some of the structures that you showed, there was redundancy – having 2 levels of pavements. And given

	Singapore's land scarcity, I'm not sure how easy that idea might run through. And I'm also wondering whether you've taken a look at Singapore's own set of laws and legislation. I'm wondering what changes you might propose in order to facilitate such a change in mindset. And lastly of course, what do you think should be useful measures of success to determine how our relationship with water can be deemed successful? Thank you very much. Sorry about the barrage of questions.
TM 00:53:20	Fantastic. Let me address them in the order in which you put them. The storm surge walls, that is a very interesting issue because all these infrastructure was built after the big 1953 flood and generally this big infrastructure has a function lifetime of 50 years. So the Netherlands are also asking themselves, what is the next storm surge barrier that will keep the country safe but still be less… intervene less harshly in the natural system? And one of the reasons that I think the storm surge wall that I shows you, would be different was because this was built in the early 60's when the budding environmentalist movement was just coming up. And they were the first to say, if you close off this sea arm completely, the estuary behind will die. So, there were some parts of it left open with the idea that the tide would be able to enter the estuary and go out again and maintain the shellfish life there. Maintain the seals that live there. And we have now discovered that is not the case. That there's not enough tide coming through these openings to keep the shellfish in the estuary alive, to keep these seals alive. The sandbars are disappearing, they were being sucked out to sea. So, one of the drivers behind all of these new developments that I talked about today, are facing the consequences of this really hard intervention in natural systems. And the Dutch are realising that you can't, it's never… It's a zero sum game. You can't intervene like this for centuries and then just be surprised when there are consequences. There are consequences. Other bodies of water for example, after the 53 flood, were closed off and salty water became fresh or brackish. But now that water is dead. There's no oxygen in it. There's no fish left and blue algae bloom on the summer and really pollute the area in a terrible way.

	So, the Netherlands are being confronted with the consequences of a lot of intervention with the natural system in perhaps decades, if not centuries. So, I don't think anybody really knows what a new stone surge wall would look like except that it would have to be less harsh in its consequences for the natural system. The evolution of the citizens' mindset. That's very interesting that you mention that also in connection with redundancy. I think redundancy would be exactly the answer for Singapore. If you can combine a space like that one I showed you in Rotterdam, where the bridge disappears into the water. If you could make that waterway useable both at low water and at high water, if you can combine those two then you actually save space. You have more space for water catchment when it rains really hard and you still have an attractive public space when it doesn't rain that hard. There's another redundancy issue which for example in New York, it's a big thing. When the rain comes crashing down into the sewers, the sewers overflow and you have sewerage out on the streets because it's called combined sewer overflow. Because they, for a long time, didn't have separate systems for sewerage and for rain water. The Netherlands mostly does. In Singapore, I don't know. Mr Tan? Separate? Ya, thank heavens. It's a big retrofit.
TNS 00:57:28	We learn from the Dutch.
TM 00:57:32	So that's a form of redundancy that I think everyone is really happy with now. So if urban design is done smartly redundancy can actually make it much more useable under different circumstances. This is what we want to move to. And the citizens might say about this, "To tell you the truth, I think most people haven't really thought about it." They're discovering now that, as I said, places can change character. They can be sometimes wet, sometimes dry. For example Bishan Park, that we were discussing Mr Tan, I think is an interesting example of how the naturalizing of this

	concrete channel into river, intercolumn river means that there is much more space for water and at times when there's drought or just not so much rainfall, the water shrinks. You can call this redundancy, you can also call it flexibility. And I think I would prefer the latter. The laws and regulations of Singapore, I'm not really the person to ask. But I must say I was struck by what Mr Tan told me about Bishan Park. The number of safety measures that were taken to ensure that people didn't fall into the water when the water was high. There are safety markers. There are sirens to warn you that in an hour, the water will be too high to be there safely. There are people who control the area all the time, on bicycles? On bicycles. And there are also life buoys that can be thrown out into the river if someone is caught. There are ropes or wires across the water that you can grab onto if you were caught. Are we up to 6 now?
Audience 3 00:59:37	Education programmes.
TM	Pardon?
Audience 3	Education programmes.
TM	Yes of course. But that's not the danger part, that's the good part. Yes, Bishan Park is also a wonderful area for getting children interested in these issues. And I think children are by far the best investment in outreach that we could possibly do. They go home and they tell the stories and what you learn as a child, that stays with you the rest of your life. So, I asked Mr Tan, actually do you think next time you do a project like Bishan Park, will it still be so covered with safety measures and what did you say?
TNS	It depends on how well we educate the population. Just to share with you

01:00:23	an anecdote…
TM	It depends on how well we educate the population.
TNS	Just to share with you an anecdote. Actually it think about 2, 3 years ago we had a very bad flood. And so the road to the school was flooded. And somebody took a picture of school children climbing onto the fence so that they avoid getting their feet wet. So in Singapore, there is this zero tolerance to water. It just floods for even one foot, for an hour, people cannot tolerate it. And there is this, even children, they are brought up with that mindset that they should avoid getting wet in water. So it's really an uphill task, how to educate the younger generation to actually embrace water. And that's why I thought maybe, you can share in Holland, how they are doing it and maybe we can learn from you. Are there any kind of efforts towards doing this?
TM 01:01:45	Yes there are. Let me just answer the last question. What is the measure of success? That is really a good question and that was what I was meaning to address when I was talking about the water squares. How they can absorb x cubic metres of water and then let it slowly seep down. But, how much open space in the city does it require and how much does it cost and how much capacity can you create in this way? This is an equation that I think we're all making now for actually all these measures. Kees, can you perhaps say something about that equation in Hamburg? How you measure success on that water square in Hamburg that I showed? Oh excuse me, I'm not the moderator at all.
TNS	No, it's ok. Proceed. Ask Mr Christiaanse to share with us his experience in doing planning for Hamburg City.
Kees Christiaanse	Maybe I extend it a little bit. We talk a lot about resilience but we also are starting to work as urban designers and architects in terms of water management with the idea of resistance. And that means that you work

(KC) 01:02:46	from the beginning with the integrated concept of water management, and that the idea behind the water management is to delay the stream of water as much as possible in order to retain as long as possible in certain places. Because if you really create a very strong retardation of the water flowing somewhere, then the water starts to evaporate. It starts to be taken by the roots of trees. It starts to be absorbed by the soil. It starts to be whatever. And therefore it is possible to create designs and architects of public spaces that contribute to this process of retardation. And by means of this retardation, in many cases you get lower flooding levels when there's a big rainstorm or something like that. So that's the kind of, let's say it's not the kind of primary solution for flooding but it's very good kind of secondary principle for working with flooding. And so this kind of retardation principle we also apply a number of those in several parts in the Netherlands. Which means that for instance you create as many roof surfaces that keep the waters as long upstairs as possible. Because if the water is on the roof, it doesn't fall out very quickly. And it doesn't over stress the sewer system or the road system. First of all. Secondly, it helps as a kind of temperature regulator of the roof mass. And therefore it is a positive effect on the household of the building. And if you also create earth mass and vegetation in combination with that, the water's also used by the vegetation and it is used also as a [indistinct] and that means that in the end, the water gets slower down onto the ground and also a little bit less water gets down to the ground. When you add all these kinds of interventions then we can get quite a lot of effect. So, in the Hamburg scheme, we have as much surface as possible not paved. But so called semi-paved which is that you, you do not create grass or earth which is difficult to maintain and gets soppy and you know what. But you create a kind of half hard surface, a little bit like the yellow stuff in the parks of Paris, which at the same time is sufficiently hard surface to use as pavement but at the same time, it's not as heavily water absorbing. And so there are a lot of techniques being developed in that sense that create this kind of a slow down, slowing down of the water stream by the rain or

	flooding and we try to implement that in the designs. Not always successfully because a lot of times regulations or politicians don't want it or investors don't want to pay for it. In the end it's cheaper but…
TM	That's always a good argument.
KC	They do not realise that so easily sometimes.
TM 01:07:34	But things are changing. I see the willingness to entertain ideas and to try new solutions as the problem becomes more urgent, the willingness to try new solutions is growing.
KC	You talked also about intermediate green, we are doing that also but we are also doing it with water. So, for instance we have built a housing neighbourhood in which part of the neighbourhood was a lake. And we designed a piece of neighbourhood that was based on street grid that was dams on the lake. That would only be built when there was demand coming up. And the houses along the stem, they were houses with gardens. But the gardens were water. And it's one of the first projects where we managed to get the water being administratively acknowledged as a plot. So, behind that house. You also saw some houses in Amsterdam, but in this particular project, everybody had a kind of virtual plot which was 50 m long. And that's why as a house, which was allocated and also paid for as plot, but it is water. And you could let's say build a part of the neighbourhood up to certain critical mass between water and built. Which is actually interesting principle. This is also about the floating condition, we have quite, we have some floating neighbourhoods, new floating neighbourhoods in the Netherlands. But these floating neighbourhoods are primarily, one-family houses being of one raft. And the public, the most important reason why you do not get neighbourhoods or the large building complexes floating realised, is the fact that there is not yet a juridical and

	especially a financial solution for the fact that a floating building or floating neighbourhood is not real estate. And therefore…
TM 01:10:29	You can't get mortgage.
KC	Exactly, so a floating construction is a boat even if it is as big as a city. And a boat is subject to depreciation. But a house or a neighbourhood is going up in value all the time. And this is one of the most important things. I work also by the way with [indistinct] on floating islands.
Audience 1	May I respond to that because he's asking me something?
TNS	Ya then, there's one question from the lady. Ok, we'll take your responses.
Audience 1 01:11:18	… This idea that the floating structure is not a real estate. I've been through several discussions of this. Legally, it's called a chattel, something movable, it's not real estate. Our human mentality is anything that's fixed to the ground is real. Anything that can be moved, is unreal. This is a manmade conception. How to tackle this idea of putting a real estate in sea is something that the legal system has not come up with, they need to develop this. For the time being, a floating structure has to be regarded like a ship. It's given a mooring right for maybe 20 years, 30 years, or 50 years until the law changes and recognize it as a real estate. The other issue you brought up has to do with appreciation of a floating structure. Even if you are talking about those small floating structures with one single house on it. We in Singapore are more thinking in terms of high density living, which means it's like a town ship. Each floating structure would be 5, 10 hectares, operating hectares and they can be connected by bridges. And they will have a floating right, a moving right, if the law does that in future. And I see no reason why such things cannot appreciate. Because

	you can construct a floating platform out of concrete or steel that is designed for 50 years life or 100 years life. In fact all oil rigs built with concrete in all, have been around for more than 50 years. So they can be designed for that kind of life. The other thing is that mortgageable? Yes, in fact there's mortgage. In fact, if I were a banker, I'll prefer to put money on floating structure because it's a movable asset. If I got a floating house somewhere in Indonesia and something goes wrong, I can pull it back. If I too have dealing in Indonesia, if there's a riot, if there's a… or the country goes to pieces…
KC	Yeah, yeah, you don't have to convince me, I'm totally with you.
Audience 1	Alright. Thank you.
TNS	Ya. Can we have a mic for the lady?
Audience 3 01:14:51	Hi, I'm Celeste. Basically I just want to understand more. How does the water that got retained by the sponges or the concrete gap, is there any visibility of it, when they seep through to the underground? How can it be… How do we ensure that this water is safe or is it clean for consumption or is it reused somewhere?
TNS	She's asking you the question cos you were talking about pavement that can soak up water. So she's… Ya, so…
Audience 3	Ya, I'm asking…
Audience 3	What happens to the water after it gets soaked up in the pavement, as it gets…

KC	I didn't talk about drinking water.
Audience 3	Yes, but is there any possibility that the water can be reused or is it just dispelled off?
KC 01:15:47	Well, I think the principle of water purification is absorbed into the underground and that depends on the cleanliness of the underground, whether purification is successful or not. And also about the capacity of absorbing the water. So that is really depends on where it happens. We cannot say here is possible but there is not possible.
TNS 01:19:44	Maybe we take the question from the front row first, ya ok.
Audience 4 01:16:26	Hi, my name is [sic:Frodo]. Great to see you, great Tracy again. And thanks for an inspiring lecture. I'm the founder of Crazy about Water, 5 years ago my adventure starts in the water scene. I'm the Chairman of the Netherlands Water House here in Singapore. My question is more related to all those urban, more outdoor concepts. As you know, Singapore is also focused on demand management, to encourage people to use less water inside. So do you have some ideas maybe on the creative design side to inspire people inside or around their own house to consume less water?
TM 01:17:13	That's why I included this gentleman with his toilet on the Central Square of Amsterdam. Because everyone understands in a very fundamental way that this expensive, delicious, treated water, that it's ridiculous the way we throw it away, for example, by flushing the toilets. And I know that there's the water board of Amsterdam, also has a programme in the neighbourhood of Amsterdam, trying to come into close contact with people, to make them, to show them actually, what the whole process is that water goes through. Why it's so expensive and why we have to be

	more careful with it. So, there's a lot of public awareness going on. But it's slow you know, so easy to turn on the tap and the water comes out. And it tastes great. It tastes good here. You don't know what went before and I think water is, yes, it's a human right but at the same time it's still also very cheap and that makes it easy to not pay attention. The Dutch now are actually starting for the first time ever, a policy to ensure that there will be enough fresh water in the future. For industry, for agriculture, for drinking. Because even a country which has always had to pump out water as quickly as it could because it had too much, now that the summers are getting hotter, the salt water is penetrating further inland into the country, there's new awareness needed that we cannot be as profligate and as careless with water as we have always been. So this is on national level, a new policy of ensuring the fresh water supply in the long run, but also on very small neighbourhood level of local water boards working together with neighbourhoods to tell people what actually goes in to making our water and trying to convince them to use less. There's an initiative also called Join the Pipe, which creates water bottles in the shape of a pipe. There are tap water points all around the city now and you can fill your bottle rather than buy a new plastic bottle. So you see, there're all sorts of budding initiatives from the very, very tiny ones pointed at individuals to a whole government programme to ensure freshwater supply in 2050 I believe.
Audience 4	Thanks.
TNS	Ya, there's a question there in the middle.
Audience 5 01:20:26	Hello, my name is Helena [sic : Osmand]. I'm from Dutch Water Research Institute – Deltares. I'm based in Singapore. You mentioned when developing this type of innovative green integrated water measures inside of urban areas, it's often quite a challenge to have engineers change their

	mindset. But when we have a lot of pilots in Netherlands also, I think now already, not anymore pilots in ABC projects in Singapore, we're working now towards mainstreaming this type of innovative solutions in water management. And what do you see for, well for Ms Metz but also for Mr Tan, as now the biggest challenges for mainstreaming this kind of solutions in common practice? Why don't we have ABC everywhere, why don't we have the type of water squares in Netherlands? What will it take to get them implemented?
TM	I'm so glad you said this because when I was talking to Mr Tan, he said exactly this. He said we're working now to mainstream these solutions to make the new normal, to make it just self-evident, that you think about water in urban designs. I think this question is for you.
TNS 01:22:00	So in fact, we have started working with URA to try to put water upfront in the planning process. So that means when the developer wants to build a new development, the consultation will have to go through this process where we would then require them to think about how they are going to design the draining system and so on. And to incorporate what we call the ABC water design features into the development. So take like for example green roofs. This is one very good example where actually you can design green roofs not only to make it look nice, but also to retain some water so then that would also slow down the storm route and at the same time it cools the building. So, these are the things that we want to actually put it into the minds of the developers, especially the architects. So that when they start thinking of a building project, they think about the water management aspect upfront rather than something that is done later.
TM	And as PUB, you have the power to do that?
TNS 01:23:20	Ya, we are working with URA, we don't have all the power. URA, they are the agency that controls development so they can actually impose some of these requirements. But it is not, it's not just making it mandatory, but

	it's really getting the whole professional bodies, the industry, to think like that so that it becomes part and parcel of the planning process.
TM	I think part of the answer led to your question in the Netherlands, but I mean you're Dutch, you know better than I do, was that the Dutch mentality for so long was to get rid of the water, there's too much of it. We have to pump it out, pump it out to sea. And now we're starting to realise that it's actually, because we have too much, we need to hold more and there's a kind of contradiction there isn't there? We have too much, so we have to hang on to it, to create catchment. I mean we understand why but this is whole new mentality and that takes a while.
TNS	Any other questions? I think we have a lot of discussions? Oh yes.
Audience 6	I think we should have more flood plain…
TNS	You can use the microphone, thanks.
Audience 6 01:24:50	I think we should have more flood plains in Singapore. Bishan Park is an excellent example of a flood plain. The word is beautiful. You see the scenery change, where there's low water levels, you have a lot of grassy inclines towards the stream that meanders through the flood plain. When there's thunderstorms for a couple of days, then the landscape changes again. You see the water flooding the plain. And it's a beautiful experience because in Singapore, you very often see the same landscape. Here behind you I can see the flood plain because there's a deluge of rainwater from the reservoir behind and from the surrounding concrete drains. So the scenery changes. Now there are many, many examples of flooded drains in Singapore like the, like the one near Sembawang Park. That can be a flood plain. After the industrial estate, you have the Sembawang River right?

	Going into the sea towards Johor, the Straits of Johor. That could be a beautiful flood plain. It faces the Straits of Johor. And East Coast. There are many, many opportunities for flood plains. Just plant grass you know? Along the river bank, and the grass absorbs the flood. So, after a while, the people of Singapore, children, adults, grandmothers, they know how to react to a flood plain. They know how to walk off when the water level rises. You don't really have to invest, over invest in the elaborate safety measures. I think it's too elaborate, over the top at Bishan Park it's too contrived actually. You should remove some of the mechanical devices.
TM	Don't be so hard on them, it's their first time.
Audience 6	Ok, thank you very much.
TNS 01:27:31	Thank you for your feedback. That was a very first project that we did so we were a bit like, what Singapore would say, "kiasu". It means over conservative. But it's really how the public is going to get used to this kind of thing. I think that's the important part. If the public really, finally, over the years, see that actually it works, that there is this risk that they can manage then I'm sure we can do more of such things.
TM	This gentleman is your best ambassador, Mr Tan.
TNS	Ya, correct. Ok I think we have to have one more last question. Anybody else besides the gentleman in blue? Ok, there's one at the back there. We will take that one there then after Mr Lim, you can have the last question.
Audience 7 01:28:35	Hello, thank you for the wonderful presentation. So, you talk about how in the UK, David Cameron wanted to implement water resilience strategies for 40 million. So I was just thinking like, there are some countries or cities that might not even have $40 million to promote such water

	resiliency or flood mitigation. But these countries or cities are the ones that need these strategies the most. So are we looking at a future where only certain cities or countries can afford to be water resilient and how about underfunded cities like New Orleans or developing countries like Bangladesh? Are there low cost solutions that certain countries have implemented for, to mitigate floods or to be water resilient? And are there methods that do not need government intervention, that are more ground up? Or even… do you think infrastructure, flood resilient infrastructure is something that should be confined to certain, the technologies, confined to certain cities or should it be something that can be implemented at a much lower cost?
TM 01:30:08	There are a couple things that immediately come to mind. One, is situation in Jakarta. Which as I'm sure you all know, is subsiding at an unbelievable rate and where there's constant flooding. And one of the reasons there is so much flooding in Jakarta is because there's a huge amount of informal settlement. People come to the city in search of work, of course they can't find a place to live. They build a little shack along the waterway on stilts and everybody throws their garbage into the waterway. The waterways all round Jakarta are completely clogged with trash. If they were not clogged with trash, the system would function much better. Perhaps even the way it originally did function. I'm not saying the subsiding would be stopped, but the flooding would be helped and that would save a lot of human suffering. So, you don't need any major concrete infrastructure to help solve this. What you need is cleaning up the waterways. And I think that's something that government could and should do. And that's not a major investment, anything comparable to that 350 million riverside project that I showed you. So, yes. There are a lot of things that can be done which are really just basic maintenance. Of course this was not done, I think these are poor people. Government does not see the necessity to invest in areas like this. But it's not investing in this neighbourhood. It's investing in the whole safety of the city. So I think this awareness hasn't really developed yet. Cleaning up the waterways would do a tremendous service to the quality

	of live everywhere in Jakarta. You mentioned Bangladesh. I think Bangladesh is perhaps one of the countries in the world that is worst situated as regards to water safety. Just its simple geographical location means the entire band of the coast is pointed directly at the water and that's also the direction from which the typhoons and cyclones come. So it's really difficult to… Bangladesh is one of the hardest countries in the world to protect. Another example where a lot can be done without huge infrastructure is the Mekong Delta. I went to the Mekong Delta for this book, to investigate how 22% of the nation's economy comes from the rice and shrimp farming there. And it's one of the most susceptible areas in the world to climate change as the sea level rises. Sea level only has to rise a tiny bit to flood the Mekong Delta. Actually, the paradox is that the farmers are now desperate for flooding because the floods coming down the Mekong from China through 9 different countries through Asia, were always the floods that washed out the fields, washed out the rats and brought new sediment for the farmers to make the fields fertile again. So that's a political question, not an infrastructure question. If China would stop building dams that stop the Mekong flowing down through the Mekong Delta then it would be a tremendous contribution to restituting the natural system. But that's a political issue, not an infrastructure issue, so it's very important but also very complex issue that you mentioned. Infrastructure is but no means the solution to everything.
Audience 7	Thank you.
TNS	Yes, ok Mr Lim.
Audience 1 01:34:24	Thank you Mr Tan for your indulgence. I am so passionate about this that I just can't sit still. There is an easy solution to harnessing water and that is having floating structures on concrete steel. And we have a few golf courses that are being evicted from their present site. Jurong, Keppel. Each

	of those golf courses is maybe 10 ha, 100,000 sq m. If you put this on a floating structure, when it rains, the water will seep through, that concrete layer within that, you can have tanks which will collect water. In Singapore we have about 2 m of rainfall a year, multiply that by 100,000 sq m, you get 200,000 cu m of water from a golf course, from a floating golf course. And floating golf course is not an innovation. It's already been tried out in Maldives. In Maldives the Dutch, what's the name of the…? Docklands is it? A company called Docklands. They are building a floating golf course.
TM	And you already have a floating wetland?
TNS	Ya we have.
Audience 1	We have a floating stadium called Marina Bay. Some, many people forget that. So, there's a very easy solution to harness water with a floating structure. On top of it, we can put a golf course. We can put a park. Something worth considering, Mr Tan. Thank you.
TNS 01:36:37	I think for reservoirs design, it's not just the direct rainfall that falls, but also the catchment area. How much, how big is the catchment area. And also what we call the reservoir EU. That means how long will the water last. Because not forgetting that it doesn't rain everyday and we're also experiencing a lot of dry spells now especially with climate change. The dry periods are going to get longer. So the issue really is, do you have enough water during the wet period to store it? So that it can last you through the dry spell.
Audience 1	It has to be very deep.

TNS 01:37:22	Correct. So it has to be pretty deep and for a floating structure, it will be pretty expensive. So, if your boss in the golf course can pay for it then that's fine. Alright, yes, so thank you very much for your attention and for coming for this lecture.
M	Thank you Tracy and Mr Tan for sharing your insights and experiences with us. We would now like to invite Mr Khoo Teng Chye, Executive Director of CLC, on stage to present tokens of appreciation to our panelist and for the photo taking session. Mr Khoo, please. Thank you Mr Khoo. Ladies and gentlemen, we have now come to the end of today's lecture. And we thank you for your participation. Do stay tuned to CLC mailers and our website for information on our upcoming events. We'll also be seeking your feedback via email and would greatly appreciate if you would take some time to help us improve the lecture series. We wish you a great evening and hope to see you again soon.
	[Recording ends at 1:39:28]