

Tanya Domi: Hi, this is Tanya Domi. Welcome to the Thought Project, recorded at The Graduate Center of the City University of New York, fostering groundbreaking research and scholarship in the arts, social sciences, and sciences. In this space, we talk with faculty and doctoral students about the big thinking and big ideas generating cutting edge research, informing New Yorkers and the world.

Tanya Domi: Jennifer Cherrier is a professor of earth and environmental sciences at The Graduate Center and chair of the earth and environmental science department at Brooklyn College. Cherrier's work focuses on water sustainability, specifically she's interested in developing approaches to counteract human impact on marine and freshwater systems, where patented EcoWEIR technology, for example, can help reduce levels of carbon and nitrogen and other contaminants in large water systems. The technology is currently being tested as a solution to Prospect Park's problem with algae bloom.

Tanya Domi: When Earth Day was created in 1970, it marked the dawn of the modern day environmental movement. Today, the calendar hosts more than 50 environmental awareness days each year, all designed to highlight the now crisis-level impact of human activities on the planet and environment. But the threats continue to grow. A recent study in Nature Climate Change suggests we may have already missed the opportunity to cap climate warming at a safe two degrees Celsius. Our waterways also play host to an increasing number of pollutants. Throughout the month of April, the Thought Project podcast is talking with Graduate Center faculty, students, and administrators who are using their scholarship and expertise to address a variety of environmental and climate change issues. We'll also aim to arm New Yorkers with the information they need to take action. Joining today is my co-host Shawn Rhea, The Graduate Center media manager for the sciences. Welcome to the Thought Project, Professor Jennifer Cherrier.

Jennifer Cherri...: Thank you. Thanks for having me. I'm excited to be here.

Shawn Rhea: So a great place for us maybe to start today would be to get a lay of the land on the health of New York City's water systems. We mentioned in the intro that algae blooms are a problem for city parks, and we know that New York is an area of active ports and that the city has an aging infrastructure, which is challenged by things like stormwater overflows. So how does all this impact the quality of the water that we drink, that we cook with and that we bathe in?

Jennifer Cherri...: So the good news is that it doesn't affect the quality of our drinking, cooking and bathing water because our water comes from upstate New York, from several pristine watersheds that serve eight million residents here in New York City. But the real problem that we have, I would argue, that it's tied to stormwater in New York City, how this runoff is managed within the city. To backtrack just a little bit, New York City is covered in pavement, which is like an impermeable barrier. So it acts like saran wrap stretched across the landscape. So when it rains, the pavement blocks rainwater from being absorbed, like it would normally be in a natural system that's covered with dirt or sand. Instead, it becomes to what we refer to as runoff. In urban areas, for example, as much as 80% of the water that

hits the ground ends up as runoff because of the pavement, whereas in natural unpaved systems, the runoff is as low as 10%.

Jennifer Cherri...: So what ends up happening when we have storm events with high rainfall in New York City is we have two challenges. First is we have localized flooding in places where the water can't move downhill fast enough to get into the storm drains or to other holes that are in the landscape. The second problem that we have is that when the water does enter our stormwater systems, we have what we call combined sewer systems, which means that both our sanitary flow water, so all the water that we use in our apartments that came from this pristine watersheds in upstate New York, ends up in our pipes, and that combines with the rain. That's why they're called combined sewer systems.

Jennifer Cherri...: So when we have large storms, what happens is the volume of water that's entering these combined stormwater drains is really large volume and exceeds the capacity that can be handled by these storm drains and so what happens is the stormwater mixes with the sewage and then that then overtops the weirs that are in our sewer pipes. That ends up as combined sewer overflows, so we end up having this dilute sewage going into our coastal water systems. So we have that and also we have any pollutants that are picked up by the stormwater as it runs across the pavement landscape.

Shawn Rhea: So it's really more an issue of the water ending up in our actual rivers as opposed to in our pipes, essentially?

Jennifer Cherri...: You mean in terms of the drinking water?

Shawn Rhea: Yes, in terms of the runoff.

Jennifer Cherri...: It's a matter of when it rains, because the stormwater is going in the same place as our wastewater is and so instead of it going to the wastewater treatment plant to be treated, the volume is too large and so it overtops these weirs that are in the pipes, and then you end up with this dilute sewage going into our coastal waterways.

Shawn Rhea: Got it, okay.

Jennifer Cherri...: That as well as the flooding. So usually it just goes to the wastewater treatment plant and it's treated, but that's not the case when we have these large storm event. So any storms that are over like one inch are really problematic. So that's one of the issues that the city is dealing with. So both of these challenges, both the flooding and this combined sewer overflow that we have that are going into our waterways, are posing a really big financial burden to New York City via the loss of property damages, as well as loss of money for tourism and recreation, and the fishery industries.

Jennifer Cherri...: The city's trying to address this by improvements to gray infrastructure, which would be like upgrades to the sewer pipes, pumps, holding tanks, and upgrades to the wastewater recovery facilities. They're also looking towards green

infrastructure, which is where you can punch holes in the saran wrap of this paved landscape. The water can be absorbed instead of going into the stormwater pipes.

Shawn Rhea: You mentioned punching holes into these permeable barriers. So is this a technology that would allow them to do something like that?

Jennifer Cherri...: So I'm going to start off and explain what eco-WARE is before I talk about how it works. So it's a smart censored pipe and valve system, and we take these pipes and valves and we place them underground at about three or four feet below the surface. We put that on top of an impermeable barrier, like a pond liner or clay. Then on top of the pipes, we put gravel, dirt, and sand. Then you can top that at the surface with either plants, like we have with green infrastructure, these punched holes in the landscape, or you can also top it with a hard scape, like sidewalks, pocket parks, green plazas, or even roads. Eco-WARE is essentially a hybrid approach to gray and green infrastructure because it combines the control of the pipes and the pumps together with the natural landscape of the soil and the grass and everything.

Jennifer Cherri...: So when it rains then, what happens is you have this exposed area where water can be absorbed by this EcoWEIR system. So once it goes into the EcoWEIR system, just like it would with green infrastructure, the eco-WARE censored pipes and valves can control what actually happens in the soil itself. For example, it can control how long the water is held in the soil. It also can control the conditions in the soil so that it can maximize what the plants and the bacteria do to degrade the pollutants. So eco-WARE essentially gives nature a boost.

Jennifer Cherri...: With green infrastructure, you have nature, but you have this tiny little postage stamp and you expect it to do all of this work that whole, vast landscape used to do. So with EcoWEIR you can control what's happening in that system so that you can ensure that you're consistently removing these pollutants and you also can ensure how much water is being held at any given time, so that you know, that you're keeping it out of the sewer system or draining the flooding that's happening.

Shawn Rhea: Got it, so you mentioned it gives a nature of boost. It gives it a little more time to do its job, it sounds like?

Jennifer Cherri...: Yeah and also the nice thing about it too, is that unlike green infrastructure, which is kind of like land that's set aside where people can't interact with, EcoWEIR systems can be customizable for whatever use that you might want to use. So, like I said, you can put a hard scape on top of it. You can have a cafe, you can have a green plaza, so private property owners or the city, you're not losing space, which is a high commodity in cities as it is. You can put it on roofs, you can put it all over the place because it's just this pipe and valve system that controls what's happening in them.

- Shawn Rhea: So it also allows the city to mitigate the problem without having to go in and do major infrastructure change. So how does that help with the cost of time to address a lot of these issues that-
- Jennifer Cherri...: Yeah, exactly. Well, so the city right now, we have two tools that we can throw at it. We have gray infrastructure, which is really important. But gray infrastructure is really expensive and it takes up a lot of space. For example, one holding tank of gray infrastructure could cost half a billion dollars. Whereas green infrastructure, the city has budgeted \$1 billion total until 2030 for all of the green infrastructure programs. So this eco-WARE system, this hybrid system, is a little more expensive than the green infrastructure, but with a lot more control, but it's significantly less expensive than the gray infrastructure.
- Shawn Rhea: Gotcha.
- Tanya Domi: Got it. Got it. So it seems that the Biden administration is being very leaning forward on addressing climate change in their new proposal, which will be a second reconciliation bill in front of the Congress, that is estimated right now it's at 2.6 trillion. We'll see what happens after it goes through the process, but this would be a once in a generation appropriations. This would be the biggest appropriation for infrastructure since the interstate highway system was built in America in the 1950s. It seems that they have recognized that they want to put technologies to work, to combat environmental and climate change issues finally. Also the Waterfront Alliance, a group of New York City activists and businesses, has proposed the four point plan for creating resilient, healthy area waterways. As a scientist and an aquatic environmentalist, what do you think needs to be the city's priority investment in this technology as we move forward to address these issues?
- Jennifer Cherri...: Yeah, that's a really great question. Part of the problems that we're having here in New York City is that we have this aging infrastructure and also our population's been growing and the area has been spreading. So this is a really great opportunity for the city. The city's been working on this slowly and actually is a leader in this, but essentially we're going to need all the tools in the toolbox to address the challenges, the water challenges that New York City is facing. We're going to need gray infrastructure, we're going to need green infrastructure. We're going to need blue tech, like eco-WARE technology. We're going to need hybrid approaches and we're going to need both small scale and large scale.
- Jennifer Cherri...: I know this seems like a bit of a cop-out answer, but I think that we're going to have to really address the problems with all of these different solutions. None of them are off the table. Gray infrastructure is capital investment, so they're very expensive, and so this is a great opportunity. But I think that one of the primary areas that we really need to think about with how the city works is we need to invest in restructuring how these water challenges are handled by the city. Right now, they're handling them in silos. There's multiple agencies and then multiple offices within each agencies, and so they're very siloed. We've got these multiple challenges with water that affect the Department of Environmental

Protection, the mayor's office, the Office of Emergency Management. So what we really need to do is invest in seeing how we can break down some of these silos and move towards-

Tanya Domi: And make it flat, right?

Jennifer Cherri...: Yeah.

Tanya Domi: Like where people are talking across agencies, instead of operating in a silo.

Jennifer Cherri...: Right and we need to move towards what we call a one water approach, which is an integrated approach that is being adopted nationally as well as internationally. As I said, the city partners internationally with the city of Copenhagen, as well as the city of Amsterdam, and also is working with municipalities in Canada, and all over the US. I see that as one of our primary challenges, because otherwise what we're going to be doing is trying to address these problems without having this unified vision that pulls it all together.

Jennifer Cherri...: I think if we do this, so the integrated one water approach, really when we think of solutions, we think about the triple bottom line. We think about the environment, which is really, really important, but we also think about communities and vulnerable communities, and how can we address the challenges without gentrification, for example? To keep these communities intact. How can we create green jobs and how can we find the solutions that optimize the benefits of all three, economics environment and the community? So moving towards this type of approach, we have the opportunity to create these blue-green jobs. We can even take this integrated approach even further to think about the food, energy and water nexus, and break down even more barriers when we think about energy conservation and pumping of water from point A to point B. So we need decentralized approaches to manage our water because it's a huge energy sink to move water from point A to point B.

Tanya Domi: I think it's really important to get off the ad hoc, let's deal with this because of Sandy, the storm that happened several years ago downtown and all the way down near the Wall Street area. Then if you're not doing an integrated approach, then the entire city really does suffer. And it's a huge city. The scaffolding, when you think about the scaffolding that enables this city to live, breathe, and work, it's an incredible undertaking. It's also, I think, very exciting with the Biden administration money that's going to be coming soon.

Jennifer Cherri...: Absolutely. It gives us an opportunity to be proactive rather than reactive, because as soon as there's a crisis, we respond to it, then we forget about it. But a lot of the things that the Waterfront Alliance posed in their statement that they put forward, these are all very proactive types of activities. But we have to base some of them in the reality of, like you said, the city, this is a living, breathing city with multiple needs and uses and lots of drivers, right.

Tanya Domi: Exactly.

Shawn Rhea: You mentioned the Waterfront Alliance, I just want to chat a little bit more about that because they, as you may have seen recently, had put their proposal forward to all of the candidates that are running for mayor. One of the candidates in fact mentioned the idea of using CUNY as an advisor on this, given just the huge wealth of intellectual capital here, as well as the diversity of the students that we serve here. So, now you're chair of a Brooklyn College's, Earth and Environmental Science Department, so I'm guessing you probably have a sense of the kinds of technologies and solutions that scientists in their labs are working on and what they might be able to bring to the table in this? So, any thoughts on how you might see a role for CUNY, in helping to shape the city's approach to environmental resilience?

Jennifer Cherri...: Yeah, absolutely. I'm so excited to be in New York City and I'm also excited to be part of CUNY. I moved here in 2015 and I moved here because, if you can make it happen in New York, you can make it happen anywhere. New York is actually incredibly progressive, but I was really excited to see that in the statement that you shared with me as well. I feel like we are totally under-utilizing the opportunities that CUNY has to interact with the cities. The city is a living lab for our students and our students, they are the people that live here and they are going to become the future leaders. So we really need to engage our students and we need to have more information exchange between the scientists and the municipalities and the private sectors. That's easier said than done, because of these silos that we have and these different languages that we speak.

Jennifer Cherri...: So, yes, absolutely. I think about this all the time and I can think of several examples for opportunities that we were already engaged in. One of them is a project that I just finished with the New York City DEP and the mayor's office, was the New York City Stormwater Resiliency Study and was a multi-institutional effort. What we were able to do was to provide flood models and maps city-wide, and at the neighborhood scale for the city. We were able to also assess the vulnerability of communities and then also propose a series of intervention strategies under multiple climate scenarios. This was a really great partnership that we had with the city.

Jennifer Cherri...: Another example of this would be some work that Brett Branco is doing. He's a faculty in my department at Brooklyn College and also in the EES at The Graduate Center. He's also the interim director of the Science and Resilience Institute at Jamaica Bay. He has a community flood watch project with sensors. So this information can be very beneficial to the city because they can't be everywhere, so that they can know where things are flooding by activating the community and engaging the students in that kind of activity.

Jennifer Cherri...: Another example is with Joshua Chang, also in my department, he runs a clean soil bank, so he uses a glacial till soil, is what it's called. It's the soil that was pushed out by the glaciers. So when New York City was first building, they would dig up all this virgin soil and put it someplace. Now we have all this contaminated soil, and so what this clean soil bank allows you to do is to dig up the contaminated soil and use this clean soil in your yards for urban farming and community gardens. So that's really exciting.

Jennifer Cherri...: Then moving out of Brooklyn College, two other examples I have are, there's Prathap Ramamurthy, who's faculty at the City College and he's working on models and ground level sensors and space sensors to look at the urban heat island effect in New York City. So that's something that needs to be shared with the city so it doesn't just end up in a journal article someplace. Then finally, there's Maria Tzortziou who's also at City College and she's been working with NASA, putting sensors on satellites, on a new generation of satellites that'll allow us to visualize sewage plumes. So if we're looking at these combined sewer overflows, if we can see these from space, that can really help the city to know what's going on. So these are just a few examples of some of the solutions or research initiatives that are going on.

Shawn Rhea: You know, what's interesting, I find those solutions very fascinating because one of the things that they all seem to have in common are sensors, right? I think we chatted recently and shared about the ASRC sensor tests. There was so much coming out of CUNY with regards to this, that [inaudible 00:20:36] the value to the city.

Jennifer Cherri...: Yeah. But I would just go back to what Tanya and I were talking about before. The number one challenge, we just finished this multi-million dollar stormwater resiliency study, but still there's these communication barriers, like how do you talk to the city? How do academics, talk to the city and how do the city talk to academics, and how can we actually build projects that are proactive rather than reactive what the city is doing right now, so that these long-term projects that are sustained, so that we can engage our students in this training? They need to learn how to be able to communicate across these different boundaries as well.

Shawn Rhea: How are you projecting 20, 30, 50 years out for the city?

Jennifer Cherri...: Yeah, so right now with the city does is they get a big, huge pot of money from Superstorm Sandy, and then they use it and they get this capital money and then they don't have funding to come after that. But if we could have the sustained collaboration with the city on these multiple fronts, where that information could actually be used and benefit our students with the training and everything, it's just win-win all the way around. So I would love to see more of that happening in New York City. I've been working hard with the Grad Center trying to do that and to engage more with the DEP and the mayor's office, as are my colleagues who I just mentioned here.

Tanya Domi: Well, given the fact that I used to work in politics, I can tell you that there should be a convening that's led by CUNY leadership on the sciences, out of the chancellor's office, somebody should be talking with the deans of science across the CUNY system and do a convening with the city and state leadership and get in the pipeline before the budgets are adopted. So it's [inaudible 00:22:24], here we are a resource, we want to help the city. We want to give back. We want to leverage our knowledge and our technical expertise to advance the interests of the city and to care for the community that we all live in. I think it's doable, I really do think it's doable if those connections can be made by the university leadership, but I believe the opportunity's there. Shawn and I are aware that

there's a lot of interaction going on in the social sciences with the city and the state and we have faculty that are on governor's commissions and city task forces.

Tanya Domi: So this moment, I'm just going to say it, it's a 21st century Biden moment that really, I think clamors for all of us that really care about these issues that have this expertise, to make that case and do some convening. I also think it's part of what CUNY needs to do when they go and talk to the city council and they go and talk in Albany to the particular committees that are relevant to these funding sources. But this also comes back to what Shawn was talking about with you earlier, about not only your research work and you're creating new technologies, but you spend a great deal of time teaching and mentoring students. It does seem in the CUNY system, because I also teach at CUNY, I teach at Hunter and I teach uptown at Columbia, but it does seem that there's a much more support for faculty in terms of teaching and mentoring in the CUNY system.

Tanya Domi: I think there are certain values that I haven't seen in other places about how important that is, because as you said, Jennifer, the students we're teaching are the future leaders. They're in our neighborhoods. We hope that they will someday be in city hall, and they'll be at the state government, and in private philanthropic organizations. Given that you have that orientation, what is it like to work with these future scientists and what has been your impression since you've been here the last five years about their future and also about the opportunities and the challenges that face us with regard to environmental conditions in the city?

Jennifer Cherri...: Right. Well, that's a fabulous question I have to say. I think the reason why I got into this business in the first place is I am totally inspired by our youth. Our youth hold the future in our hands and it's up to us to help to train them to assume those leadership positions. My impression of our students is that in New York City, things are tough, it's hard to get from point A to point B. I have been so impressed with our students in that they're juggling full-time jobs, while going to school, while having to commute from point A to point B. They're doing this all at a very high level, some of the most talented students that I've taught, although I taught many talented students at Florida A&M university too, but I have nothing but hope for our students.

Jennifer Cherri...: I have a current PhD student who I'm trying to, and I know that my colleagues are doing the same thing, is try to engage her in the research that she's doing, but also for her to see the big picture and how that ties into addressing real challenges that our city and other cities and places around the globe are facing, because it's really important that we ground their work in that big picture piece. But not only that, I'm training future scientists, and you mentioned different social scientists that are working in there on different taskforce, and I have colleagues that are on those as well, but there's still very little communication between disciplines, even. So really what we need to do, is we need to be preparing these students for these integrated jobs that they're going to be

having so that they can learn how to speak the languages of these different disciplines and to speak the speak of the municipalities or the private sectors.

Tanya Domi: Yes, because we work intersectionally. They don't talk about that when you're sitting in History 101. You know, you do work intersectionally, as you point out.

Jennifer Cherri...: Yeah and this is a challenge just within a department, within people that I work that are interdisciplinary, just to talk across those disciplines. So, just to pull it full circle, our students are going to be that future workforce. They're incredibly hardworking. I'm thrilled that one of the mayor candidates tied some of the initiatives that we should be doing to address our water challenges to CUNY, because CUNY is our community. We need to invest more in CUNY because that's going to set up what our future's going to look like. So an investment in CUNY right now is going to be an investment for the future.

Tanya Domi: Thank you so very much. This has been a great conversation.

Jennifer Cherri...: Yeah, thank you so much. It's been a pleasure to be here. I appreciate you inviting me.

Tanya Domi: Thanks for tuning into the Thought Project and thanks to our guest, Professor Jennifer Cherrier, chair of the Earth and Environmental Science Department at Brooklyn College and professor of earth and environmental sciences at The Graduate Center, CUNY. The Thought Project is brought to you with production engineering and technical assistance by Kevin Wolfe of CUNY TV. I'm Tanya Domi, tune in next week.