

## Climate Webinar June 2015

Thank you all for standing by and welcome to our webinar entitled A Tale of Two Cities, Assessing Green Infrastructure Costs and Benefits in Toledo, Ohio and Duluth, Minnesota. These webinars are an initiative of the Ohio State University Climate Change Outreach Team, a multi-departmental effort within the University led by Ohio Sea Grant Office of Research, Ohio Super Computer, [unclear :24] and several other OSU departments to help localize the climate change issue for Ohioans and Great Lakes residents.

I am Jill Jentes Banicki from Ohio Sea Grant and Stone Laboratory and joining me today are two experts within the National Oceanic and Atmospheric Administration, Lori Cary-Kothera and Tashya Allen. Lori is the Operations Manager for the Science and Geospatial Services division at NOAA office of Coastal Management. She works on a variety of projects helping local coastal resource agencies better utilize technologies including GIS and social media. Also joining us today is Tashya Allen, a coastal hazard specialist working for the [unclear 1:08] Group at the NOAA Office of Coastal Management. Her background is in community based risk and vulnerability assessment. She also specializes in development of decision support tools for hazard management and community resilient planning. We are delighted to have both of them here today to talk about a few case studies. This is a part two implementation and assessment to a May, 2013 webinar that they did several years ago so we're really excited to have them back.

Before we get started, a few logistical issues. During our presentation, all participants will be in a 'listen only' mode. Afterwards, I will conduct a question and answer session. If you would like to ask a question during the presentation, please feel free to use the chat feature located on the right hand side of your screen and I will collect and post questions out to Lori and Tashya at the end of their presentation. We have nearly 200 participants on this webinar so far, a great diverse group representing governmental agencies, academia and nonprofit groups from the Great Lakes region and around the country. Please keep those questions coming throughout the presentation and we should have a great Q&A session. As a reminder, this webinar is being recorded and will be posted onto our website for later viewing. Also we will post a webinar survey in the chat feature towards the end of the hour. Please take a few minutes after the webinar to fill out that survey. It will help us to continue to bring you better webinars.

So without any further delay, I'd like to introduce Lori Cary-Kothera and Tashya Allen who will present A Tale of Two Cities, Assessing Green Infrastructure Costs and Benefits in Toledo, Ohio and Duluth, Minnesota. Lori and Tashya, you should be good to go. You are muted.

Lori: Thank you Jill. Can you hear me okay?

Jill: You sound great.

Lori: Great. Thank you. Well thanks everyone. This is Lori Cary-Kothera and we are delighted to be here and to be invited back to share some of the results. The first time that we did this webinar a couple of years ago, we were overwhelmed by the interest as well as the questions that you all asked us, so hopefully we're going to be able to answer those questions for you today and really working hard to take some time at the end to answer any additional questions that may come up as well. We've put our hashtags if you're a Twitter user. We have a hashtag for our office down in the bottom left corner of the screen, as well as my own personal Twitter handle as well too.

So with that, today we're going to be focusing on sharing the results from two projects that we worked on over the past two years and we call this type of presentation "The Tale of Two Cities" and so what we really tried to do with this project was figure out is green infrastructure a viable option and how communities deal with the flood issues they're facing and we looked at the current and future scenarios to do that. So the areas that we focused in on were Toledo, Ohio and Duluth, Minnesota so I just wanted to give for those of you who might be geography challenged, Toledo is on the shores of Lake Erie and Duluth is on the shores of Lake Superior. Both have significant flooding issues.

Tashya: Hi, this is Tashya Allen and I'm going to tag teaming with Lori because we thought it would be more interesting than hearing some single person go on and on. I also participated in the study and the study is really for planning purposes. We conducted this to help inform green infrastructure strategies at communities [unclear 4:48] and also provide economic backing for the use of green infrastructure to help reduce flooding that communities often need and so it's really for planning purposes and when a community is ready to implement their green infrastructure strategy, then a more detailed modeling and engineering phase would need to be done to help determine what green infrastructure, how much of it and where it needs to go.

Lori: Well our tale is going to start in Toledo, Ohio and the image that you see is from a couple that live in the area and as you can see, their basement is flooded. They not only have standing water that's fairly a significant amount of standing water, but there's also some debris floating in the basement as well. If you look closely on the wooden posts, you can see that there are water marks indicating that this is not the first time that they have been flooded. This is a chronic problem that citizens in Toledo are facing. Citizens are dealing with this issue and how it affects them and their daily finances and the City, it's a huge issue for the City staff as well. When we began the project, the City of Toledo shared with us this map that you see on the screen now and that's over a five year period and it highlights all of the complaints, the standing water complaints that they've had in regard to basement flooding and street flooding. So you can see it's a fairly significant issue and each one of those calls represents something that the City has to take action for. They need to go out and investigate the complaint and hopefully try to find a solution to help mitigate it as well.

Tashya: This is what Duluth citizens woke up to on one June morning in 2012 and the story is a little bit different in Duluth. Toledo has a lot more nuisance flooding, a lot more localized flooding that occurs. In Duluth, they don't have that problem as much. It's more about the extremes that do happen and so in June they had, [unclear 6:54] storm that caused major damages and a lot of it had to do with there was just too much water too quickly, too soon, overwhelming the storm [unclear 7:06] infrastructure systems and the water coming up through the street. We were really interested in working with the City of Duluth so it could also have green infrastructure to help reduce some of the more extreme flooding events.

Those communities are very interested in using green infrastructure, but they need to know how to use it more holistically and also does it make sense economically and you know, can they use it to compliment their existing storm water infrastructure or even help prolong its life.

Communities aren't sure where to start. What type of questions do they ask and what sort of assessment do they conduct to be able to figure out whether green infrastructure is feasible for them. So we kind of focused on helping communities answer these types of questions. What are my options? What type of benefits do I see? What are the costs that are entailed? What type of data and information are available to help me determine whether green infrastructure can help me reduce flooding impacts?

We worked with these partners to help us develop an assessment and partners are so critical as most of you folks on this call probably know and so this was the group of people that we worked with and all of them played a different role either through community connections, helping identify the local issues, the modeling, H&H modeling, [unclear 8:35] modeling and then just helping us kind of see how this information can be used.

This is the framework that we developed to help answer those questions you saw on the previous slide and we're going to kind of go through these different [unclear 8:49] and talk a little more about what came out of going through these steps with those in the community.

Right and before I start with the steps, I just wanted to let you know that this work was funded through the Great Lakes Administration Initiative and it was a two year pilot project that we did and we built in to do, to have a year to do the research and to get this project together and then we also built time into the project to help support the communities with technical assistance to help them understand the study, what it meant, what the options were, as well as to help them brain storm some implementation strategies and we'll share some of that with you at the end of this presentation.

The main thing is with the frame work, really the first thing that we had to do was define the flood problem and for us, that meant really thinking about the scale of the study. There's a variety of green infrastructures that are out there looking at a number of different scales and for our particular project, we chose watershed. The watersheds are fairly small. They did not encompass the entire municipality of both areas, but did serve as a good study area and at first looking more holistically at a watershed. We have some graphics up on the screen right now so you can see a little bit of the areas that we studied. One is to sort of point out again some very unique differences between the two site areas.

In Toledo, Ohio that watershed was very urban. I would say about 80-90% of the watershed was fully developed and has quite a bit of pervious pavement in it, which was also contributing to some of their flood related issues. In Duluth on the other hand, they have perhaps about 60% of their watersheds developed. If you look over on the watershed, there's sort of almost a vertical yellow line towards the middle right under where it says Chester Creek Watershed and in that area there, there's a bluff and the bluff has a 600 ft drop and so that's contributing [unclear 11:03] earlier the velocity issues that they deal with with flooding. Water tends to not stay around in Duluth, but when they get a lot of it, it races and rips up that watershed and creates other types of issues.

Next step in our assessment was to look at current and future flooding. We did four scenarios to help us identify what the current and future flooding issues were and how the flooding issues can be reduced using green infrastructure. So you'll see here we have what we call two flood impact scenarios and that looks at the current and future land use and precipitation and then we have two flood reduction scenarios that looks at both those current and future flood precipitation and land use, but then we add in looking at using green infrastructure to reduce those flood impacts.

Now that we know what our scenario is, we really start to sector the process of identifying the volume of water that these watersheds are going to see. The first step really was to figure out how much rain is there right now and then looking to the future. For the current range trend we used NOAA and rain data to figure out the volume of rain in both watersheds and we used planning scenario of 20/35 and we used the EPA create model to project what future precipitation patterns might look like. Then we needed to know how much water could cause flooding. We took the information from both the current rainfall frequencies and then the future projected change and we put change in those rainfall

frequencies and then we were able to model that using hydro-logic and hydrolic models. We used USGS regression equations to do our hydrology and then we used [unclear 12:56] to do our own hydrolic modeling. This provides a [unclear 13:02] and told us where the flooding would occur and then we were able to input that into FEMA's locked estimation model called [unclear 13:10]. How this helps us figure out where the flooding would occur, which was the third step in this area and has this enabled us to not only begin to visualize what the flooding patterns look like, but it was also tied to building infrastructure damage so we were able to look at, it does have some limitations, which we're happy to talk about a bit later in the Q&A, but for all intents and purposes, it showed us where the flooding was going to occur and then what the cost to building infrastructure that would happen through those flooding scenarios.

In Toledo, to again look at what the flood damage would cost, we estimated using the information from the modeling that the building damages were going to be approximately \$740,000 with the damage in this watershed and the screen graph in the background is a tool that was developed by our partners, [unclear 14:11] and that allows you to take all of the data that we described from these models and plug it in to a web based interface that allows the City to look at or any user actually to look at the estimated damages in a number of scenarios. Here it's showing you the current flood state damages for Toledo. The next slide is looking at what the future damages would be. You can see there that the number jumps from \$740,000 up to \$930,000 of damages in the future.

We were also able to do the same thing in Duluth. Now Duluth, because the streams are so entrenched, there's not a lot of development in the flood plain so the damages were a little bit less and that's what we're going to talk about, some limitations because we were only able to look at building damages, but we were able to see if there was under current precipitation [unclear 15:07] about \$400,000 in building damages and then if we were to look into the future, that would go up just a little bit as well because it's just the nature of the streams in that area, but we did in talking to the City from the June, 2012 slide, there was a lot of damage to the [unclear 15:26] structure and that sort of thing that had the storms not accounted for those types of damage.

Now that we have where the water is going and the damage that might happen, the next step is to begin to select what our green infrastructure options are. As you guys probably know, there are lots of options out there and I just want to take kind of a moment to pause. We are really looking at green infrastructure options that provide a lot of storage because for us, it's not necessarily focusing on some of the water quality benefits that green infrastructure can offer communities, but we're really looking at storage capacity and so we try to identify particular green infrastructure options that would help provide that storage capacity from the flood.

The next step was to figure out exactly how much capacity we needed. We worked with each community and we saw through based upon their current land use and how much land they had available how much they thought they reduce their discharge from their 1% annual chance storm and so because Duluth still has a lot of undeveloped land, they thought that they could probably reduce that peak discharge by about 20% and because Toledo is highly urban and they're almost filled out, they thought they could only get about 10% reduction in that peak discharge using green infrastructure storage.

Here we're going to talk through how much does that really equal so if you want to reduce your peak discharge of your 1% annual change storm, how much storage is really needed. In Duluth because they wanted a 20% reduction, they had to acquire a lot more storage and so that's reported in acre-feet. Basically one acre of land, that's one [unclear 17:28] feet of water. That's how much storage they would

need and for Duluth in their current conditions would need 76 acre-feet and then for future is 86. Toledo again because they're only looking at a 10% reduction, they only need 30 and 32 to be able to meet that target.

Then we wanted to do a paper activity where we just went through and did an exercise to look at what green infrastructure both communities were interested in using to help them to reach that target and then how much of each they thought was feasible and this was really good based upon their land use and also the community needs and interests. Again this was just a paper activity. There was no actual floatation done. We were just checking to see if the target rate was really feasible.

As I mentioned, we were really looking for green infrastructure that provided significant storage capacity and so the options that we narrowed in on based on feedback from the communities were Bioswales, Blue Roofs, Permeable Pavement, Underground Storage, Parcel Buy-Outs and Extended Detention Wetlands. I'm going to just take a pause for a minute and talk a little bit about blue roofs because we always get that question. It's a bit of a new green infrastructure technique, but essentially what it is is there is a system of panels and drains that can be installed on roof tops and it provides some storage capacity for rainfall that then can be let out and drained at a slower rate and helps to diffuse some of the flood waters. It's a great solution for an urban environment, which is why Toledo was particularly interested in it, but it can be a challenge as you can imagine because if you're trying to put a blue roof on an older building, you might have some additional infrastructure challenges in your future. At any rate, those are the options that these communities were considering. One thing about parcel buy-outs, Toledo has seen [unclear 19:33] economic down turn. They have a lot of homes in the foreclosure process and so there was potential possibly to do some buy-outs of some of their homes and maybe do smaller, some sort of retention there and so that was something they were very interested in since they might have a lot of vacant properties in the future as well. One last thing too, should underground storage, that was one of the most expensive green infrastructure options Duluth was interested in because they have a number of roads that might be, they were being updated them and could [unclear 20:09] storage as they enhanced their infrastructure in the city. So they were looking to that as a pretty viable option for them.

So once I figured out what the storage was, this is where the team collectively said "holy moly, can we even find that amount of storage in these watersheds" and there was a moment of panic. I cannot lie. So what we did, we kind of took calculations and we went back to each community and we did a bit of a [unclear 20:40] and said "looking at these different options that are going to give us the biggest bang for our storage, can we find places in these watersheds that they will fit" and we were successful to find the storage that you need and this map shows you a couple of ideas and locations our planning team and the members in the community identified as potential places to fit their green infrastructures.

Then we did the same activity in Duluth and this is right up those folks alley. There was a lot of researchers and people in the community that are really like to roll their sleeves up and so again they went through the same activity and laid paper maps down and we just brain stormed and really thought that there was possibly opportunities for green infrastructure and one thing I really liked is we were working with a woman from Parks and Recreation and she just had an 'aha' moment about one of their projects that was under way and she though "maybe we should try to make that a little bit greener and maybe using more pervious type of materials as opposed to impervious" so there was a really nice opportunity for folks to roll up their sleeves and think through what is possible.

The next step was to look at how much flooding could be reduced using green infrastructure. We're just reminding you again about what our flood reduction scenarios are. Basically what we did was we went

back and ran the same scenarios, but we incorporated green infrastructure into the current and future scenarios. We did see a difference. In Toledo, looking at the infrastructure versus the current damages of \$740,000. Using green infrastructure to help [unclear 22:34] of that water, the damages were reduced down to \$453,000. There was a substantial savings to the community. We followed similar trends with the future scenarios as well and actually a bit of a greater [unclear 22:49] heavier in the change.

For Duluth under our current conditions, we found a \$100,000 reduction in [unclear 22:59] current conditions and in the future we saw a little bit less than \$100,000 as well. We still saw some reduction in damages to the building.

What this slide is trying to show is that looking at from a worst case flood scenario and incorporating green infrastructure storage options, the risk is reduced to the communities for infrastructure damage. You can look at this slide and if you have some questions about the numbers, we're happy to walk through in a bit more detail, but in essence the hypothesis we started this study is you can green infrastructure be in effect of storage, we found that to be the case in Toledo.

The same is actually true in Duluth. We found that our risk of that 1% annual chance damaging peak discharge could actually be reduced using green infrastructure.

So now comes the real [unclear 24:11] figure out the comparative cost and benefits and to find out if it's economically feasible to incorporate the infrastructure. So how we did that was we really took all of the cost estimates for each green infrastructure option that the community was interested in providing and we used national averages and the best available data that each of these communities had for any pilot projects that they may have implemented the infrastructure in the communities.

So how that information having those unit costs can be used is first of all we put all of our unit costs into a common unit. We used cubic foot of storage because you're looking at volume of water and we need to be able to compare storage from one option to the next. So for example, if Toledo needs 30 acre-feet of storage to reduce their 1% annual chance of discharge, these are just a couple of options that they were interested in so what it does is it says okay if you're looking at a storm water wetland at an estimated cost of \$1.30 per cubic foot of storage, to get 30 acre-feet will cost about \$1.7 million. If you were to look at option 2 underground storage, which is almost \$42 per cubic foot, it will cost about \$55 million. Now most likely the community is not going to pick just one option. They're going to look at multiple options so what this does is it helps you kind of get rough estimates of what different action costs based upon the amount of storage that provides and it really helps to inform your green infrastructures and that's really what we're looking at is planning and developing that green infrastructure strategy.

For our analysis, we looked at the least expensive green infrastructure, which was extended to [unclear 26:09] wetlands and this is with doing out analysis so providing Toledo with 30 acre-feet using that least expensive measure. It would cost \$1.77 million and then Duluth we looked at providing 76 acre-feet of storage using that extended retention wetland it would cost about \$4.3 million. This was the cost, one of the costs associated as part of our economic analysis.

Really when you're doing an economic analysis, our benefit here mean damages avoided so what we mean there can be translated into real people words is that by incorporating green infrastructure we are going to avoid damages to our building infrastructure.

For Toledo, the cost really in a nut shell what we found is that green infrastructure is not soundly a viable option, but is a long term investment and over a 20 year period the cost for implementing green infrastructure in Toledo were a bit higher than the actual damages that were not avoided to the buildings. Over a 50 year period, that's really where you had more of a break even sort of economic break down. One thing was we weren't able to look at all the damages so in Toledo we were only able to look at what happened, which was building damages so there's a whole lot of other flood damages that are not accounted for and the same is in Duluth. In Duluth we have a little bit more information available to us. We were able to look at storm water infrastructure damages from the June 2012 flood and also some repairs that had to be made. We were able to look at damages to stream banks and what they were spending to restore damaged banks and then we were also able to look at impacts to recreation. The study watershed area had a really large part in there that was very critical to the community and a lot of recreational use going on there so we were able to look at some additional damages the flooding caused. Also, we were not able to look at, we only looked at using green infrastructure is flooding. We didn't look at other types of ecosystem services or services provided by green infrastructure such as water quality graph study.

Tashya: So as Lori stated earlier, this basically is in a nut shell, benefits are seen when you use a longer planning horizon and so what that really means is looking at green infrastructure that's going to last longer because you really do start around 30-50 years you're really going to start seeing a break even and then start seeing benefits and then also just like with any type of project, we were always limited in data. We try to use the best available information that we had as a proof of kind of concept of what we could do, but you know I guess the more information you have the more details you're probably going to get.

Lori: As Tashya mentioned, to do this type of analysis is a fairly heavy data exercise and so recommended data steps for this are listed up here on the screen and they include buildings, roads, infrastructure damage, recreation, wages and damages to your landscape. We were a bit limited in this project. A lot of it had to do with the scope and scale of the project as well as our timing and as Tashya mentioned, we really had building damages for Toledo only and we were able to supplement a bit more in Duluth mostly because their damages weren't contributing to actually to the buildings. They had damages that were more significant in other areas of their watershed and we worked pretty hard with the communities to identify some additional data. At any rate, the data that you have is going to really impact the results of your study.

So now that we have the study completed, we have as I mentioned earlier, [unclear 30:31] providing some technical support to the communities. Once the study was completed, we did a number of webinars as well as one day work shops with community members to help them, the communities and agencies really to help them understand the results and the options that they could explore in implementing green infrastructure and so to highlight just one of the test stories from Toledo. Toledo again, I mean their watershed was barely developed and one of the big footprints in the watershed was with GM so they have the Toledo plant there and the city, using the results of the study, approached GM and asked them if they would be interested in exploring implementing some green infrastructure options on their site and so they worked with a University of Michigan graduate student who then used funding from this project to develop site specific green infrastructure plans and are in the process of [unclear 31:30] around the plant. We're pretty excited about that. We think it's a really great example of a public/private partnership. The city also invested some funding from the grant project to [unclear 31:46] infrastructure projects in the watershed. [unclear 31:50] that the city really needs some help understanding what green infrastructure is, what it looks like, why it's there so that [unclear 31:59]. They put official media package in place to help the outreach and then they also created some coloring

books for school aged kids to help share green infrastructure and what it can do.

From more the municipality side, they've also developed a green storm water task force and that was already in the process of forming through their sustainability planning effort and what we helped do last fall was [unclear 32:28] some goals set out, but they were really trying to think more comprehensively and what it does is it entails the county and the city of Toledo, Toledo's municipality and the county, but what we helped them do is kind of think through how can they establish these private kind of partnerships, how can they do more outreach, how do they secure more long term funding and we were able to bring some experts to the table such as [unclear 32:54] district to speak to these folks. Dave and his team have been through this and it was really helpful to help guide this group of decision makers that are really trying to think holistically and comprehensively and think across the municipal boundaries.

Then Duluth, as you guys saw through the story we're telling, the flooding is a little bit different and so Duluth has a little bit more time since they're not experiencing such new flooding, localized flooding. It's more of an extreme event so sort of the way the community works is they like to do a lot more studies and so they're doing some more analysis and they've been implementing a couple of [unclear 33:35] projects based upon the flooding that occurred in June 2012. There's some additional researchers, that's what one of these photos is. Looking at [unclear 33:43] places, looking at more details of where you can actually get some of that story and what maybe you would put there and then have you kind of work some of the [unclear 33:52]. Another thing we worked very closely [unclear 33:54] They were instrumental in helping us build a relationship and get to know a lot of local issues and so we partnered with them to do what was called open house and they were really interested in Duluth. It's kind of a ground up sort of decision making and courage there and a lot of push from the local citizens. They're very active and very sure as to what's going on in their community. So in the open house, we were able to boil down our technical report into different stations and so people could come through and look at posters and kind of understand the process we go through. We talked to them about them and this is an example of someone that took a pledge and was already doing some smaller private property owner green infrastructure project.

Alright, so here we are with lessons learned. We touched on a number of these as we walked through the presentation, but you know just wanted to kind of come back and maybe just hit a couple of them. I do think Tashya mentioned earlier focusing on the long term is a pretty critical piece of this project and if you want to do these types of projects in your community, something that you really need to consider and plan up front with your planning team. In terms of the data, we have in both communities the data was a lot harder to get than anyone in the planning team had thought. I think that they're in the [unclear 35:24] sometimes that people have all the data that they need and it wasn't the case and I guess I would encourage if you are a local city to make sure that if you have some photos of flood or a national disaster that you're focused on figuring out what the damage, collect the data on the damage, of what it cost to make those repairs and how long those repairs took and how many because you know everybody, in both of the communities we worked with, they all thought that they had the data, that [unclear 35:59] down to the layers. There was a gap in the community and I think that sometimes going into [unclear 36:08] like this it can be a little bit overwhelming. We looked at all these green infrastructure projects, we showed different opportunities, but again this is something that needs to be done over time and it needs to be [unclear 36:19] that you have to go out and do next year or next month or whatever and then also think about what you are doing, like in Duluth. They're going to eventually need to update some of their roads so that might be a time where they actually think about implementing the underground storage. Also just thinking about your capital improvement plan, where is it in there you can look for opportunities or maybe through that budgeting and then I think another



big thing is that we definitely wanted to focus in on the cost of benefits, but I think a lot of it comes down, that stuff is important in decision making and you really have to be able to do budgets, you really do have to have you know is this economically feasible, but there are a lot of other benefits that cannot be monetized and so you really need to think what is important to my community. Toledo, they had done projects in the past that maybe didn't make sense, but they knew it helped really give them a sense of community and it helped kind of bring the community together when things economically were in a down turn and so looking at some of the other benefits, I know it sounds like a lot, but it is really critical and then I just really like to highlight the partners. I mean we from OCOs perspective, we couldn't have done this without all of our partners and our local communities. They were instrumental from the beginning and so we would just like to say thank you for their help.

I think in addition to partners, it's also bringing diverse skill sets. I think sometimes partners can be a generalized word and definitely the local communities of Sea Grant and the task force that we work with, they are all amazing, but I think what was also really helpful and critical really for having these projects was the diverse skill set. We had a hydrologist modeler on board with us and we had a GIF person. We had an economist. We had a hazard specialist. A lot of those skill sets are really critical if you want to undertake a project like this to really pull in not only diverse partners, but diverse professional skills as well too.

Lori: So what's next for NOAA? As you've heard, we wrapped up our study, we've supported our communities with some technical assistance and they are well on their way to beginning implementing, but for us, we really want to share what we've learned and you know we invested heavily in these projects, it was a learning opportunity just to test the methodology and perhaps develop some resources that can be used in other communities. We have been working on what we call [unclear 38:57] and then two other complimentary products that support the guide and so what the guide is really intended to do is to take the process that Tashya and I have been talking through with you this morning and break it down into manageable steps and tasks and we designed it so communities that wanted to actually pursue a full study and perhaps get funding to do this type of thing, they would have a bit of a manual to be able to know how to do that. We've also found that testing this, we actually tested the methodology out in Hawaii to see if it could be translated to a completely different other geography and you know, minus the coral reefs, there's actually quite a bit of similarity between Hawaii and Duluth, Minnesota. You would be surprised! There are clearly some differences, but more similarities than any of us realize and when we tested developing this process guide, the community that we worked with out in Hawaii was called [unclear 40:06] and they did not have the funding to do a full on study. Talking through these steps with a stake holder group of about 12 people and a facilitator, they were actually able to come up with some actions and strategies that they thought were very helpful in using their discussions about how to address some of their flooding issues forward.

Tashya: Then as Lori mentioned, we have several companion pieces that go with the process guide. These are in the final stages of development and so one of them is options to reduce flooding and basically what it does is it walks through different green infrastructure options that both our communities were interested in and then tips on using those in different considerations, you know land use considerations and then also that example going through estimates for a potential cost and then we also have a data check list and like Lori said, we were shocked at how challenging that is and we get asked this a lot so we thought what we'd do is put together a data checklist of what we use in each of the steps and then we also have optional versus what is required and you know, the optional will just enhance your analysis. Then we showed this example before, but this is a tool that's been recently developed by [unclear 41:33] managers and I think what's really great about this is [unclear 41:38], he was the one that ran the [unclear 41:41] model and it helped put a lot of information and so it was

really hard to kind of do a comparison and look at all those individual tables and maps and so that was really kind of [unclear 41:51] for that community because you can see that information together in a visual format so that you can look at potential hot spots or you can do out reach and then you can you know put that with additional information such as your land use, your other flooding, your green infrastructure projects.

I will say just real briefly about this tool. We did a joint presentation with the [unclear 41:14] out there, just their recent conference in Atlanta this June and one of the things that they offered is that this is open GIF platform, so if others are interested in using, wanting to develop this, they're willing to offer the code so we have our contact information here on the left slide and if you are interested in that or any of the other products that we talked about, we put our email up there so that you can contact us with additional questions. Also I put two URLs up there so that there's a place that you can find some resources. On our Digital Coast website, we have a section that's dedicated to green infrastructure and you can find, that's where all of the products that we talked about will be located hopefully in another month or so and then you can find the Technical Report at our ridiculously long URL. The last thing I wanted to mention is that the Office for Coastal Management, Tashya and I are located in our Charleston office. We do have a presence in the Great Lakes and Brandon Kumwiede whose name is also on this slide, is our Geospatial coordinator for the Great Lakes. He is a wealth of knowledge and if you have technical questions, he is a great resource for you to tap into as well. With that, I'm going to turn it back to you Jill to see if there are any questions.

Jill: Great. Thanks ladies. I have a couple of just clarification in terms of the materials. Several people were asking and I just wanted to double check with you. We have several people asking whether the guide to assessing that, is that one of these URLs that is listed on the slide?

No. It's not. It hasn't, the guide, let me click back here so that that is clear. So this process guide is what we're going to call this. We have this with our communications in the group and so as soon as they get the graphics done we will release it, but it will probably be about 3-4 weeks. These process companion pieces are in the same place. They're just waiting for their final design and then when they are done, you can find them at the Digital Coast Green Infrastructure Resource page. They will be posted there.

Jill: Okay. Thank you. Another question is we had several people asking whether or not the details of the case studies are on line beyond these pages or is this where the case studies details would be located?

Yeah, right now if folks are interested in understanding really the number crunching and the calculations behind the report, that would be, you would go to the Technical Report, which is listed on this last slide here and that has 160 pages, it has all the over views of all of the projects and the results of that study are detailed out in that Technical Report. We are in the process of putting a little less technical case studies together and when those come available, I'm happy to send you the link as well.

Jill: Okay, great. One last question in dealing with materials and then I want to go into you know a lot of questions. I want to get into as many as we can. Someone was asking also the coloring books that you were mentioning. Is that handy in terms of a URL as well? Would we be able to post that URL onto our site as supplementary materials?

I think that those are hard copies. Those were developed by the City of Toledo so we can check with them and get back to you.

Jill: Great, great. Alright, well let me get to some of the questions that we had. We had quite a few questions that were specific to slides. What I'd like to do is go through some of the other ones and then go back to specific slide clarifications. One question that we had was, there were a lot of questions asking about whether or not your green infrastructure costs for green infrastructure took into account land purchase costs?

No they did not take in land purchase costs. They took, but they did account for maintenance.

Jill: Okay, okay and we had

Lori: And I think part of, well let me elaborate the results here. I think that because Tashya sort of eluded earlier in the presentation that Toledo scenario and they are in a tax portion situation where it's a little bit different than a city going out and actually trying to acquire the land.

Tashya: [unclear 47:38] that would probably have been arranged so we just did not include that in the assessment so we did not identify specific parcels and then what that would cost with the market value was, so that's not something that we did include in that.

Jill: Okay. Other questions that we had actually were specifically dealing with long term maintenance costs, whether or not those were taken into account, did the green infrastructure practices have a life cycle of 20 years or 50 years and did you consider replacement? Those kinds of details.

There is long term and again what we're using is we're looking at other projects that are out there so any type of project has been published, that was a lot of the source of our information because as most people know, it's kind of hard to find information so we were looking at studies, private studies and looking at what the costs were, what the maintenance costs were. So some of the green infrastructure that we looked at, there is cost, maintenance costs in there, but we did not. There was another question in there. I'm sorry. I lost it. About let me think. Life cycles. We did not, but they are a really good resource and the name has escaped me right now, but it's a calculator. The national, I can't remember the exact name, but they actually do have a resource in there. They did things that we did. They went through and looked at a bunch of studies and they have averaged or estimated life cycles, how long something will last for different types of green infrastructure. That was not something that we accounted for. Maintenance cost was something that we looked at, but not the life cycle.

Jill: Okay. Another question and we had several questions dealing with the future of rainfall so we had one question specifically that was talking about the national climate assessment and that the mid-west would have a 37% increase in heaviest rainfall since the mid-20th century. Has this trend been taken into account in your future risk reduction analysis?

Yeah, it was and it was really a big driver for why we wanted to, well which we were very fortunate to be able to do this kind of study because that's the trend. It was definitely their flooding isn't going to get better with looking forward and incorporating climate risk in there that they're going to have more intense precipitation events that are probably going to make their flooding much more difficult.

Jill: Alright. Thank you. Another question we had was did you look at the cost effectiveness of green infrastructure solutions in relation to traditional infrastructure?

No we didn't. We get that question a lot and we just with the scale and the funding that we had, we couldn't incorporate that. I think if we did, maybe a fourth or third pilot project, we would definitely

factor that in because there is some considerable interest and definitely some data gaps on those comparisons.

Jill: Alright. Thank you. Another question, this is a clarification question. The damages that were shown were only due to flooding and not due to degradation of water quality. Is that right?

That is correct.

Jill: Okay. Another question that we had and I'm going to go a little bit into some of the specific, these are referencing slides and I think I got most of them in terms of what number we're talking about, but I could be off on a few. This one, several people asked about the model that was mentioned and I think it was on slide 17, just for clarification.

I'm trying to get there.

Jill: You should be able to if you use the drop down. Click on the, yeah there you go and you should just be able to go up. If you want, I can take the ball and I can do it.

I think we've got it. This is slide 17. Is this the slide you're referring to Jill?

Jill: No, it must have been maybe shortly after that. Yes, it must be that one. So the, you had mentioned a model and they were just wanting to know the name of that model.

Yeah, so this is [unclear 53:03] tool that takes the data from the model. We actually used a couple of different models and so I'm actually going to go back to slide 17. So in how much water can cause flooding, we used hydrolic modeling to determine that. So we used, for the rainfall, we used technical paper 40 and we also used a crate which also looks at historical information and then it looks at, it takes, basically down scales some of the global [unclear 53:38] models and you actually choose your climate station so that you're getting more of that true like what's happening in that area and it looks at percent change from a historical so that gave us basically our rainfall frequency. Then we used USGA regression equations because of the [unclear 53:58] levels, that's why we didn't have this detailed and [unclear 54:02]. They had better hydrology models and they didn't. They were older and we couldn't get them to work and then we used [unclear 54:07] to do hydraulics and then we were able to [unclear 54:11] and then we were able to insert that into [unclear 54:14] estimation tool. You can get that from FEMA's website.

Then the FEMA results from [unclear 54:22] went into these different visualization tools that [unclear 54:27] developed. The output from, the sequential outputs that came from the modeling could then be visualized in this web tool. I hope that helps.

Jill: Yes, that does.

That's all detailed in that Technical Report, that really long URL at the end.

Jill: Okay. We had several people ask about the meetings on identifying opportunities for storage and like how and also what types of people were in the local planning teams. So could you talk a little about like how many meetings, how were they facilitated, what were the challenges, who were the key people present?

Lori: Yeah, that's a great question. So this is Lori and I'll talk a little bit about what we did in Toledo. We worked with our point person there is [unclear 55:31] Bannister who is amazing to work with and she pulled in a number of [unclear 55:37] from their water division so they were fixed from sewers and public works and then environmental programs, engineering. They also brought in their elected officials and and board members and so we did maybe over the course of the project, we did maybe three different meetings with them and to kind of make sure that they were brought in, that they understood the project and that they were able to provide feedback and ask questions at key moments and key decision points within the project. When it came down to identifying the level, the areas that you're looking at on the Toledo map, that we basically used that group. I think at that point some of the elected officials left, but there is a pretty diverse troop of folks across this city and then there are some folks that weren't able to attend, so [unclear 56:32] who works in her office worked to get feedback from others in the area. We also contracted this project out with research groups. They pulled a lot of this information and the analysis for us so they were sort of the third party that was helping in on research. Once we had this map, what we did was we went out and [unclear 56:58] the watershed and actually physically looked at these sites so it was kind of a two step, brainstorming, match site visit kind of thing. In Duluth we followed somewhat of the same process. Our project team in Duluth was Minnesota Sea Grant. There's a local EPA lab. I think it's in [unclear 57:20] ecology labs. There's the [unclear 57:25] natural resources institute. There is city staff there. We had Parks and Recreation [unclear 57:30] engineering. We had a GIS data planner there. Our data person and then a planner as well and then we had a couple of elected officials, like the Mayor's assistant was there and we worked through some of the same process. One thing we were able to do with this project was do several onsite meetings, which I think is really critical. We had to do a lot on the phone, but the onsite meetings were great because we could roll our sleeves up, talk face to face and they could just ask us a lot of questions that we could go through and make these decisions together and this was really neat. We had Minnesota Sea Grant basically did this with Google Earth and so we were able to put these pins in digitally as we were having the conversations. We had the maps projected on a piece of paper and so we just went and kind of talked through some of this as well. Those face to face meetings are so critical. Having those point people as well. They kind of keep the team coming and going and rounded up and see who to [unclear 58:37] as well.

Jill: Alright. Thank you. I had a couple more questions. We're almost out of time so I'm trying to scan quickly anything. We had several people talking about Duluth and asking specific questions dealing with Duluth. I wanted to give you a couple of those. One question was whether or not did you think about analyzing the performance after the flood of the existing green infrastructures put in the Miller Creek for the last 20 years as a local comparison?

Yeah, it was a little bit out of the scope. To answer the initial question, no. However, the flood of 2012 was front and center in this particular study and there was a lot of skepticism about if green infrastructures could even be a viable option in Duluth because of the frequency issues and the velocity. [unclear 1:00:02]. So there was a lot of discussion about is that going to work? Is it a good option? Would it have helped the scenario? So you know, we talked through a lot of those options. We didn't actually run an additional scenario. One of the things as a follow up on and Duluth is very interested in viewing is they want to expand the study throughout the entire watershed. I think that they're also trying to secure some implementation funding. I think they got an EPA grant to begin to put in some of these green infrastructure storage options and tests. Naturally kind of where the money [unclear 1:00:43]. Is it going to work in the scenario so they are steadily working towards trying to understand those options and make it better. I hope that helps.

Jill: Yes, it does. Another question dealing specifically with Duluth, did you look at the age of the storm

water infrastructure and whether it was a significant factor in flooding damages and where the flooding happened?

Not specifically. When we did our first site visit in Duluth, we did go around and look at, we looked at places that were damaged from the June 2012 flood and then of course some additional information came out, but we did not in our analysis look at the age of any of that. There were a lot of assumptions made in this project and so I think we were mainly looking at how maybe green infrastructure could help prolong the life of some of those older infrastructure because there's more wear and tear on them so that was sort of an assumption that we made, but we did not do a specific assessment of that and then compare the cost different, ages of infrastructure and how well green infrastructure helped prolong the life.

The City really, I think we really kind of came from the perspective as we knew that there were going to be some opportunities to update infrastructure and so this study was helping to form options so when they came to decision points, they can consider if they wanted to continue down the gray route or supplement things using the green infrastructure. It's a really good idea though.

Jill: Alright. I think we are actually a little over time. We have some other great questions and so I have asked Lori and Tashya if they would be willing to answer those questions in a document that we'll post later on and they were very willing to so we will have your questions that we haven't gotten to answered reasonably shortly so we will let you know when those answers are available. I would like to wrap up. I wanted to again thank Lori and Tashya for their willingness to talk to us today about two Great Lakes case studies. This was a great way for us to be able to see a project that started a couple of years ago and what great findings they have found that we can possibly use to implement another city. It was really a great discussion. We really appreciate their help in reeling that information. Also a special thank you to NOAA and Minnesota Sea Grant for funding this webinar. I did want to remind everyone that our survey URL for this webinar is in the chat feature so please take a few minutes to fill that out. I also wanted to refer you to resources and archive of all previous webinar presentations, which are located on our [ChangingClimate.osu.edu](http://ChangingClimate.osu.edu) website as well as our regional site at [GreatLakesClimate.com](http://GreatLakesClimate.com). This webinar series is sponsored by the OSU Climate Change outreach team and we'll host new webinars in the coming months. We'll email you when that registration is available. Thank you again Lori and Tashya and all the participants on this webinar. We hope this was beneficial and hope you'll join us again in another upcoming webinar. Thank you again Lori and Tashya. This was a great presentation so we really appreciate it. So many people are looking forward to it so thank you for taking the time to present this to us.

Thank you.

Thank you. Everyone take care.

Jill: Thanks everyone and have a great afternoon.