Green Infrastructure for Localized Flood Management

Webcast Transcript

Tuesday, December 2, 2014

Speakers:

- **Lori Cary-Kothera**, Operations Manager, National Oceanic and Atmospheric Administration's (NOAA) Office for Coastal Management
- **Patekka Bannister**, City of Toledo, Division of Environmental Services
- **Tony V. Demasi**, City Engineer, City of Cuyahoga Falls, OH
- **Kari A. Mackenbach**, URS Corporation, National Green Infrastructure Practice Leader

Transcript:

Slide: Innovative Financing for Green Infrastructure

Eva Birk
All right. Well, good afternoon and welcome to today's webcast titled "Green Infrastructure for Localized Flood Management." And this webcast is sponsored by EPA's Office of Wastewater Management. And my name is Eva Birk. I'm an ORISE Fellow here at EPA's Green Infrastructure Program, and I will be moderating today's webcast along with my colleague, Emily Ashton. So thank you for joining us. We had a few technical difficulties here getting started. We're a few minutes late, but we have plenty of time buffered in for a question and answer period, so we're getting off to a good start.

Slide: Logistics

And before we get to our presentations, however, I would like to go over a few housekeeping items. So first, we'll have a question and answer session at the end of the presentations, as I just mentioned. And in order to ask a question, simply type your question into the "Questions" box on your control panel and click the "Send" button. If your control panel is not showing, click on the small orange box with the little white arrow to expand it, and you'll be able to see your complete control panel then.

And you don't need to actually wait until the end of the presentation to ask a question. There are a large number of participants today. We highly encourage you to submit your questions early. We will try and answer as many questions as possible at the end of the webcast. However, due to the high number of participants, not all questions will be answered. So please feel free to contact the speakers after the webcast, and we'll have their contact information as the last slide of the webcast presentation today. Moving on to possible technical issues, so if you have any technical issues, such as audio problems, please click on the "Questions" box on the right-hand side of your screen, type in your issue, and press the "Send" button, and Emily and I will do our best to troubleshoot.

You can also call the GoToWebinar support number listed on the screen here and give the assistant our conference ID number, which is unique to us, listed on the screen. Last but not

least, we'd like to remind you that the views and materials presented by our speakers here today are their own and do not necessarily reflect those of the EPA.

Slide: Webcast Agenda

So we'll get on to our agenda for today's webcast. Today we're going to be covering a topic that's very popular. We've gotten a lot of response asking for webcasts on this topic. We're going to be talking about green infrastructure for localized flood management. So chronic flooding is, as we know, a critical problem facing many communities, and in urban areas impacted by localized or "neighborhood" flood events, green infrastructure practices can absorb rainfall, preventing water from overwhelming pipe networks and pooling in streets or basements. And for communities experiencing overbank or riverine flooding – you know, larger flood events that are moving out of the river corridor – larger networks of green infrastructure can provide extra storage during heavy storm events. So today we will be covering a range of practices, both the small-scale practices and large-scale practices, that can help communities build flood resilience from anything that has to do with small-scale interventions, such as rain gardens and permeable pavement, to coordinated open space and floodplain preservation. And our first two speakers will cover general lessons learned from implementing green infrastructure for flood resiliency in the Great Lakes region, while our second set of speakers will hone in on a case study in Cuyahoga Falls, Ohio, where local officials successfully turned a problematic flood damaged area into a green infrastructure pocket park. And this is something that residents now view as an amenity and a community asset rather than an eyesore in a flood prone property damaged area. So by presenting these two levels of experience and four very expert practitioners today, we're hoping that both of these stories -- results from wider research in the Great Lakes region and a site specific example in Cuyahoga Falls -- will provide some replicable and useful information to those folks on the line looking to replicate similar practices in their community.

So with that, I'd like to kick off today's webcast by introducing our speakers. First up we'll hear from Lori Cary-Kothera, from NOAA's Office of Coastal Management, and Patekka Bannister, from the City of Toledo, Division of Environmental Services. And then we'll hear from Tony Demasi, from the City of Cuyahoga Falls, and Kari Mackenbach, from the URF Corporation.

Slide: Assessing Green Infrastructure Costs and Benefits

And with that, I'll go ahead and introduce our first speakers, Lori Cary-Kothera and Patekka Bannister. And Lori and Patekka already have their slide presentation up. They're on it. You guys are using the software wonderfully. And I'll go ahead and introduce them both while they're prepping for their presentation. So Lori is Operations Manager at NOAA's Office of Coastal Management. And in addition to leading the effort for Digital Coast, a very popular tool, Lori works on a variety of projects helping coastal resource agencies better utilize technologies, including GIS and social media. Recently, Lori has been working with a number of communities in the Great Lakes region, helping to address their flooding issues, using green infrastructure technologies. Lori Has a BS in Biology and Environmental Science from Bowling Green State University and an MS degree in Biological Oceanography from Florida Institute of Technology. So Lori will be assisted in her presentation by Patekka Pope Bannister. And Patekka, who I just met recently at the Green Infrastructure Community Summit in Cleveland and am glad to have her on the webcast today, is Chief of Water Resources at the City of Toledo, Ohio. She has over ten years of experience working in environmental compliance issues, and she has a wide range of experience including manufacturing, government

contracting, and municipal operations. And she has become a leader in the Toledo Lucas County area for implementing green infrastructure to help reduce their recurring flood problems. So with that, I think we have you both unmuted now, Lori and Patekka. We'll hand the presentation over to you, and thanks again for joining us today.

Patekka Bannister

Thank you so much. The great thing about technology – hopefully everyone can hear us okay. The great thing about technology is I can be in Ohio, and Lori can be in South Carolina, and we can collaborate on projects like what we're about to present here. In Toledo, we've had the wonderful opportunity to work with NOAA on using green infrastructure, and that and what I'll talk about here in a minute is not just using it as demonstration projects, but to kind of expand on that a little bit and look beyond just using it for our stormwater and our CSOs. So I'll enter the first slide.

Slide: Photo of a Flooded Basement

You'll see here some flooding issues that we have here in Toledo. We're not like other cities. Unlike other cities in the Midwest and the East Coast, Toledo has experienced noticeable changes in weather patterns, specifically extreme rain events that produce flooding issues. Here, the storms -- or sometimes, in the wintertime, we have freeze-thaw events that produce pockets of flooding, and that's scattered throughout the area. These events produce basement and street flooding, shifting foundations, business destruction and disruption, property loss, and millions of dollars in damage.

Slide: Basement and Street Flooding Complaints 2007 – 2012

On the next slide, you can see a map of our project area that Lori and I are talking about, which is one of our smaller watersheds here in the Toledo area. And you can see the data from 2007 to 2012. And in this one area, we experience chronic water in basements and standing water in the streets. So you can see how many calls that we've received from this area.

Slide: Toledo Proof of Concept GI Projects

And the next slide, when we start looking at green infrastructure locally, we began with researching or learning the concept of green infrastructure – you know, what is this concept that everybody was talking about? Then we moved to small demonstration projects, and this third step was putting large-scale projects in the ground near high-profile areas like what you see here, along a busy high-traffic roadway near the Ohio Turnpike. This is what we call our Reynolds Road Project. This type of project allowed us to look at green infrastructure construction, operation, and maintenance. Also, this project and others provided an excellent demonstration for local buy-in. And we have thousands of people driving in this area daily and start asking questions and asking for these types of projects. That was really helpful as we continued along with our project.

Slide: G.I. Volume Reduction Projects Maywood Ave, & Conrad St.

In the next slide, I want to highlight two other important projects here in our area. These are in our residential area. Our Maywood Avenue project, which was installed in 2009, and this was an American Recovery and Reinvestment Act funded project, or ARRA funding. This site

includes a four-foot wide pervious concrete sidewalk -- and these are the two pictures of the top here -- pervious concrete driveway aprons, curb and gutter, which was existing, curb cuts, and an eight-foot wide planting strip as part of the street reconstruction. The planting strips included plantings of the owners' choosing. They could choose native plants, a lawn, or trees. And what we're seeing now as far as our overflow results for this project is a reduction of about 65 percent. The pictures that you see at the bottom allowed for our next step from the Maywood project was to see if the same concept could be applied to unimproved residential streets. Unimproved streets are areas without curb and gutter that experience ponding in lawns, driveways, and streets.

This project was funded through the Ohio EPA Surface Water Improvement Fund that received dollars through the US EPA Great Lakes Restoration Initiative. Similar to Maywood, bioswales were created using planting strips, and property owners were given a choice of lawn, native plants, or, in this case, gravel parking lots. These choices were picked based on residential engagement. The goal of this project was to come up with low cost alternatives to constructing curb and gutters to address street ponding. This project was a success and is one of the flood reduction strategies that we can utilize. And Lori will talk about that in a minute. Just a comment about maintenance, when starting to put green infrastructure projects together, the long-term maintenance is really key to the success. We have looked at residential training, in-house maintenance, and contracting maintenance services. Ultimately, the maintenance on the projects in the right-of-way is the responsibility of the City of Toledo, and we keep that in mind with all the projects that we move forward with.

Slide: We need help with green infrastructure long-term planning

In the next slide, I described earlier how we started with researching or learning the concept of green infrastructure, then moving to small demonstration projects. And the third step was putting large-scale projects in the ground near high-profile areas, while the fourth and current step is where Lori and her team of experts come in. We have an understanding of green infrastructure and good projects in the ground, but now is the time to look at a city-wide, watershed-based, long-term green infrastructure plan. We need to assess how these practices are implemented and budgeted for future projects. And as we worked on our sustainability plan, these were the kinds of things that we were keeping in mind on a regional level. Now Lori is going to talk about the great work that she and her team have done to help get us started in this process.

Slide: Economic Assessment Steps

Lori Cary-Kothera

Thank you, Patekka. That was a great – oh, my gosh. Perfect timing for my phone to go off. Sorry about that. But thank you very much for that overview. I think it's very clear from the overview that you provided that Toledo currently has a flooding problem, and they are looking for green infrastructure as an option to help mitigate that problem. So where NOAA came in is we received funding from the Great Lakes Restoration Initiative to do a two-year project to work with actually two communities to help understand their flooding issues and then to see if green infrastructure could be an economically viable solution to help prevent and determine – deter some of the flooding that these communities were having. We did work in Toledo and also in Duluth. Because of the time limitations with the webinar, we're going to focus in on the Toledo example but happy to entertain questions later in the webinar if you are curious about what happened in Minnesota.

Slide: Toledo Study Area

So what I'm going to walk you through is really the seven steps that we undertook with Toledo to do this economic assessment. And the first one is really focused on defining the problem and figuring out the flooding related issues in that particular watershed. And the watershed that we undertook was the Silver Creek Watershed. It's in the northwest part of the city, and the upper part, where you see the box around Silver Creek, actually touches the Michigan state line. This watershed drains down into the Maumee River, which then empties out into Lake Erie. The watershed is about 15 square miles. So this was our study area. And then the next step was we needed to really understand both current and future flooding scenarios that were happening in this watershed.

Slide: Flood Impact Scenarios

So to do that, we looked at a number of flood impact scenarios. So the first one was really to understand what current precipitation rates were and current land use options, what the current lay of the land is. And then the next step was to look at future projections of precipitation and what future land use options were going to happen in this particular watershed. And then, after we did that [inaudible] scenarios, we were able then to look at flood reduction scenarios by incorporating green infrastructure into those options.

Slide: How much rain now and in the future

So how we started this was the first thing we had to do was determine how much rain was going to happen now and in the future. And to do this, we used EPA CREAT model, and it's got predictions for current and future precipitation results. Once we understood how much rain was going to fall from the skies, we were then – we needed to figure out how that water was going to move on the landscapes. And so we partnered up with US Army Corps, and they helped us with some hydrology modeling to give us that picture. And then finally, we needed to figure out where that flooding was going to occur and what kinds of impacts it was going to have within the watershed. And that's where we partnered up with the Association of State Floodplain Managers, who helped us do our HAZUS -- we used a HAZUS FEMA model to understand the impacts to buildings.

Slide: Flood damage costs: current

This next slide that I'm going to show you, this is actually an awesome tool that ASFPM has developed. It's currently in beta version right now but hopefully will be available on their website in the next few weeks. But they developed this tool for us to show a variety of flood scenarios, and then it automatically calculates the damages to buildings in those different scenarios. So for example, we used, in our study, we used chose the hundred year flood model and wanted to understand what the flood damages were to the building structures. And so, in this particular watershed, you're looking at $740,000 worth of damages. In our future scenario, those building damages increased, and they go up to almost a million dollars' worth of damages in just this section of the watershed. There – I think the slides are loading a little bit slowly, so sorry about that. Hopefully, you can see the slide now. But again, this is just to show the flood damages to buildings in the future scenario.

Our third step, then, was we needed to identify the flood reduction strategies that green infrastructure offered.

Slide: Many Options

So, as Petekka said, there are lots and lots of options out there, and they all have their pros and cons.

Slide: Target

And so before we got down in the weeds about which green infrastructure options we were going to choose, we actually needed to kind of take a step back and look at the flood scenario that we chose for the study. So again, we chose a hundred year flood event, and we worked with the city through an iterative process to determine that we wanted to reduce that peak flow by ten percent.

Slide: How much green infrastructure storage is needed to reach this target?

So in order to reduce the flow by ten percent, we then needed to figure out how much green infrastructure storage that we needed. So for our current conditions, we needed to have 30 acre feet of storage. And for our future conditions, we needed 32 acre feet of storage. Before I started this project, I did not know what an acre foot of storage was. So to give you a concept of how much storage that is, one acre foot is approximately 327,000 gallons of water. So it's a significant amount of storage that we are after.

Slide: What and how much of each?

So knowing that, then we need to figure out, well, of these green infrastructure options that we're interested in, how much storage do each one of these yield? And the most important question was, can we even find that volume of storage in this watershed?

Slide: Silver Creek Watershed and Subwatersheds Map

One of the things that is really helpful to know about Toledo, the municipality of Toledo, and this watershed in particular, is that it's a very developed area. It's heavily urbanized. This watershed is about 90 percent pervious pavement. So understanding that that was the storage we were looking for was an initial concern when we started this study. However, we did a number of site visits and worked with the City of Toledo and did a number of interviews and ground truthed that it actually was possible to find that volume of storage through a variety of structions (ph) and options that they had within the watershed.

Slide: GI Options of Interest

So again, okay, so we know it's possible. We want to narrow down that list. I think, initially in the study, we gave Toledo maybe 25 different options for green infrastructure. And based on the region and the soil and the interests of the city, we narrowed it down to the six that you see on the screen. So they were interested in focusing in on bioretention, blue roof, permeable pavements for sidewalks and roadways, underground storage, and then also parcel buy-out. Again, Toledo is in a little bit of a unique situation where they have a lot of tax-forfeited properties and really have a unique opportunity to come in and buy those parcels out and actually redevelop the city in a way that's maybe a little bit more flood friendly.

Slide: Step 4. Assess how much flood damages are reduced using GI

So the fourth step, then, was – okay, so now we have a handle on the options of green infrastructure and the storage we need. We need to reassess the flood damages, using green infrastructure. And are we actually able to reduce the damages using these green infrastructure techniques?

Slide: Flood Reduction Scenarios

And so, in order to do that, we had to rerun our flood model. So we, again, looked at the current precipitation and current land use, using green infrastructure, and then we also looked at the future precipitation and future land use, again, using the green infrastructure storage, incorporating that into the model. And what we found was that actually we were able to reduce the damages by a substantial amount.

Slide: How much are future flood damages

So our model showed that we would have approximately $740,000 worth of damages in this watershed, and by using green infrastructure, we could reduce those damages down to $450,000. So really pleased to see those numbers and also saw a similar trend for our future flood scenarios – so, again, reducing our damages from approximately $900,000 worth of damages down to $500,000. So we were pretty excited to see those numbers.

Slide: Step 5. Estimate costs and benefits

The fifth step is about the economics, so really trying to figure out what's the return on investment of green infrastructure? What's it going to cost to implement this, and what benefits are we going to get in return?

Slide: Costs = Flood Damages

And so, for this study, we're focused on costs are equaling – are equivalent to the flood damages that the city receives,

Slide: Benefits = Damages Avoided

and the benefits are equal to the damages avoided. So having things like rain gardens – this is actually a picture of the rain garden behind Patekka's office, so it's a really lovely area.

Slide: Toledo's Benefits

So what we found was that -- doing the economic analysis, we found that for a 20-year period, Toledo's benefit would be not spending $700,000 on flood damages to buildings. And for a 50-year period, the benefits would increase to $1.7 million not spent on flood damages to buildings. I think the take-home lesson here is that green infrastructure options, they can be a little bit expensive to implement, and it can take a while in order to see the return on investment. Our – we didn't have – we don't have site plan level designs done for this particular project, and so there were a lot of estimations used to calculate the cost of what green infrastructure – the implementation costs of green infrastructure. Using some of the options that are less expensive, that would still yield the amount of storage we needed, we were looking at a price tag of about $1.7 million for the watershed that we studied. So

essentially, you're not going to see the return – you're not going to have a break-even cost until 50 years. There are a lot of caveats with economic assessments.

Slide: You need…

And so, in order -- when you do this, and you're trying to figure out your damages and your benefits, you need to have a lot of data. You need to have data around your buildings, so the impacts that are going to happen to your buildings and your roads and your bridges and your stormwater, impacts that you may have to your recreation areas, lost wages, land damages. There's a lot of factors that can be considered when you do this kind of study.

Slide: We had…

For the Toledo part of the study, the only data that we had about cost damages were focused around buildings. So I think it's fair to say that if we were able to expand the study and include more of these datasets, that you would probably see a much shorter return on investment, much sooner than 50 years for this type of implementation strategy.

Slide: Step 6 and Step 7

So the last two steps I wanted to talk to you – I wanted to talk to them together. So step six is really to develop your approach for implementation, and step seven, communicate the assessment results. The picture that you see on the slide is actually Patekka at a workshop that we held jointly in the end of September. And during that workshop, we did a couple of things. We shared the information about the study with folks across the city as well as also Lucas County, which is where Toledo is located, the county that Toledo is located in.

We had folks from their green infrastructure taskforce that were there, and we had a number of representatives from the Ohio [inaudible] program and the Floodplain Managers Association to come and participate in this workshop. And so the morning we really spent giving an overview about some climate changes and some regional changes that they would expect to have in northwest Ohio and also shared the results from our study of what we found. We went into a little bit more technical details at the workshop. And then we broke for lunch.

After lunch, we came back and really spent the afternoon brainstorming what they want to do, the options that they want to move forward on this particular project.

Slide: How Toledo is using Results

And so just to give you an example of some of the things that they brainstormed, really wanted to make sure that they were focused on both using the money that the city provided for green infrastructure and then working with other partners to go after and then leverage additional dollars to fully realize their green infrastructure plans. They spent a bunch of time talking about the private sector. There are a number of large corporations within the Toledo municipal areas. Smucker's is one of them, and they have a very large building footprint. And so one of the things that they're exploring with Smucker's and some of these other companies in particular is incorporating blue roofs as well as other green infrastructure techniques on their site properties. So it's a really exciting public-private partnership that they're trying to undertake there. They're also working with – one of the next things that they want to do is work with the folks that live in the communities, so revisiting folks that live on Maywood and some of the

other areas that Patekka showed at the beginning of the slides, to share with them the results of the study and help encourage them to take on green infrastructure, rain gardens, localized things that they can do on their property to help. And then finally, making sure that their stormwater credit manuals are very supportive of green infrastructure and that there aren't any – they aren't creating any barriers.

Slide: Lessons Learned

I know we're running a little bit short on time, but I just wanted to highlight a few lessons that we learned in this project. And really, partners are a critical part of the success of this project. Patekka said that we worked in a team, and we did. There were folks from NOAA, but we also had folks from the City, we had folks from the County, we had the Association of State Floodplain Managers, US Army Corps, Eastern Research Group contracted to actually do the study. There were lots and lots of people involved, and I think the take-home message is that these projects are complicated, and you really need to build partnerships that supplement the skills, take advantage of the network and the resources that are out there, and figure out how to leverage those. It takes time to implement green infrastructure, so give yourself a break. It's not going to happen overnight, and build that into your implementation plans.

Slide: What's next for NOAA

And then the last thing that I wanted to mention is to look at the big picture. As Patekka mentioned at the beginning, they started with very small projects, and it was really helpful to get community buy-in and support for green infrastructure. As we went through our study, one of the things that came to light was to make sure that you're thinking about the big picture in a hydrologic sense and making sure that the projects that you're putting in are taking into consideration the hydrology and really helping to resolve the flooding problem and not actually making it worse.

And the last thing I wanted to mention is, down at the bottom of this last slide is the full report that's available right now on Digital Coast. I know it's a pretty long URL, but that's where it's available. I'm happy to e-mail that out to Eva after the session, as well, to you. The things that we're working on next, post this project, are taking the seven steps that I talked you guys through today and providing them in a high-level process guide. The target audience for that is for communities that are thinking about this process and want to get started and kind of need some questions to think about to determine if this is really the right type of study for them. And we'll continue with our outreach, doing webinars like this, and also presenting at a lot of conferences. We're still committed to working with our communities. We have about another six to nine months that we're providing technical assistance, then, to help them with implementation techniques that they chose to implement green infrastructure. And then finally, we're continuing to develop some products to help people take the information from this project and make it a little bit more user friendly.

Slide: Contact Information

And so with that, I'll just end with our contact information and turn it back over to Eva.

Eva Birk

Great. Thank you, Lori, and thank you, Patekka. That was a really great story to share, and I'm very happy it's all written up in results in a report that's shareable. So I appreciate all your hard

work on that project, and I think that's a great transition from going from that programmatic example of what happened in Toledo to a very site-specific, soup-to-nuts explanation of how to do a great demonstration project, which is what Tony and Kari will be talking about next. So thank you both very much.

Slide: Poll

And a few housekeeping comes before we move on to our next set of speakers. First, just a quick reminder that slides will be available in about two to three weeks, as well as a transcript of this webcast, on EPA's Green Infrastructure website. And then, next, before we get on to our second round of speakers, I'd like to send out a poll to the audience to see how many people are viewing our webcast today. So I just launched the poll. We'll take about 20 seconds here to have folks punch in, and then we'll be sending the presentation over to Tony. All right.

With that, I'd like to introduce our next speakers, Tony Demasi and Kari Mackenbach. Tony Demasi is the City Engineer for the City of Cuyahoga Falls, Ohio, and his responsibilities include the oversights of the design and construction of all public improvement projects, including roads, bridges, sewers, and water lines.

Slide: Rain Garden Reserve, Managing Flooding with Green Infrastructure Solutions in Cuyahoga Falls

And as a floodplain manager, Tony reviews all site plans located in central flood hazard areas and coordinates such activities with Army Corps of Engineers, Ohio Department of Natural Resources, and Ohio Environmental Protection Agency. Tony is a member of the Akron Metropolitan Area Transportation Study Technical Advisory Committee and Transportation Improvement Plan sub-committee and the Northeast Ohio Four-County Regional Planning and Development Organization. And on that organization, he sits on the Environmental Resources Technical Advisory Committee. And with Tony today presenting will be Kari Mackenbach. And Kari is currently the National Green Infrastructure Practice Leader for URF Corporation, and she coordinates the efforts of the practice across the US. She's responsible for the overall quality of the practice related to work performed by the URF's Green Infrastructure Practice Group, and one of her key responsibilities is to leverage lessons learned from other cities across the country on green infrastructure design innovations, new operation and maintenance strategies, and work to standardize these approaches across the country. Mackenbach's background as a board certified Environmental Scientist, a Certified Floodplain Manager, and as an American Rainwater Catchment Systems Association Accredited Professional provides her with a unique capability to work with communities and other professionals on multiple levels as it relates to sustainability and, more specifically, green infrastructure initiatives. So again, thank you, Kari, and thank you, Tony, for taking the time to present with us today. We're very excited to hear the details of the case study you've developed in Cuyahoga Falls.

Kari Mackenbach
Thank you, Eva.

Tony, if you want to go to the next slide, I think she did a good enough job introducing us. Thank you so much for that introduction.

Slide: Presentation Topics

I wanted to talk today to everybody about some of the presentation topics we're going to cover today. Some of the things that we're realizing, both nationally and more on a local level, like in Cuyahoga Falls, is the connectivity of green infrastructure and flooding. How are they connected, and how can we use our resources appropriately enough to address both? We're going to cover the project of the Rain Scape Rewards Program – I'm sorry, the rain garden in Cuyahoga Falls, the background there, the process followed, the benefits that we saw, both very short-term and long-term. We're looking at this project being in the ground for over six years now, so there's a lot of great lessons learned that we've gathered over time. Some of the obstacles, and lastly I'm going to cover some local and national lessons learned. Okay.

Slide: The Rain Garden Reserve

So one of the great things about this project that I love is I was first a Certified Floodplain Manager before I became a green infrastructure expert, and I always saw the connection, but it was sort of hard to explain to folks that stormwater and floodplain management is connected. And so this was a great case study and example for people to use across the nation to look at how can we look at traditional solutions to floodplain management and use innovative approaches?

Slide: How is Green Infrastructure & Flooding Connected?

This was the first project – whoops, Tony, you're going a little fast. That's okay. This was the first project for FEMA Region 5 approved using green infrastructure. I remember them saying they weren't even sure this was going to work, so it's awesome to see in demonstration that it was working. The results of many months of planning and public meetings, funding applications, and construction have created this great project and example that everyone can benefit from.

So onto the slide that Tony has in front of us now, one of the things that we're seeing with urbanization is urbanization has dramatically changed the effects of how our watersheds function. Regulatory requirements like the National Pollutant Discharge Elimination program, as well as the NFIP, already require us as communities to do certain things. The goal is – or the question is, I guess, is, is that enough? And can we try to solve our stormwater and floodplain management problems collectively with innovative solutions? Next slide.

Slide: Can GI Solve Localized Flooding?

Okay. So green infrastructure is not going to fix the hundred year flood. Okay. That's the reality. But green infrastructure, you know, the National Flood Insurance Program and the delineated floodplains are there for a reason. But green infrastructure, I believe, and I think all the speakers who are on here believe, can dramatically affect the one- and two-year storm events, which are causing the most damage to our natural infrastructure and waterways. Our streams, our rivers, all of those are dramatically impacted by those small events. And if we can mitigate those small events with green infrastructure, this helps further provide resiliency for our natural infrastructure and, if you will, we're doing something right if we're doing that. Next slide.

Slide: Distributed Stormwater Controls Close to Runoff Sources

So the goal of green infrastructure is not to entirely replace traditional infrastructure. In fact, we can look at the existing infrastructure – if you see the description on your left that shows how we've mitigated or how we've managed stormwater in the past with traditional solutions such as detention basins. The goal is to figure out how to cost effectively poke holes in the plexiglass of our watersheds that will help us promote infiltration and eliminate the strain on our existing infrastructure such as the detention basins. Cuyahoga Falls is a great example of how, early on in the movement of green infrastructure, we were able to look outside the box and come up with innovative and cost effective solutions for stormwater and flooding problems. And I think this is – Tony is going to now go over some of the very detailed information about how we got started on this project and this rain garden reserve effort. Tony, I'll hand it over to you.

Tony Demasi

Slide: Project Location

Thank you, Kari. I appreciate it. I'd like to give a little bit of background on Cuyahoga Falls. Cuyahoga Falls is located in northeast Ohio, just north of Akron. We have a population of around 50,000 people. We've been named Tree City USA for over 25 years, and we're very proud of that achievement. That's not an achievement that's comes quite lightly. We put a lot of effort into that every year. We're well known for our park systems. We have 24 neighborhood pocket parks, an 18-hole golf course, a natatorium, and an outdoor family aquatic center. We're big recyclers here in Cuyahoga Falls. We encourage our residents to separate trash and recyclables, using 96-gallon fully automated carts. And when you do that, residents that participate will get a monthly credit. And just this year, we also provided 96-gallon yard waste carts. Very popular program. You can put your grass clippings, your sticks, leaves into that, very, very popular. And in 2009, we were ranked as one of America's top 100 places to live. So all in all, a pretty nice place to live, I think.

Slide: Project Area

In 2003 and in 2004, severe storms hit the city, and the city was declared a federal disaster area after both events. The 2003 event alone produced six inches of rain in just 12 hours, causing over $1 million in damages citywide. Following these events, the city completed some great solutions, such as replacing old pipe with larger pipes of greater capacity, and we looked at green solutions. In particular, we focused on a residential area that had sustained substantial damage during the flooding events. This area had a total drainage area of about 111 acres.

Slide: History of Flooding

One area of six homes in this neighborhood alone sustained over $100,000 in damages. And these homes had documented damages going back to 1999. This neighborhood was built in the early 1950s, and it was designed for surface water to drain towards the back of the properties. But then it had nowhere to go. It was simply a place for water to accumulate, causing property damage. This water that drained here was only from the property. No roadway water drained to this area. Of the six homes experiencing repetitive losses, four agreed to participate with the program -- or with this particular project.

Slide: What the typical allowable use was after using mitigation dollars from FEMA

So what are the typical types of allowable uses for mitigation projects? In 2005, the city applied for FEMA mitigation moneys to purchase these properties. However, we wanted to go above and beyond the standard mitigation. We wanted to improve the area in an innovative way to provide stormwater management while at the same time installing some green infrastructure. This meant combining open space, recreational, and stormwater or floodplain management.

Slide: Allowable Uses

Typical allowable uses within an area that has used mitigation dollars requires that the land remain open. Under the Stafford Act, any land purchased with Hazard Mitigation Grant Program funds must be restricted to open space, recreational, and wetlands management uses in perpetuity. Most often, a local government takes responsibility, but if a state or federal agency takes ownership of the land, the deed restrictions still apply. One of our biggest concerns we had was that this site was literally right in a middle of an established neighborhood, so could we do anything after these houses were removed to continue to promote continuity in the area?

Slide: Benefits of the Project

This is when we started looking at innovative alternatives to the traditional solutions provided by FEMA. We wanted a project that provided controls to relief flooding, reduced impervious area in the neighborhood, and provided additional storage for rain events. We wanted a project that we would be able to show developers that a best management practice could be integrated with a stormwater management device to increase water quality and provide flood control. We wanted a project that provided us a showcase for green infrastructure and how it works. We wanted to be able to create another neighborhood park, and we wanted to add another tool to our toolbox of available solutions for both stormwater management and BMPs.

Slide: Debunking Myths/Public Outreach

One of the first things we had to do was debunk the myths that were out there. No one had done this before in FEMA Region 5, let alone could we find any examples of similar solutions implemented across the country. Not only did we have to work with greater public interests, but we had to focus on how this project would directly affect the adjoining neighbors next to the reserve. We heard it all. We heard that this solution won't work in the middle of a neighborhood, won't work in the winter, rain gardens are ugly. So we had to work through those myths one by one.

Slide: Myth

An example is that they won't work in the winter. Surprisingly, this was one of our biggest concerns -- flooding during the winter, imagine that. While it may be true that rain gardens work best in the summer, because of the deep roots and fractured soils caused by the plants we chose, water was still draining to the sub-soils during the winter months. We worked with the adjacent land owners to show them how the system worked and also showed them how the system worked if it received too much water. An overflow pipe was part of the overall design. We are now entering the seventh winter with this rain garden, and we've not experienced any problems with prolonged standing water during the winter months. So they do work.

Slide: Mosquito Traps

We don't get this question that often anymore, but this was almost a deal killer for the project. The general public – this is about mosquitos. The general public have misconceptions about what green infrastructure was and how the system was designed to infiltrate 24 to 48 hours. A little education went a long way when it came to this topic. When a rain garden is properly designed and constructed, they actually become mosquito traps. Remember that rain gardens are designed to drain quickly, typically 24 to 48 hours. While mosquitos may lay their eggs in some standing water after a rain event, this water will be gone before they had any chance to complete the transformation from larvae over to mosquitos.

Slide: Visualization was Key…

During public meetings, people wanted to have an idea of what the project would look like. I've been to many public meetings – I'm just waiting for the screen to catch up. I've been to many public meetings as a city engineer, and the one thing I've learned is that you can't always lay out the engineering drawings and expect everyone to understand them, let alone be able to transform that drawing into an image in their head. So being able to see what the end result would look like was very important to receive buy-in for the project.

All the misconceptions that we were building a wetland or a detention basin were laid to rest when the visual pictures of the end result were presented to them. We even allowed the residents to help pick the plant palette for the rain gardens.

Slide: Designing the Raingardens

Many factors went into the design of the rain garden. We looked at not only the size of the watershed feeding into the garden – in this case 3.11 acres – but also the soil types, slopes of the yards, and what type of groundcover was present in the watershed, such as grass, concrete, asphalt, or wooded areas. This area was determined to have a 50 percent impervious area.

We also had to choose a storm event to design to. Typical rain gardens generally hold and percolate 100 percent of the impervious water from a one-year event and 75 percent of a two-year event. For our area, that meant we needed to design for an event between .907 and .99 inches per hour, which produced a runoff into the garden of between 1.1 and 1.2 cubic feet per second. Since this would be a combination stormwater management tool and a best management practice, we needed to provide a pipe outfall for those events that produced water in the garden greater than eight-inch depth. This was done by installing a ten-inch outfall pipe that would provide flood relief for these storms. Using all of this data, the final design we ended up with was a garden a little over 6,000 square feet.

Slide: Project Implementation

The project began in early 2008 with a local non-profit, called Habitat for Humanity, recovering some of the items from the homes to be reused on other projects. The basement excavations provided depressions in the ground that, in fact, made the construction of the garden much easier. Basically, our hole, our depressions were already built for us. We didn't have to shape them out. We next installed the overflow drainage and amended the soils so that they would accept the new plants. That was very important. We had to make sure that the soils were the right soils for these plants that we were installing.

Slide: Infrastructure Improvements Spring 2008

The construction continued throughout the spring, with the walking paths and the storm sewer outfall. A curb was added to define the rain garden limits so the maintenance staffs knew very clearly where to stop their lawn maintenance activities. We went back and forth on the curb design during design, wondering if the surface water was going to be able to make it to the rain garden. But after six years of service, it seems to be working just fine.

Slide: Planting Spring 2008

We chose very specific plants for the garden. We wanted plants that could be maintenance free and could handle both long periods of drought and occasional flooded conditions. Their roots could extend down several feet, providing additional infiltration benefits. A lot of time went into deciding where the plants would be located and how close to one another they would be so that they wouldn't crowd other plants. It's very important to have someone such as a landscape architect on the team to provide advice on the plant sites and spacing. It takes all the guesswork out of the equations.

Slide: Finishing Touches

Since this was going to be a showcase for us, we wanted to add additional features to the project that would be examples of the types of improvements we would like to see in other developments throughout the city. We added pervious sidewalk, both concrete and asphalt pervious sidewalk, as an example of how you can lower the impervious area on a property. We added solar bollards which don't cost anything to operate and provide a safe walking path at night while not being too bright for the neighbors. And developers are taking note because we've started to see these types of features in various other projects throughout the city.

Slide: Open for Business

And so the rain garden was completed and opened to the public on Arbor Day of 2008. To commemorate the event, we planted a swamp oak tree. It seemed appropriate even though we abated the problem. The park has seen many visitors, including EPA tours and school outings. And in this photograph here, you can see a couple of small additional rain gardens that we built on the project. So we have the big main one, as you can see in the background, at 6,000 square feet. And that's a kidney-shaped. But we wanted to show developers that there's opportunities to build smaller ones of different shapes. We have an oval one and a round one there, as well.

Slide: Summer 2014

So now let's fast forward six years, and let's see how the park is doing. As far as maintenance, we estimate less than $700 a year in maintenance cost, and really that can just be attributed to some additional mulch that is needed from time to time to refresh the garden. We do a really good job of removing plants that are not on the list, not on the plant list. If you're not on the plant list, you're not invited to stick around for the rest of the year. You will be removed. It's very important to remove those invasives. Another important feature that we've noticed is that there's no watering needed for the rain garden. These plants are tolerant of both wet conditions – you know, the garden could be underwater for a day or two and then drain – or we could have two to three weeks of no water, and it appears to be drought. But these plants that we've chosen really do well in both of those types of conditions.

Slide: Fall 2014

Here are some photos from this fall. As you can see – waiting for it to catch up. Here it is. As you can see, we have plant bloomings that occur all season long, which is good for a deep, deep root growth and nutrient uptake. So that's telling us that it's working as a water quality tool. This year, it seems like we're having – most every year now. We had another big storm event on May 12th. This one was pretty monumental. We had four inches of rain in 45 minutes. And while the city as a whole suffered severe damage, both on the private and the public sides, including nine homes that had to be condemned and two of those demolished, we had no reported stormwater damage in this neighborhood. So that's telling us that it's also working as a water management tool. So we could have just simply built a detention basin in this neighborhood. It would have been ugly. It would have been functional, but it wouldn't have looked nice at all. But we wanted to go above and beyond and make it a combination tool, and we believe that we've certainly succeeded in that.

Slide: Lessons Learned Locally

One of the biggest things we've learned during this project was that subsurface investigations are very important. We found, during construction, a perched water condition that caused us to redesign the garden to accommodate the shallow groundwater. Now, you know, had we done some additional soil bore-ins, we probably would have found this then, and we could have designed for it. So we would have had to still deal with it either way, but it would have been nice to have to know about it ahead of time. So that is something that I recommend, is do a really, really good job of knowing what your sub-soils are out there.

Maintaining the garden is not unlike maintaining other parks in the city. So the staff training on how to maintain this type of feature is very, very simple. Keeping the public engaged early in the process and throughout will help promote a stakeholder type of mentality that will be very constructive. Let everybody have a say. Hold your public meetings and not be afraid to listen to them, to their ideas, and incorporate those into the final design. And so we were able to show that, by the use of this type of green infrastructure, we're able to abate an otherwise stormwater management problem while also providing some water quality benefit, as well. And Kari, I think I'll throw it back to you.

Kari Mackenbach
Thank you, Tony. Well, last couple slides here, folks.

Slide: Lessons Learned Nationally

And I think what this case study provides us is demonstrating that floodplain management and stormwater management are intimately connected. We're all starting to look closer at watersheds and the connectivity of watersheds, and I think, as we look at innovative solutions that are cost effective, we're going to really help our overall bottom dollar line, if you will, and also come up with some neat solutions. Number two, another lesson learned that I think this really helped to demonstrate, both locally and we're seeing nationally, is the resiliency strategies should be connected to the local infrastructure. You know, there's a lot of money being spent on hurricanes and evaluation of coastlines and all that great stuff, and one of the things that I like to say is, looking at resiliency strategies that address our local waterways and infrastructure is one of the best ways to be resilient against those big storms. If your natural infrastructure can bounce back after those events, you're better off.

Green infrastructure can be a cost effective solution for flooding and stormwater management. I think sometimes the jury is still out on this one, but this example in Cuyahoga Falls, which is over six years old now, and the city of Toledo, and there are many, many, many examples out there that green infrastructure can be cost effective. And it's just a matter of picking the right types of solutions, and what is that long-term benefit that you're trying to get. So, Tony, if you want to go to the next slide.

Slide: Questions?

I think, with that, we're going to wrap it up a hair early. So if there's any questions, I'll hand it back over to Eva.

Eva Birk
Great. Thanks, Kari. And thank you, Tony. That was a great presentation and a great soup-to-nuts description of how you get a successful demonstration project in the ground.

Tony Demasi
Sure. Thank you.

Eva Birk
So we're going ahead and unmuting all the speakers so we can have a full discussion with Kari, Lori, Petekka, and Tony. And while we're doing that, we had I a quick question for Tony and Kari. We saw in the pictures here, we have a few questions on the fact that the rain gardens have a small, very low curb around them. How does water get into the rain gardens when there's that curb element there?

Tony Demasi
Yeah, I can take that. This isn't your typical curb that goes down 18 inches into the ground. It's a real shallow curb. The purpose of it, again, was just to define the limits of it, to keep the maintenance staff aware of where they need to define their work limits. During real heavy events, water will still flow over the curb. And then during just your normal events – I say normal – your normal events, water tends to go underneath the curb and enter the garden that way. So it's still getting into that permeable sub-soil that we've amended there – we put some very permeable soil, so it is still functioning.

Eva Birk
Great. Thanks for clarifying that. And our first question for Lori and Petekka was on the public engagement portion of the project that you described in Toledo. So when you did roll out the results of your initial study and you did the community engagement piece, did you have any lessons learned on what information was more accessible than other types of information or what the local elected officials responded to most? And looking forward towards implementation of a green infrastructure plan, is the community now demanding any different types of information that you wish you would have included in the process in modeling, say, the front or just general lessons learned in terms of format of information and presenting that to the community.

Lori Cary-Kothera
Petekka, would you like me to start, and then you can fill in from your perspective?

Petekka Bannister
Sure. That's fine.

Lori Cary-Kothera
Okay. I think, just taking a step back, one of the things that I didn't mention in the overview was that when we selected the cities for our study, we wanted to make sure that the cities were actively engaged in the process all the way through. And I think that that really made a difference because – you know, I think this team did an amazing job at tracking down so much information for us. There were a lot of models. There was a lot of data that was collected. And they were great in helping us find it, and we would have never been able to get that sort of information if we had not been partnered up with the City. I think the other benefit that it had from our perspective was that Petekka was really great at getting key stakeholders engaged from day one. She had their commissioner involved and the heads of several departments in her program that worked with us. And so they are part of the process all the way through. So it made it, when it came time for sharing the results, they weren't a surprise for most of the folks there and were really, at least from my perspective, a little bit more ready to jump into the implementation phase. And I don't know – Petekka, do you want to add anything to that?

Slide: Speaker Contacts

Petekka Bannister
Yeah, I mean, really, when Lori and her team came on board, you know, we shared with them that we're very data rich. We have a lot of information. But, you know, we need someone to kind of go through it and help us put that information together so that we can make decisions. And one of the last workshops that we had, Lori had these big huge questions on the board, and people went around and voted. And one thing that kind of confirmed for us is the types of green infrastructure that people were interested in. We didn't have a lot of people that are interested in cisterns, and I'm not sure if that's because we don't have as many demonstration projects or because people are concerned about the large size or, you know, any other issues dealing with cisterns and that type of green infrastructure. They're more interested in conservation areas and tree planting and bioswales and rain gardens. So those are the kinds of information that's important for us as we're making decisions. And also, our next step, Lori kind of talked about the technical assistance from here on. And part of that is some of our social media. We don't do a very good job with that, getting our message out, so that's one of the things that we're really going to key in on, and updating our outreach materials for the young kids, all the way up to our seniors in our community.

Eva Birk
Great. Thanks, Petekka, and thanks, Lori. That's a great overview of the nitty-gritty details, when you get into what works and what doesn't work for a community engagement, especially around green infrastructure. So I appreciate you guys sharing the place that you're in now with moving forward with a green infrastructure plan. So thank you for that. Speaking of different BMP practices and ones that are more well-known, more accepted, less well known, less – just less accepted because they're maybe not so well known yet, we had multiple, multiple questions about what is a blue roof? And so we're wondering if you could just give us a quick description of what is a blue roof, and why should we care?

Lori Cary-Kothera
Yes. So blue roofs are – they're a really great green infrastructure technique for urbanized areas. And so the way that a blue roof works is they're designed – they're sort of like a square,

a grid type that you put on top of the roof. And each one of the squares have a tray, and they can hold up to eight inches of water in the surface. And the benefit of them is that they can hold the water and then let the water slowly drain into the landscape. So they sort of act as a temporary storage so the water is moving at a little bit slower pace into the environment.

Kari Mackenbach
New York City promotes them quite a bit.

Eva Birk
Excellent. Thank you both. So before we have maybe one or two questions for the entire group at the end, I wanted to zero in on Tony and Kari for a moment. We had a few questions about scaling up from such a great demonstration project, like the one you demonstrated with the green infrastructure rain garden pocket park. Once you've had that success and you're ready to move forward, maybe talk about getting the information to maintenance staff on your public works crews, getting information out to residents. Once you have that first success, what's your plan moving forward, using the lessons that you've learned, to upscale that first demonstration project? And do you have any – is there any information that you don't have now that you need to get that next phase off the ground?

Tony Demasi
I think we have everything that we need. We're always learning something every year from this project. We're monitoring it, and we're learning what's working and what's not every year. So we're building on that type of information. I recall the mayor at the time when this first went in had a vision that we would have hundreds of these rain gardens all throughout the city. As it stands, we did have some areas that, as I mentioned earlier in my presentation, in May of this year, that experienced some severe flooding. In fact, we're going to go ahead and purchase two homes and demolish them. We're using some land bank money here from the County to do that. And when we do that, we're not just going to leave a bowl. We've already told city council, the administration, that we're going to be doing there, at these two locations, what we did here, whether it's a – now it might not be a rain garden, but it could be a bioretention system. But it will be something where it will not only resolve the flooding issue that happened in those particular neighborhoods, but it will also add to the water quality benefit that is desperately needed here. We are a Phase Two community, and everything that we can do to promote water quality into the Cuyahoga River will certainly help.

Kari Mackenbach
Just a real – an extra little recap on that, Eva. One of the great things about Cuyahoga Falls is, you know, they are a good example for a smaller-sized community to say look at what we can do with our resources that we have. And one of the biggest concerns we hear all the time is operation and maintenance, operation and maintenance. And when Tony told me how little it was costing to maintain this park, I was floored -- $700 a year. And now, granted, they have pocket parks, and their maintenance crew sort of knows the drill and – but still, that's important to realize. Six years later, they are really – the cost of the park is paying for itself.

Tony Demasi
Yep.

Eva Birk
Great. Thank you both, Tony and Kari, for that explanation. And I think that's a lot of good lessons learned because there's a lot of communities across the US that have just started with

that one great demonstration project, and they're planning on scaling up. They're kind of jumping off the cliff. And you seem to have a great plan together and are using results from this first project to move forward, so I think that's a great case study to have out there and to share nationally. So thank you. A few questions that we had coming in specifically for Kari and Tony are just questions having to do, again, with how you receive funding from FEMA to help this project along. So we know that you did have a repetitive loss area, and how did you go from having a repetitive loss area to receiving FEMA grants or loans to either just remove structures or actually build on the site?

Tony Demasi
Yeah, that was a very long process. If anybody has ever attempted to get mitigation funds, we have – I have a binder here, it's about a four-inch binder. That was the application. So that was fun. But these homes, although they're not located within a special flood hazard area, they do – they did have flood insurance. Flood insurance is available to anybody. You don't need to be in a special flood hazard zone to obtain that. And because of the history of repetitive losses out here, these homeowners talked to their insurance companies, and they purchased the FEMA insurance. Well, FEMA was paying them almost on a yearly basis for their continued losses. And so that was really helpful to us. When we approached FEMA, when we approached the State of Ohio EMA about considering purchasing these homes, using mitigation projects -- money, having that history of payment from FEMA over and over and over again really helped our cause. I don't – I think it would be difficult to try to get that type of money for a property that was just getting flooded, but they didn't – but there was no previous federal money being dispersed into it. So we're very grateful that these property owners did what they did. Their bookkeeping was phenomenal, their records, and so a lot of effort that we had to – and again, we talked about storms that happened in 2003 and 2004. We put the application together in 2005, and we got the funding in 2006. So you need to be diligent. You need to stick with it and work with the property owners to get all the records that you can.

Eva Birk
Okay. Great. So I have – we have plenty of time left, and so I think what we'll do is just have one or two more questions just for the entire group. And I see a little – the operator will make it off to see who wants to answer first, but we can just go with the flow. And the one question that we had rolling in from a few different audience members was how did you address different – or how are you addressing, within these two communities, Toledo and Cuyahoga Falls, different types of flooding? You know, you have, like we mentioned at the beginning of this webcast, the overbank or riverine flood events that happen in the floodplain and are typically larger events and have certain effects and certain ways you can mitigate them. And then there's the different issue of small neighborhood or "basement back-up" flood events that something like this rain garden pocket park would – is working to address. So when you are looking at your entire program management objectives, do you have separate ways that you model and use green infrastructure to address the overbank flooding versus neighborhood or basement back-up flooding? Have you seen communities respond to installing one over the other? And have you had success with both or just one? So that's a pretty packed question, but I'm hoping that we can just delve into the issue a bit more of different types of flooding because we know that green infrastructure across different scales, larger and smaller, can help those two different types. Who would like to take a stab first?

Petekka Bannister
Well, this is Petekka from Toledo. When Lori and her team were looking at the data that we had – and that goes back to one of the first slides we had, and you can see the map. And our biggest issue is really the wet basements, the water in the streets when we have -- in the wintertime, when we have our freeze-thaw, when we have big piles of snow and they melt. So those are the ones that we really concentrated on in this study and the ones that we focus on here in our area because that is our biggest chronic issue, is the wet basements. And on our Maywood that's one of the reasons why that area was chosen, that street was chosen, because of the wet basement and the water in the street issues that they had. That is a small area. It's an actual two-block area. So the green infrastructure strategies that we used with the sidewalks and the bioswales was specifically designed to address those issues.

Eva Birk
Great. Thank you. And then one question we just got in was, what type of modeling did you use to address the – what modeling tools did you use to address that neighborhood basement back-up issue? What do you use, like SWMM? Which type of stormwater model?

Petekka Bannister
I don't recall. I think, Lori, do you remember? Did they use SWMM's, SWMM model?

Lori Cary-Kothera
I think we used a little bit of that, but it wasn't as much of a focus. We really – even though – the way that we did the study, even though the standing water was the big issue for Toledo, we were really modeling riverine flooding and the riverine overfills and trying to focus on reducing that volume of water. It was just a little bit easier with the tools that we were trying to use to do it that way. And so the logic was that if we can reduce the volume through the storage mechanisms, that that will then help to decrease the flooding events. And so a lot of that list that we showed, a lot of the green infrastructure techniques that Toledo was focused on really are around techniques that can absorb water and store it and then release it more slowly into the environment. So that's where the blue roofs come in and the underground road storage and some of the bioswales were really targeted to be able to stock up that water to help prevent some of the basement flooding and the standing water issues.

Eva Birk
Great. Thanks, Lori, and thanks, Petekka. And Tony and Kari, do you have anything to add?

Tony Demasi
Yeah, let me just say, for Cuyahoga Falls what – another positive that came out of those 2003, 2004 storms was our stormwater utility that was developed. We've actually always had a stormwater utility, but it was never funded. So as far as stormwater projects, those were probably about 100 to $120,000 annually, and that always came out of the capital projects fund. So we were really limited to the amount of projects that we could complete every year. But because of those storms, we took advantage of that -- and the city council -- and got a rate approval. So now we generate close to $1 million a year in revenue through our stormwater utility, and that's based on impervious areas for both residential and commercial. It's essentially $3 per month per unit, and a unit is considered 3,000 square feet of impervious. So now we went from $100,000 a year to $1 million a year of cleaning our storm sewers, disconnecting clean water connections to our sanitaries, which can cause back-ups, building some of these detention areas or green infrastructures, as well, pipe replacements. So that's been a huge, huge program for us, and we look to move that forward. Now, as far as overbank

flooding, we've sort of tried to handle that through our ordinances. We've instituted a riparian setback ordinance a few years ago, so any developments that occur in our rural part of our city that has some ravines and some waterways, those developments do need to maintain the riparian setbacks away. So we're going to still allow the rivers and creeks and streams to flood as they've always done, but they won't be near any homes. So that takes care of all the new projects. And then here in town, obviously, all the old rivers and creeks and streams are basically in storm sewers that were basically built hundreds of years – a hundred years ago. So for those, we need to find some green solutions like we did here that will basically take some of the stormwater offline, out of the stormwater system, and infiltrate it into the ground and provide flood relief for our stormwater systems.

Eva Birk
Great. Thanks, Tony. That's a good perspective to have, where you have certain management mechanisms that are going to work just for one problem, certain funding mechanisms that work for both, and balancing that. Makes a lot of sense. So Kari, do you have anything to add before we wrap up?

Kari Mackenbach
Well, I just want to say this was one of my favorite projects, and I'm not saying that just because Tony is on the line, but it was a great project. And I will say this. Being – I cut my teeth in this world as a floodplain manager at a local county. So I know full well how emotional flooding is. It's a very emotional thing. It's a very you lose everything type of feeling. And so being able to take stormwater mitigation ideas that are innovative, like green infrastructure, that have a good face to them, and being able to provide that as a solution to maybe some localized flooding, you know, the only other alternative that I would have seen that we would have done here is do nothing. And so you buy the houses, you leave it open, and then every time a person drives by there, they see a vacant hole in this established neighborhood. So we were able to take innovative solutions like green infrastructure and apply it to something that wouldn't have had an alternative otherwise than just open space. So I know that FEMA and NOAA and all the other great – all the other agencies out there, being able to cross-connect your solutions like this is something that should be further promoted. And I know you guys are doing that at the EPA, so thank you.

Eva Birk
Great. Thanks, Kari. I couldn't have wrapped it up better myself. That's definitely – thank you for sharing that. So with that, I think that about wraps it up. I'd like to thank Lori, Patekka, Tony, and Kari for joining us today and all of our participants for listening in. And I did also want to add, while we have everyone's contact info up on the screen, and we also put a resource that we just put out here, here at EPA headquarters.

For your reading enjoyment, on the bottom of the screen, this is part of a new website we have reflecting how you can use green infrastructure to build community resiliency around climate issues, using green infrastructure. And the website that we've highlighted here talks about that in the specific context of flooding, and it does break down what we talked about today in terms of localized flooding can be a reflection of overbank and riverine events as well as basement back-up events, and how different sized green infrastructure practices can help you with those different problems. So go ahead and check out that website.

Check out the NOAA report that Lori mentioned. I've read it. It's a great report, has great granular examples, and it's definitely useful if you're wanting to start a similar green infrastructure program in your community.

And also, we'd love to have you join us in 2015 when we kick off next year's green infrastructure webcast series. So you can stay tuned for alerts and dates and speakers for next year's series by joining EPA's green infrastructure list serve called Green Stream.

I know that a lot of you are already on Green Stream because you tuned in today because you had an e-mail from us through Green Stream. But if you are not, you can join our list serve -- which we don't tend to spam folks out information on too often -- by sending a blank e-mail to join-greenstream@lists.epa.gov. So make sure to do that if you haven't already.

And thanks again to all of our speakers today. And this ends our webcast. See you next time. Bye, everyone. Thanks.