The Art & Science of Stormwater Retrofitting

Event 107156

John Kosco: Good afternoon and welcome to today's webcast on "The Art & Science of Stormwater Retrofitting." This webcast is sponsored by EPA's Office of Wastewater Management. I'm John Kosco with Tetra Tech and I will moderate today's session. Thank you for joining us today.

We are going to get started in a few moments. While we wait for others to join in, I would like to cover a few basic housekeeping items. The material in this webcast has been reviewed by EPA for technical accuracy, however the views of the speakers and the speakers' organizations are their own and do not necessarily reflect those of the EPA. Mention of any commercial enterprise, product or publication does not mean that EPA endorses them. For those of you new to EPA's stormwater webcasts, I want to briefly summarize some of the webcast features. First, if you have any technical difficulties you can call 800-833-2812, or click on the Help button to receive technical support. You may also use the Ask a Question area to post any technical issues you are experiencing. Please include a telephone number where you can be reached and we will help you troubleshoot your problem. Again, that telephone number for technical help is 800-833-2812.

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We will try to answer as many questions as possible, however due to the high number of participants, all questions will not be answered. Today's speaker contact information is provided on your screen should you have any questions following the webcast.

There will also be several occasions where our presenters will ask you questions. The presenter will pose questions in the slide window. Please submit your answers in that same slide window by clicking the radio button, not in the Ask a Question box. If you would like to see closed captioning, click on the closed captioning button on the lower left hand corner of your screen.

And at the end of the webcast you will be asked to complete an evaluation survey. This survey will appear in a pop-up window so please turn off your pop-up blocker at this time.

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As a reminder, this webcast will be archived indefinitely so you can access it after today's live presentation. The archived webcast will be posted within a couple of weeks on this same EPA website.

Now we are ready to kick off today's session. Today's speakers are Michael Novotney and Deb Caraco with the Center for Watershed Protection and Dan Frisbee with the City of Charlottesville, Virginia. We are also joined on this Stormwater webcast as always by our good friend Nikos Singelis. Nikos is a Senior Program Analyst with EPA's Stormwater Program. He has been with the EPA Stormwater Program for the last 7 years, worked for many projects aimed at helping Phase II communities implement this challenging program. He co-authored EPA's Guidance on Developing Your Stormwater Pollution Prevention Plan, a guide for construction sites, led the development of EPA's Urban B&P tool, and is a speaker across the country on various stormwater topics.

Mike Novotney is a Water Resources Engineer at the Center for Watershed Protection. His responsibilities include project management, watershed planning and assessment, technical writing and analysis and training and education. Mike was one of the co-authors of the Urban Stormwater Retrofit Practices Manual which will be a focus of today's discussion. Prior to joining the center, Mike worked as a consultant engineer in Northeastern Illinois where he planned and designed stormwater management practices. Mike holds a BS and MS in Field Engineering.

Deb Caraco is a Senior Water Resources Engineer also at the Center. She recently rejoined the Center after having left to move to New York State in 2004, where she worked for New York State Stormwater Conservation Committee and a private engineering firm. Her areas of

expertise include stormwater design, illicit discharge detection elimination, pollutant load analysis and stormwater program development. Deb holds a BS and MS in Biological and Environmental Engineering.

Finally, Dan Frisbee is Environment Stormwater Program Coordinator for the City of Charlottesville, Virginia. He has worked in the City's administration division of the public works department for the last 4.5 years. His responsibilities with the city include coordinating key elements of the city's stormwater management program, and MS4 Phase II stormwater discharge permit, assisting in development and implementation of the city's stormwater management system, as well as performing staff training, maintenance analysis of GIS data, and public education. Dan holds a BS in Geography. Now I will turn it over to Nikos who will talk about the topics we will discuss for today's webcast.

Nikos Singelis: Thank you, John. This is Nikos Singelis with EPA's Office of Water. And I want to welcome my fellow speakers here today to this webcast. We have a very big audience online with us today including I want to welcome specifically folks in Beaufort County, South Carolina, where I understand they have this webcast playing in the County Council Chambers and who knows where else, but they have a big crowd down there. So welcome Beaufort County. And also welcome to the many other locations around the country that have joined us.

Later on in this webcast we will give you a tally of how many people are actually online. We had something like 1300 computers register for this webcast. So that should translate into one of our biggest audiences yet. So to get into today's webcast I am going to be talking about the very important topic of retrofits which fits in with the Stormwater Phase II program under the heading of Post-Construction. And in a minute we will explain a little bit more about how that fits in, but as you will see as we go through this webcast, retrofits really are going to be an essential strategy that all of us are going to need to undertake at one level or another if we are going to achieve our water quality goals. So we, EPA, gave a grant to the Center for Watershed Protection a couple of years ago and those who have attended other webcasts know about our ongoing relationship with the Center and the excellent products that they provide. But they have been working on this retrofit manual for stormwater practices for the last couple of years. And it came out a couple of months ago you probably saw an announcement on NPDES News about it.

And so today we wanted to feature that. So we are going to go through some of the basics about what retrofits are so that everybody is on the same page and how they fit into the NPDES

Stormwater Program. We are going to be talking about the whole planning process, because like any other part of the Stormwater Program we want to make sure that communities are really planning and targeting their efforts to get the most "bang for their buck" if you will. The most sort of cost-effective and water quality-effective actions on the field. So we are going to talk about that whole planning process; we are going to talk about identifying potential locations where you can retrofit and also practices that might fit into those various locations.

We are going to be talking about how to actually go out into the field and assess different sites so that you can evaluate them. And also touch on design construction and maintenance of practices. And then we are going to try something a little different. We have Dan Frisbee from the City of Charlottesville, Virginia, with us today. And we usually do have a case study, and those of you who have attended before usually know that the case study comes at the end. Well, today we are going to try something a little different because we actually have Dan in the room with us today. So we are going to intersperse information from how Charlottesville actually took some of these ideas and implemented them in the field as we work our way through this. So we will be hearing from Dan on and off as we go through.

So a couple of things just to get started here. On this next slide here you are seeing the cover for the manual. It is available at the Center for Watershed Protection's website. It is also available on the NPDES website. So you can get it either way. And it really is like any good Center for Watershed Protection Manual the soup to nuts guide. Of course, it is very thick and you don't want to actually try to read this all in one sitting because you will probably fall asleep by about page 2. But you do want to take a look and skim around and jump around and that is what we are going to do today is pick and choose different sections from different places within this manual to highlight for you. But it is a really, really good reference material. A couple of things to point out too – it does have some information about pollutant removal performance for different kinds of BMPs and also some very interesting cost information on how much, particularly I found very interesting how much different BMPs cost on a per-acre basis so that you can make some comparisons about your cost and benefits of tackling different projects.

So there is a lot to this manual and we will be going through and highlighting some of that for you today. But again you can download it from either of the websites. So one thing before we really launch into this, I just wanted to explain a little bit more in detail how we see this idea of retrofitting fitting into the post-construction requirement in the Phase II Stormwater Program. As you know the Phase II program requires MS4s to address Stormwater control on new development and redevelopment; any project that would impact an acre or more of land. And so on the left you see New Development, Redevelopment and then Existing Development. So the

regulatory requirements span those first two areas of new development and redevelopment. And of course as you know, there is no regulatory requirement for existing development. And the way we in the Center look at retrofits, and this is somewhat of a definitional issue, but we see retrofits spanning both the regulatory side and if you will the voluntary side. So retrofits when we are talking about it today will be useful in redevelopment situations which come under the heading of the regulatory program, but will also be useful in existing development.

And one of the keys that I think that we all need to look at when we are planning for what we are going to do in an individual MS4 is to really look at sort of what the situations are; do we have a lot of growth going on? Is it an environment that is already built out? What are the water quality issues? Where are the areas of impervious surface within the watershed? What kind of stormwater controls do we or don't we already have? And then we want to make some strategic decisions, and we will be talking about this in more detail about where we target our efforts and probably in a lot of cases in order to really make water quality changes happen, we are going to have to do some combination of addressing new development, redevelopment and existing development. And so you MS4s should be taking credit while technically not required on existing development in your annual report. You should be taking credit for your existing, your work on existing lands in your annual reports to your permitting authorities.

So hopefully that explains what we are talking about, so again we are spanning this area between the regulatory requirements and the voluntary, if you will. So next we are going to get into some of the details here, and maybe Mike since you were one of the authors on this great and large manual, you can tell us a little bit about sort of what is in it and how we are going to go through this, and particularly I guess let's define what retrofits are first.

Michael Novotney: Sure, I think that is a great place to start. And before we do define I wanted to give a shout out to a few of the other authors and particularly Tom Schuler who was the primary author on the manual as well as Dave Hirschman from the Center, Jennifer Zelinski who used to be with the Center, and Sally Hoyt who also used to be at the Center, but all put in some great work on this manual.

As Nikos gave, I think he gave a really good introduction to the manual itself and sort of the bulk of the contents that are in there. I think it is important to set the stage for our presentation today by talking about what exactly is a stormwater retrofit. And up on your screen you will see a

pretty simple definition of stormwater retrofits. And that is stormwater management practice in a location where stormwater controls either did not exist or were ineffective.

Nikos Singelis: And Mike, we should probably add there too that especially what we are talking about is when a city has a conveyance structure, we are saying that is not a stormwater control, right?

Michael Novotney: Correct.

Nikos Singelis: So many cities have conveyance structures that are channeling stormwater straight to the streams without any kind of intervening BMPs, and that is the situation that we are talking about here.

Michael Novotney: That's right. These controls that we are going to be talking about would address water quality, channel protection, flood control. Our stormwater conveyance systems aren't typically going to do that.

So we talked about the definition of a retrofit, and sort of a key question is, well why retrofit in the first place? And Nikos gave a good introduction to why to undertake retrofitting, to address redevelopment and existing development. But to get a little bit larger scale than that, and maybe a little higher altitude, retrofitting is undertaken simply to address those situations where we have ineffective stormwater controls or stormwater controls that don't do everything that we want to do. They are not treating water quality; they are not providing channel protection. The great thing about retrofits is that they can address those problems that are caused by having that ineffective stormwater infrastructure. And they can help restore and address a lot of those situations, a lot of those problems that have occurred because we don't have that infrastructure. And we will talk about a couple of these on the next slides here.

And communities have really undertaken retrofitting for a number of reasons, primary one being to fix past mistakes and maintenance problems. It is a common way to go back and concentrate in particular areas within a municipality or a sub watershed, go back and find those culverts that might be undersized, the stormwater infrastructure that might cause localized flooding, or those chronic BMPs that are a maintenance nightmare.

Also communities will undertake retrofitting to solve some chronic flooding problems, tied in maybe with the infrastructure but also addressing particular stream reaches or going into the stream corridor and adding large retrofit practices to retain flood volumes before they pass downstream. Communities like the City of Charlottesville, and Dan is here with us today, have also undertaken retrofitting for demonstration education reasons – to show the development community, redevelopment community how you can use stormwater BMPs, ultra-urban sites and work them in as you are going back and redeveloping sites. I think a primary one to point out is the reducing of pollutants of concern. And whether to address TMDLs or here in the Chesapeake Bay area, tributary strategy goals for the Chesapeake Bay for moving things such as nitrogen and phosphorus in sediment, retrofits can really do a good job at reducing pollutants of concern both from redevelopment and existing development.

We will move on here to a couple of other big retrofit reasons, and I think a nice one to point out is reducing stormwater runoff volumes, both stormwater runoff volumes that are conveyed into the storm drain system, but also into the combined sewer system, communities like Portland, Oregon, Detroit, Michigan, Milwaukee, Wisconsin, have used stormwater retrofitting through residential downspout disconnection to reduce stormwater runoff volumes into their combined sewer systems, and attack those problems.

Nikos Singelis: And Mike, that is a great point maybe to interject too, that EPA sometimes makes these rather artificial distinctions between stormwater and CSO cities, and actually many cities actually have both combined systems and separate systems. But a lot of the work that we are doing on the landscape really is about the same objective which is reducing the amount of, the big volumes of stormwater getting into the system, whether that is a separate system as we focus on, or whether that is a combined system that might result in an overflow at some point. But really the work on the land is the same, right?

Michael Novotney: That's the great thing about retrofitting is that it can help address all of those objectives and all of those problems that we have within our watershed. There are a few others up on your screen. If you are interested in trapping trash and floatables, retrofits can be very effective at doing that. And then they can also help reduce downstream channel erosion and support stream restoration projects by controlling the hydrology from the developed areas upstream, those upstream restoration corridors.

With all of that being said, retrofitting is a great – there is great potential behind stormwater retrofitting, but it is important to point out that it is also challenging and can be expensive as well. I think that it is important to point out that your required storage volumes, your capture volumes, whether it is the water quality treatment, channel protection, flood control, can get prohibitively large within developed watersheds, particularly when you are going after channel protection and flood control. And depending on the amount of development and the amount of impervious cover within your watershed you might need a lot of retrofits, I'm talking dozens, maybe hundreds of retrofits to make a real difference and address those goals that you are trying to meet. And that is the crux of the problem – the more developed a watershed becomes the more help it needs to recover to be restored, the more storage volume and capture volume you have to provide, but the more difficult it becomes to find retrofit sites.

So it can be really challenging, but it is fun to get out there in the watersheds and figure out where you can address these problems.

Nikos Singelis: Yes, and as those who have heard other webcasts in this series, we have talked about the value of a new development getting the design right in the first place, because that is always your cheapest option, right Mike?

Michael Novotney: That is correct, yes.

Nikos Singelis: But in many cases and I think we will hear from Charlottesville, which is an already developed area, there aren't that many opportunities to address impacts from new development and if we are going to make those water quality gains they are going to have to come from some kind of existing or redevelopment scenario. And that is probably going to be more expensive on an acre by acre basis, but that is the world that we live in, I guess, and we have to tackle that as it comes along, right?

Michael Novotney: Yes, since we didn't do it right the first time, we have to pay 4 times as much to go back and do it right.

Nikos Singelis: Well hopefully not 4 times, right? Maybe 3.5.

Michael Novotney: Well continuing on that thread, we have got a little hypothetical watershed example here, and it is a 5000 acre watershed that we did a little bit of modeling on just to show the amount of storage that you have to provide. And by storage we are talking about really our capture volume to address a number of different restoration objectives, whether it is to improve ground water recharge, treat water quality, provide channel protection. What this shows, it is a simple example, but what it shows is that as you get more impervious cover within your watershed, it becomes more difficult to retrofit because you have a larger capture volume that you have to capture and treat or otherwise manage.

So I think it is an important point that while you can go after a lot of these problems that you are having within your watershed, it can be really difficult to get there. And continuing on that example, we are looking at that hypothetical example watershed where we have 30% impervious cover; we are trying to treat the water quality volume. We have had some initial stakeholder meetings and our watershed was developed without adequate stormwater controls. They don't provide water quality treatment so we are going to go back in and use retrofitting to capture and treat that water quality volume. So setting a reasonable goal of maybe treating 75% of that capture volume and assuming that we are going to treat 80% of that with storage, large scale retrofits, and 20% of it with onsite retrofits, small scale retrofits. And you can see on your screen we have some estimates of how much each of those, how much impervious acreage that each of those would treat. Running the numbers we see that we need about 20 of those big retrofits and over 400 of the small scale retrofits. So as you can see, that's a lot of retrofits. So it can be daunting.

Nikos Singelis: Yes, it looks like it could be a very daunting process.

Michael Novotney: It can, but the great thing about the retrofit manual and the process that we will talk to today is it lays out a systematic and really process-driven approach to identifying, implementing retrofit projects that can address those problems. And the key is really to use a comprehensive delivery strategy that includes both large scale and small scale projects; a lot of stormwater managers will make the mistake of thinking that stormwater retrofits involve just those large scale capital improvement projects. But a comprehensive retrofit program involves not only those but also some of the small scale downspout disconnection type projects as well. And they can be delivered through a variety of methods, through redevelopment projects, through demonstration and education projects. There is a lot of different methods that can be used and the retrofit manual talks on those methods quite a bit.

I think one important one to point out is redevelopment, not only on redevelopment sites, but also using stormwater management criteria on redevelopment sites to perhaps trigger other retrofits off site in a mitigation type approach or a fee in lieu of program type approach.

Nikos Singelis: Yes, right, there can be a whole range of design credits and also if you will financial credits, particularly in communities that have stormwater utilities. They can set up the fee structure to give financial credits to homeowners and businesses based on retrofit options which can spur that kind of change through an incentive program. So, yes, there are a lot of options for getting this down. And the city shouldn't think that they have to pay for and undertake everything themselves. They can find ways to incentivize some of these behaviors and certainly to require them in the redevelopment phase particularly.

Michael Novotney: That's right.

Nikos Singelis: So we have a poll question. For those who have attended our webcasts before, you know how these work. But I will explain it real quick. We have a number of these poll questions where we are asking you questions and so this is our first one here and we will have a couple of these spread out throughout the webcast today. So this first one asks, what is your community's experience with stormwater retrofits? And we have a range of answers there. The way to answer these things is to click on the little radio button, the little circle to the left of one of the options. So we will give you a couple of seconds to do that. And if you are in a big group, maybe you can figure out some way to come up with an average answer or something like that and report it to us as well.

The first one, we have an active stormwater retrofit program. The second one, we have tried a couple of retrofits but are just kind of getting started there; don't have much of a program set up yet. We are thinking about it but we haven't done anything yet. And this is the first time we have heard about retrofits since the last option and that's why we have signed on to this webcast. So again, click on the radio button to the left there and we will take a look and see what the results are there and we will show you those in just a second.

Okay, it looks like a few people have responded. I will give you a couple of seconds more. And by the way, we have several question and answer breaks during this webcast, so make sure to

submit your questions to us and we will try to answer as many of those as we can. We have got I think 3 or 4 question breaks coming up so we will be taking questions from the audience as well.

John Kosco: And that's right, Nikos, the questions are coming in. We just encourage people to type them in as we go along. Don't wait until the first question break to start typing in your question.

Nikos Singelis: Alright, let's take a look and see what these results are. So here we have a nifty graphic. But hey, this is pretty impressive. 19% say they have an active retrofit program.

Michael Novotney: Great.

Nikos Singelis: Wow, that's great. 30% have done a little bit. And then we have another, about 50% there that are basically getting started. So I guess that is sort of to be expected. But wow, 19%.

Michael Novotney: I'm impressed by that number.

Nikos Singelis: Yes, that's great. Now we always have people who want to put their best foot forward in these webcasts, so we will see. But if you have some examples of good retrofit programs that you want to send to us, we would certainly appreciate an email with some kind of a short description. We can always use that kind of information to help publicize this program.

Okay, and so, as I said, we have Dan Frisbee from the City of Charlottesville in Virginia here with us today, and so we are going to try to intersperse some of the Charlottesville experience with this throughout this webcast. So welcome, Dan. Thank you for joining us.

Dan Frisbee: Thanks very much Nikos, I appreciate it. Good afternoon everyone. It is a pleasure to be here to speak with you all today about the City of Charlottesville's stormwater retrofitting experiences, and particularly our Stormwater Stewardship on Public Lands study.

Just to give you a little outline of what I will cover today in our case study, we will talk about some of the factors that have led Charlottesville to arrive at the point of even conducting a formal retrofitting study in the first place. We will walk through the methodology, the process and the results of the study and then we will talk a little bit about how our past experiences with retrofitting and now this study have positioned Charlottesville really to incorporate retrofitting into what we are calling our culture of water resources protection and overall environmental sustainability.

And then finally we will wrap it all up with a few key pieces of information and advice.

Nikos Singelis: So Dan, this study is available on your website, right?

Dan Frisbee: It is indeed, and later in the webcast, towards the end, there is a web link on one of my slides to it.

Nikos Singelis: And it is also in the resources guide that you can click on on your console there. And one of the really nice things about this study is that it really does give an organized kind of approach for targeting this. So it is not as you will see, it is not just a random sort of hit or miss thing, but there is some real thought behind it. So Charlottesville is a Phase II city, right?

Dan Frisbee: That's correct, we are a Phase II city, and as such we have held a stormwater discharge permit from the Virginia Department of Conservation and Recreation since 2003. Just to get you a little bit familiarized with Charlottesville if you are not familiar with where we are, we are in central Virginia at the foothills of the Blue Ridge Mountains. We are the urban center of the Rivanna River Watershed which flows into the James River which as many of you know is a major tributary to the Chesapeake Bay.

The picture that was on my first slide and was actually of the Rivanna River and I put that up there because really that is the focal point for a lot of the local stormwater and watershed management activities in the Charlottesville area.

We are only about 10.4 square miles as a city and we have 40,000 residents, and since we are home to the University of Virginia, we have become even denser when classes are in session because you add about an additional 20,000 students in town.

Nikos: So for a total of 60,000?

Dan Frisbee: 60,000. Yes, before I get really into the guts of the study itself, I think it is probably useful to talk a little bit about how Charlottesville got to the point of undertaking it in the first place. And really, due in large part to the history of the city, you saw on the first slide, 1888, a lot of the development that took place, and we are mostly built out at this point, a lot of that development took place without the benefit of stormwater management regulations and certainly without our current understanding of stormwater's relationship to water quality and overall watershed health.

Michael Novotney: So you lack a lot of that stormwater controls that we were talking about earlier?

Dan Frisbee: Exactly. We have a lot of existing development, much of it without any stormwater management whatsoever, simply conveyance. And as a result of that we do have some fairly major impacts to our urban stream network including severe stream bank erosion in places and an associated sedimentation problem. Several of our local streams do not meet water quality standards and we have official TMDLs established. We also recognize that we are part of the greater Chesapeake Bay watershed so our efforts are not only for our own local streams but are playing into a larger, significant and very important restoration effort to address the problems that the bay is facing today.

As Nikos mentioned, and I touched on, we are also a Phase IV – sorry, a Phase II Community.

Nikos Singelis: No, no, not a stage IV. We don't want to alarm anybody in the audience there – there is no Phase III or Phase IV coming.

Dan: Phase II.

Dan Frisbee: Yes, more appropriate. So we do have a stormwater discharge permit with the 6 minimum control measures that a lot of you are very familiar with out there. And we found that stormwater retrofitting can be a very effective strategy for addressing various components of our overall stormwater management program, and I will talk a little bit more about how the retrofitting program is at least partially addressing elements of our permit throughout the course of the presentation.

Charlottesville is also a city that has made several formal commitments to environmental stewardship including adopting an environmental sustainability policy, pursuing an environmental management system, a water protection ordinance was adopted, we signed on to the US Mayor's Climate Protection Agreement in addition to a whole host of environmental programs and initiatives, energy and water conservation, urban forestry, recycling are all things that the city is looking at. So this really just fits into the fold nicely as another way that we are addressing overall environmental sustainability.

Nikos Singelis: Dan, just out of curiosity, what is the source of drinking water for the City of Charlottesville?

Dan Frisbee: We have two surface water reservoirs, one is up right in the foot hills of Blue Ridge Mountains, so it is to a very pristine source of water, and another one is a surface water reservoir where actually the Rivanna River is impounded. And we are going to a very comprehensive water supply process in Charlottesville right now. So those issues are very much on people's minds.

And beyond the historical impacts we are facing and our environmental commitments, we do have current regulations that are in place for new development in the city. For that new development we are encouraging and incentivizing use of low impact development and other water quality-based BMPs. The city itself, when we have the opportunity and we have a new construction project is also pursuing those kinds of stormwater management, but really we don't have a lot of new construction that we are actually undertaking. So as a result of all that we have really come to see that the opportunity and importance of installing BMPs as retrofits on existing public lands is going to be the way to address some of these historic impacts, address some of these commitments, address some water quality goals while at the same time allowing us to demonstrate and promote the types of practices we want to see widely adopted across the city, public and private.

The retrofit ball really got rolling in Charlottesville back in 2005. The potential grant opportunity came up and it served as the impetus to get some of our folks out in the field and go take a first look at a subset of some of our public lands to assess where do we have some retrofit opportunities. We evaluated a few properties and admittedly we had little distinct methodology, established performance goals, scientific evaluation criteria, a lot of things you are going to hear us talking about throughout the course of the webcast. But we did come up with a spot, that was our Greenleaf Park, and it was identified to be a great place to put a rain garden. We pursued and received a grant from EPA's Chesapeake Bay Program in the Virginia DCR. The design was contracted out and then our own crews actually developed a landscape plan and constructed the rain garden in the park.

And now here is where I want to make the first tie back to our MS4 permit, MCMs I and II, public education, outreach and involvement. And this is because nearly 50 volunteers from the community assisted in this project whether it be tasks in the construction such as grading, laying filter fabric, mulching, planting plants. We also had a webpage that tracked the construction progress so the community could see lots of pictures and a description of the different pieces of the construction, what went into it. We also have some very high quality educational signage out on the site for folks to come and take a look at.

The retrofit even beyond that has served as public education piece – we have had tours for the public there, it is an outdoor classroom for the local elementary school. Environmental news stories by the media have been staged there. So all the success associated with this retrofit led us to feel we want to do some more of these things so we got to the point where we thought, you know we really need to look at this in a methodical, strategic and defensible examination beyond just going and picking one here, one there. So this kind of got us to the point where the Stormwater Stewardship on Public Lands study was conceived. We decided to limit the study to public lands and particularly to parks and school campuses because we really wanted these retrofits to be publicly accessible so that they could serve as demonstration projects and interactive learning opportunities for the community.

So early in the process we pulled in some key partners including those that are listed on the slide here, and we collaborated together on a grant proposal which we were awarded by the National Fish and Wildlife Foundation. And the Center for Watershed Protection was selected as the contractor to perform the study which was a perfect fit given the fact that at the time they were working on and finalizing the retrofit practices manual we are going to be hearing more about today.

So the major study objectives included the systematic evaluation of our parks and school campuses in order to identify really a prioritized set of retrofits that would improve water quality. We wanted it to remove pollutants, increase ground water recharge, decrease stormwater volume and velocity.

And the end result would be a catalog of retrofit opportunities that were tailored to those particular sites in and around the public lands and which could serve as stormwater education and outreach opportunities. The study was envisioned to be a blueprint and a guide that we would use for future city retrofitting efforts.

Nikos Singelis: Thanks Dan. And it is interesting too in what you are saying is how this idea of a demonstration project can then blossom. And of course as you mentioned, pass multiple objectives across various parts of the regulatory program as you mentioned, education and outreach and public involvement. And it is interesting too; maybe you could just say a little bit more about why you decided or what advantage you thought it was to focus on public lands kind of as your first strategy.

Dan Frisbee: Sure, I mean first and foremost we really wanted the project to be publicly accessible and as publicly accessible as possible, so that is not only public lands, for example not our public works yard where we don't want a lot of folks wandering in and out of but schools and parks that are open for folks just to come in, that we can lead guided tours through if we want to. And we wanted to utilize those public lands to provide some real tangible examples of the kind of stormwater management we want to see. And since we have control over those properties it really made sense and frankly we had to kind of limit the scope somewhere because we couldn't take on the entire City of Charlottesville as a whole. So all of those things combined it seemed to make the most sense to say parks and schools, we'll start there and in the future we can expand our search.

Nikos Singelis: Yes, yes, that makes sense, particularly in the issue of having control. As you kind of did, and we will talk about this more later, but as a kind of cost benefit as to the different things that you are going to evaluate, having control over the land is definitely a benefit to moving forward with a particular project.

Michael Novotney: And the great thing about the city's scope and their approach was that it was very focused and had a real purpose. And we will touch on that more today.

Nikos Singelis: Okay, so we've got another poll question here, actually two poll questions – these are the basics so that we can get a better idea of who is with us. The first one just asks you who you are with. Are you with a Phase I MS4? A Phase II MS4? And by the way, apologies to any Phase I cities; I keep mentioning the six minimum measures which are in the Phase II Program but the same basic ideas appear in most all of the permits of the Phase I Program. So we hope this applies to you as well. Are you with a state or federal government, consultant, industry or some other group that we haven't mentioned there? So again, just choose the radio button to the left of the answer that best applies to you. And we will take a look and see what those results are.

Let's see, we've got a pretty good selection here. So just in the interest of time I will show you what we've got so far. Let's see, we've got 14% are in Phase I cities, 30% in Phase IIs as expected, actually it looks like a very good representation from state and federal governments today, 24% there. That is quite higher than usual. 20%, 21% consultants. And that is pretty common actually because there are a lot of consultants out there that work directly for Phase I and Phase II cities and do a lot of helping out there. And then we have one more question here for you which I will show you now. And this really helps us get a better tally of how many people are out there. We know there are people sitting in their cubes by themselves but we also know there are conference rooms set up around the country where there are multiple people. So if somebody can get to a computer and give us an answer there, again just select the radio button. If you can't get to the computer and want to send us your answer via email later on we can accept that as well. But this will help us get a better tally of how many people are participating today.

John Kosco: Nikos, while people are doing that, if you have a room with a lot of people in it, more than 20, if you can click the radio button for more than 20 but then also in the Ask a Question box give us the estimate for how many people are in your room, that helps us get a better estimate of how many people are signed in.

Nikos Singelis: Yes, absolutely. And again those people in Beaufort County, South Carolina better tell us how many people are there listening in today.

John Kosco: Actually while we wait for people to respond in, I would like to remind people that if you want the slides there is a, I believe, a Download Slides button on your screen that you can click and download a PDF of the slides. And then also there is a resources button where you click that and download a PDF of the resources which will include copies of these forms that Mike and Deb are going to be talking about next, I believe.

Nikos Singelis: Okay, so looks like we have got some results here, let's get those out. Okay, most people are in cube land today, and that applies to I think everybody in this room. And then we have some groups there, so very good. Again, if you have a big group and want to tell us how many people are in that group we would certainly like to know. But in the interest of time we are going to move on to the next part of this.

So now it is incumbent upon me to make fun of the Center for Watershed Protection because of this diagram. This, they call it the "Football Diagram," which if you are at all familiar with any of those products you will see rehashed over and over and over and over again in any possible scenario; they always seem to manage to come up with 8 steps of whatever the heck it is and they just change the captions under there and then sell it back to the government as a final product. Right Mike?

Michael Novotney: Well, it is a nice round number and we save money in producing graphics so we are looking out for you.

Nikos Singelis: Absolutely, they are very efficient. So Mike, why don't you take us into some of the details here and we are going to go through some of these steps right?

Michael Novotney: Sure, we talked a little bit about why retrofit, to address specific problems within our watershed and now we are going to talk about how you go about addressing those problems through this systematic 8-step process you define and implement retrofit projects. And this process which we have developed over the years at the Center is cost effective. I think applicable to both small and large watersheds and then can be scaled for both small onset practices as well as large storage type retrofits.

Before we dive into the particulars of the process I do want to point out a few prerequisites because retrofitting is a little bit different than designing a new stormwater practice and in that regard you are going to be – instead of working with a clean slate and a nice new Greenfield development site, you are going to be working in a heavily developed site with a lot of site constraints. So it is going to require a lot of creativity, a lot of investigative skills and patience, and you also need the technical knowledge about hydrology and hydraulics and stormwater engineering, local stormwater engineering, local stormwater management practices that have been used, the knowledge of potential retrofit locations, and an understanding of the big picture. And I think this is something that we never should lose sight of when we undertake any of these efforts. The City of Charlottesville had a great focus for their retrofit study, but whether it is a nice wooded riparian stream corridor or an estuary or a coastal marshland or a drinking water reservoir, you have got to keep in mind what you are actually working for and the goals that you are trying to meet with retrofitting.

So without any further adieu we will dive into Step 1 of the process which is Retrofit Scoping. And I pointed out at the end of Dan's presentation that giving your retrofit program a specific focus and purpose is extremely important. So we will spend a lot of time on this stuff this morning. And through Retrofit Scoping you are defining that strategy, it's going to meet those goals that you want to meet in your watershed and really tackle those problems. There are a few key tasks that are involved; I'm not going to spend time on that first one there on your screen but the last three we are going to talk about in more detail this morning. The first of those tasks is defining your retrofit objectives. And again, this is tying your retrofitting into what you are actually working for, answering and solving the problems that you are actually trying to address. And we have some nice examples of stormwater retrofitting objectives up on the screen. The key point here is to tie maybe your larger big picture restoration objectives, reducing pollutants of concern that might be conveyed into a bay or drinking water reservoir into a specific and measurable retrofitting goal. So we have a few examples here on the screen of how you can tie big picture restoration objectives into some retrofitting actions. So a key is to translate those big picture goals into more specific measureable goals and to make sure that those goals are realistic as well.

Nikos Singelis: Not everybody knows to set measurable goals. Very good Mike.

Michael Novotney: That's right. Setting some bars to hit and not setting them too high that you can't ever jump over them, but giving a real purpose to your retrofitting study and I think while it is nice to look at these hypothetical examples, I think we should take a good look at what the City of Charlottesville did in defining their retrofit goals and scoping their program out.

Dan Frisbee: Sure, I'll talk about that a little bit more. We talked earlier about the overall objectives of the study that were developed when the idea was hatched, but early in the process, we also came up with some performance goals for the retrofit that we would be searching for, like generally the ones Mike had on his last slide. And we really took care to ensure that the specific retrofit performance goals were complementary to, it would help achieve the overall study objectives.

We had a kick off meeting with the center in the city. First of all they gave us a good review of what retrofitting was and then some group discussions, some subsequent meetings resulted in the performance goals you see on your screen here. Now I'm not going to read through them all but I will touch on a few of them. The primary goals: pollutant removal and we chose the focus on local and regional pollutants of concern. Sedimentation, as I had mentioned before, has been identified as one of the greatest threats to the health of the Rivanna River Watershed where Charlottesville is, and several of our local streams that have the TMDLs are for bacteria. So those were certainly pollutants that we were interested in seeing these retrofits address. Nitrogen and phosphorus are two of the major nutrients being targeted for reductions in Chesapeake Bay restoration efforts, so those were also ones we wanted to look at.

Runoff reduction, we wanted retrofits that could achieve overall reductions in stormwater volume which lead to helping to address some of that down stream channel erosion issues which then gets to your sedimentation problem. So trying to look at these things in the context of what really are our local water quality goals and issues that we are trying to address.

A couple of the secondary goals just to give you another idea, the naturalization and recreation one you see there, since these were schools and parks we wanted to ensure that there was going to be a sensitivity to the existing and the future active recreational programs on those public lands. We didn't want there to be conflicts and be fighting over what we were going to do on these public spaces.

And quick implementation – we thought it was really important to identify a few retrofits that we could implement right away in the near future in order to capitalize on that momentum created by the study.

Deb Caraco: Well, thanks, I will take it from there, this is Deb Caraco.

Nikos Singelis: I'm sorry Deb.

Deb Caraco: No, that's okay.

Nikos Singelis: I momentarily spaced out here. Welcome Deb Caraco who now gets to actually talk, who has been patiently sitting here for a little while. Thanks Deb for coming down from New York State to join us today.

Deb Caraco: Thank you. I'm going to be discussing now during this portion the different locations where stormwater retrofits can be placed. The retrofit manual divides retrofits into two larger groups, storage retrofits and on-site retrofits. These will be they are described in detail in Chapter 2 in the manual. And again I want to emphasize that the word storage refers to both storage within ponds as well as overall watershed storage and bioretention, other types of practices.

Nikos Singelis: So when we talk about storage, we are not trying to imply big ponds only; that might be one of your options. But infiltration into the ground is also a storage option and we will talk about a range of those things. So hopefully nobody is sort of confused; you know we are always trying to find the right terminology and the right way to say things and sometimes it is a little bit of a forced fit with some of these words.

Deb Caraco: Again, we are to almost Nikos' favorite diagram. This one only has 6 –

Nikos Singelis: Oh, look it changed.

Deb Caraco: The same amount of graphics effort to produce this one. Just describing the different – so storage retrofits are basically retrofits that capture a large drainage area; these are our big site retrofits. Typically they are capturing on the order of 5 to 500 acres. They typically can address both quality and quantity channel protection types of criteria. Usually they would be located on public lands. The most common types of practices that get used in these are ponds and wetlands. As far as cost, they are typically moderately cost per acre and they are in general quite difficult to implement on very highly urbanized watersheds. Some of the typical ones are

described here. And you are looking at existing ponds, very large parking lots within the conveyance system. So again you are looking for areas where you can capture a quite large drainage area. And in a little bit I am going to highlight a couple of different types of practices among these – types of locations among these, excuse me.

Nikos Singelis: And yet now one with 7. How innovative.

Deb Caraco: I think a couple might be stretched a little bit to accommodate the 7 as well. The other large groups of retrofits that are a category of locations of retrofits are on-site retrofits. So these practices are typically capturing less than 5 acres. And some of the times the individual practice of capture is as small as a tenth of an acre. Typically the primary goal as far as what you are trying to achieve with them is for water quality and for ground water recharge. It is typically hard to accommodate flood control or channel protection goals within these practices. Very often, not always, but very often a community will have to look to locations on private property as well as public property. And the types of practices are looking again at these very small scale, typically looking at stormwater filtering types of practices, small infiltration practices, some low impacted development types of techniques. They are typically more expensive per acre than the storage retrofits and they can be applied typically within the ultra-urban setting. So again, in looking at the specific locations you can use, we are looking to these smaller areas, targeting hotspot operations. This might be for example within an individual gas station, individual rooftops, just looking at small areas of streets.

Nikos Singelis: So some of those particularly would be good when a site is being redeveloped so that you can apply those as part of your redevelopment package that you negotiate with the developer.

Deb Caraco: Yes, that's right. That's a great point. So when you are tying to decide which locations and which blend of locations you want to go to to conduct your retrofit inventory or select which types of retrofits you are going to use, you have to consider unique challenges for each one as well as the overall, again not losing sight of what objectives are you trying to achieve. Now Charlottesville, Dan, I know you were discussing public ownership was an important criterion that you used in your initial selection. I think that is true for many communities. And I just want to next, in the next two slides, just go in a little bit more detail as far as some of the specific retrofits locations that can be used.

Within the manual there is a coding of SR for Storage Retrofits and OS for On-Site Retrofits. One of the most common things to do when you are doing a retrofit inventory is just looking to existing ponds. These are some of the easiest areas to conduct a stormwater retrofit, especially in communities that have had a history of flood control but maybe not water quality.

Okay, some of the strategies you are trying to do within existing ponds – often you are trying to somehow increase the volume of the ponds so that you can for example accommodate both water quality and channel protection in a pond that has historically only done flood control. One of the things you do when you go to the pond, look to see if you can perhaps excavate the pond bottom. You would want pond bottoms to be flat and dry ideally in order to do that. Or perhaps there is room to raise the pond embankment to create more volume within the pond. Some ponds have done controls for several different storms and you can then trade storage, that is use storage that has been traditionally used, for example, controlling a 2-year storm design and then change that outlook structure so you can achieve more goals.

Another thing that is commonly done with an existing pond is just adding elements that provide for additional water quality. Providing a longer flow path. Sometimes ponds will have a concrete channel through them, going through and modifying that so you can get just some additional stormwater quality treatment within an existing facility.

Typically these start out as ponds. Often they start out perhaps as a dry facility, the end product is a pond or a wetland.

Michael Novotney: I think it is important to point out that it is a very common one, since a lot of our watersheds were developed maybe 20/30 years ago; maybe you had flood control, good opportunity to convert to get water quality treatment in those ponds.

Nikos Singelis: And a lot of the ponds as we talked about in our last webcast on BMP performance frankly are under performing BMPs. And so there are some things as Deb mentioned that we can do to make them better performing, for instance taking a dry pond and perhaps turning it into a wet pond, or taking a wet pond and turning it into a wetland, or adding trees, or extending the flow paths, or doing all sorts of things to make those have higher values, not only for water quality but for habitat, things like that.

Deb Caraco: It's true. And another opportunity within pond retrofits is that you are revisiting a past practice that perhaps even just needs some simple maintenance. So you are able to kind of get two things done at one time when you go to ponds because you can just do kind of a standard inspection of the pond just to see does it need regular maintenance, does it need to have sediments removed. And at the same time improve the water quality. In general ponds have less challenges than other practices. One place where it can be difficult is where the pond barely has enough volume or space to achieve its original design goal.

Nikos Singelis: Why don't we move ahead here just in the interest in time and talk about the hotspots.

Deb Caraco: Alright, so as Nikos is moving on through I will just start talking about them a little bit. Stormwater hotspots encompass various land uses within commercial, industrial, sometimes a highway barn for example could be a municipal hotspot. These are areas within the watershed that have the highest level of stormwater pollutants. Typically they would be hydrocarbons and nurseries pictured here might have a very high nutrient load. Even if you are able to capture much of the watershed within some of the larger storage retrofits, it is really important to focus on these areas that can include a very significant amount of pollutant load within the watershed.

Nikos Singelis: One question we get asked a lot Deb is whether we can use LID kinds of concepts that promote infiltration in a hotspot area.

Deb Caraco: And that is a very good question. Typically infiltration is highly restricted within hotspot operations just because of concerns of contaminating ground water. I know piece of information we were talking about before the webcast was for example if you use porous pavement you can end up with an area that if you have oil spill for example that would be capturing all this oil below ground. However one application where you could try to do it is if you use a treatment practice prior to that infiltration process. Sometimes you can even do it with a very large pretreatment practice such as an oil grid separator, and in some areas especially if they are concerned about contaminating a sole source aquifer they may require complete stormwater treatment advice on things such as a filter before infiltrating.

Nikos Singelis: Yes, those are all good points. So it is very site specific but it certainly not out of the question is the net result of that.

Deb Caraco: And on hotspot operations, typically the types of practices we mostly would focus on are stormwater filtering practices. Sand filter would be really the classic practice that would be used in a hotspot. Often this can be coupled with pretreatment types of practices again such as oil grid separators, that one of the main things they can do is if there is some sort of spill act to capture that. One thing I always want to emphasize on these too though is that for many hotspots it is the land use, but it is the specific operations that happen with on that land use that create the pollutant load. There is another manual, Manual 8 that looks very much like Manual 3, Pollution Source Control Practices Manual that really goes through and looks at some of the specific practices you can do on hotspots to try to minimize their pollutant potential combined with retrofit.

Another one of the on-site types of retrofits is small parking lots. Often this could be again a mixture of some of these might be public properties, some of them might be private property, and this is the classic place to really implement a lot of the low impact development types of practices. Within a parking lot you are typically dividing it up and trying to look for places to implement several smaller practices rather than looking at one large practice.

And this next slide just sort of shows kind of the conceptual view of how a small parking lot might be looked at. Again, looking at just several types of practices; often you would be looking at some site design, just reducing impervious cover. Often we will go out to a site and just say, "I think this parking lot could be reduced in size, reducing impervious cover." Combined with some of the filtering practices, and in this example looking to the landscape islands and saying maybe they could be used as bioretention. Or perhaps we could use bioretention at the perimeter of the site. Sometimes you might use a swale type of practice. Sometimes look to the parking lot and see there is overflow parking area and maybe we could use a permeable pavement in that area. Sometimes it might even include some kind of a sand filter and in this design towards the top there is a perimeter sand filter. So again you are looking at quite a few different options within the same site often.

Individual rooftops. This one, I think one of the really important kind of take home messages with it is rooftops both commercial and individual are kind of scattered throughout the watershed. And both of them present unique challenges. And I will talk a little bit in the others about the specific mechanisms of treating these rooftops, but one of the really important things is the delivery system to make these happen. Typically when you are doing rooftop retrofits it would be asking many individuals to try to do it. Some of the places that have done, that have some good programs for this is Portland, Oregon, which has rooftop disconnection program and

includes a combination of financial incentives as well as technical support to help individuals conduct rooftop runoff.

Some types of rooftop treatment might be required as a part of redevelopment in some other areas. Nikos kind of alluded to a specific link on this, but the green infrastructure website?

Nikos Singelis: Yes, for our NPDES green infrastructure initiative which is on the EPA website at epa.gov/npdes/greeninfrastructure has a bunch of information about green roofs in particular as one possible option for implementing this sort of, if you will, effective rooftop disconnection.

Deb Caraco: And then I would like to just look a little bit more detail into each of the types. Residential rooftops present a very different type of challenge and a different type of strategy that you might use than commercial rooftops, so just in general large, flatter rooftops. Residential rooftops typically may be using very small practices like a rain barrel or a small rain garden. And one of the real things we are looking at is just trying to catch each individual downspout.

Commercial rooftops on the other hand, often there is kind of a larger area that is draining to each practice you might use. Sometimes they even have an internal drainage system. So you may be looking for something with much more structural or a significant undertaking, like such as a green rooftop. Rather than using rain barrels, kind of a very similar type of practice would be to use a much larger cistern that can in some cases be combined with the irrigation system or occasionally even can be used for gray water within the building.

And then, again, as you are just kind of summing up, as you are going through and trying to decide where you would like to retrofit within the watershed, it is really important to understand what your different retrofit options are, what your restrictions are as far as property ownership and combine those again with trying to make sure you are able to achieve the goals you need to for your retrofit options.

Nikos Singelis: Alright, thank you Deb. We have a quick poll question here which I am going to try to hopefully fit in. We want to find out, particularly for those of you who have done some retrofits before, what kinds of practices you might have used in the past. So same thing as

before, just choose one of the options. Perhaps you have used more than one, but just pick the most common one if you have used several. And we will take a look at the answer there. And actually we are doing, I think, okay on time. So we will manage to wrap this up and have plenty of time for questions.

So let's see what the results are here. We have got – we need some more people to report, come on guys, start clicking those computers there; we only have 18 people reporting so far.

Michael Novotney: Maybe some of them lied about the extent of their –

Nikos Singelis: Alright, let's see what we've got here. Ah, okay, now we have some better results here.

Michael Novotney: Oh, look.

Nikos Singelis: Oh, this is interesting. Wow. 26% and 28% there for bioretention and swale. Wow, that's encouraging. Those are among the more effective practices that we see. Extended detention there to kind of dry pond at about 17%, wet ponds trailing that at 11%; kind of like a horse race here. Poor wetlands only 3.3%. Well that's not so good; those wetlands really can be somewhat more effective than some of the other ones. So anyway, very interesting poll results there. So we will continue on now and Deb.

So now we are going to talk about how we figure out what the preferred practices are.

Deb Caraco: Again, I guess you all understand which of these practices were since you were responding to the poll question. But again using kind of a full suite of practices that are available. Within ponds you can have drier ponds that have used extended detention, wet ponds that use a permanent pool and wetlands again, that source kind of category of wet ponds. Extended detention wetlands typically work very well when they are capturing a much larger drainage area. The remainder, bioretention, filtering, infiltration and swales are typically applied more with these on-site retrofits, or at least for smaller drainage area practices. Other can include a wide variety of practices. It can include some pretreatment types of practices. Again, I

think I mentioned oil water separator or just even deep set some catch basins included. Also the whole variety of low impact development practices can also be considered as part of retrofitting.

Okay and I just want to talk a little bit about the ways to choose the practices. A lot of which practices you choose is going to fall out of the locations you are able to do it. So again if you have gone through and decided that the main thing that you want to do is focus on your existing ponds, then that is going to lead you toward of course pond retrofits. If again you decided instead you want to focus on a bunch of smaller parking lots in the watershed or look at some on-site type of practices, you are going to be looking more toward practices like bioretention practices like, of low impact development. And one of the things, the other things you really want to consider as you get a little bit more specific is how much do the practices cost, how they are able to remove pollutants. If you have a goal of reducing the volume of runoff you might want to look to infiltration practices as well. Another thing that is really important to consider is well is just the long term maintenance. Is your community going to be able to deal with many small practices are the maintenance burden in each of these practices. And another part I will talk a little bit more when I am speaking later in the webcast is other benefits to the community. Is it a safe practice? Does the community view it as a benefit? And Dan I don't know if you want to talk a little bit about ways that you decided to assess or define which ones you wanted to do?

Dan Frisbee: Sure, when we came into our study, I guess we maybe came into it slightly differently because we weren't really locked into any particular practices when we came in, and that was really for several reasons. The sites that we were dealing with really kind of span the range from wide open spaces for some of our bigger parks to very urban school campuses where there is just not a lot of room. So we had a lot of latitude for the types of practices. We wanted to look at both storage and on-site opportunities and we were holding out some hope that we would find some good opportunities to really accomplish some significant sub-watershed treatment on some of our properties. And we did find a couple of those instances, but we ended up finding a large majority to the on-site practices, which was fine; we wanted to do the study to assess what our potential options were. We came into it wanting practices that would provide water quality treatment through filtering and infiltration. We wanted to address volume issues and address channel protection issues. So we kind of came into it knowing what we wanted to get out of it and the types of places that were there and then went out and did the assessment and it just kind of naturally spelled out which practices matched up and met those performance goals.

Nikos Singelis: Either way that you come about going at this you are still trying to figure out basically what your highest priorities are going to be and what your most sort of cost effective

approaches will be and all that sort of stuff. So there are probably multiple ways of skinning the cat if you will.

Deb Caraco: And another thing the manual has that can be helpful in this process is Appendix E of the manual has some detailed cost information both by practice and by location, and Appendices E and D have information regarding pollutant removal of the different practices. So that is another as far as how to evaluate each of these practices. Chapter 3 outlines the different practice options there are for stormwater retrofits and this table, just show a little bit, go over what it means, looks at for each location what types of practices are the most applicable and I will just go over some of the ones we already talked about. For SR-1 which is Existing Ponds, the black dots would be, it's the preferred option. So if we are going to be using Existing Ponds, we are going to be leaning more toward extended detention or wet ponds or wetlands. You an occasionally try to incorporate bioretention or filtering elements within existing ponds. And sometimes swales and infiltration are a little bit more difficult to incorporate.

Looking at hotpots, the easiest practices to incorporate are typically bioretention and filtering. So you can kind of use this as a screening to say, okay if here are the types of locations I was able to find within my watershed, what are the practices that I am going to most easily gravitate toward once I have those practices in place.

Nikos Singelis: Great, and on this next slide we have some additional information for you on BMP performance so that you can look at some of the different websites out there. Our webcast from last time, the urban BMP performance tool that we have, the International BMP Database that we featured last time, the Center for Watershed Protection's Pollutant Removal Database, and a number of other manuals that have information as well. And so while you are looking at that, John why don't we take some questions from the audience. I will just leave this slide up there for a few seconds. I imagine we must have some questions now.

John Kosco: We have tons of questions. The first question is actually for Dan. Jerry asks for Dan, if possible, to identify, what was the one issue that convinced your governing body to launch the initial retrofit screening effort? Why did they do it?

Dan Frisbee: Well, I guess it is hard to pick out one in particular. It really is a whole host of issues that were coming together at the same time and it gets back to one of the slides I had up

earlier for "How did we get here?" It is the fact that maybe first and foremost we have a citizenry in Charlottesville that is really interested and very engaged in water quality and stormwater issues, and it just, if anything, we are not moving fast enough. So it really was just an obvious choice. This came to us as an obvious choice to mix it in with our MS4 permit and really just to kind of keep the ball rolling and keep the momentum going on these issues.

John Kosco: Great. The next question is Darryl from Virginia, and I will open it up to either Deb or Mike. But he asks how important is it to perform retrofits on a coordinated basis with some strategy versus doing them on a kind of isolated one-by-one basis as they present themselves.

Deb Caraco: In my opinion I think it is pretty important to try to do it on a coordinated basis. One of the main reasons at least in my opinion that is important to do is because I think you save money in the long term by trying to achieve the specific goals for the lowest possible cost. And there are some initial costs to going out and doing field work and a comprehensive assessment, but I think that it pays off in the long term to try to find what the really best bang for the buck is.

Michael Novotney: I think that's the point right there; you save, you use your time and your money most effectively when you perform retrofitting systematically.

Nikos Singelis: Yes, I think so too, and I think we make a stronger connection to water quality benefits. It's certainly possible to do some retrofits in your watersheds that might be great demonstration projects and might be valuable for some other reasons but they may not have that great a water quality benefit. And so if you strategically pick the sites that you are looking at you may be able to hit multiple benefits there, both having as Charlottesville did education and outreach and also something that is actually contributing to water quality improvements.

John Kosco: Great. Next question, Keith from Las Vegas brings up the small versus large on-site BMP issue. He asks does the rate you require storage volumes for flood control or channel protection is it better to have a dozen larger detention basins to minimize maintenance headaches, etc., or hundreds of smaller detention on-site areas scattered throughout the city?

Michael Novotney: I think that the approach that a lot of communities have taken to particularly address flood control rather than doing it spread out across the entire sub-watershed is to pick one or two particular stream regions or problem areas and provide larger regional detention type facilities to address that particular restoration objective.

Deb Caraco: I think I agree with that too. And for flood control, channel protection you are typically looking for the larger practices.

Nikos Singelis: I think too just to add a slightly different point of view on this one, that it is a choice. You know one of the things that we talk about with low impact development is you are going to have many more practices to deal with. And so the city should be sort of cognizant of that in terms of the long term management of those things. And it is true that it might be easier to manage a few big ponds than it is to manage a hundred bioretention cells or 200 bioretention cells, but you also have to figure out whether that is really going to get you to your water quality objectives. And there are lots of cases where having big wet ponds is not going to do it. For instance you have a coldwater fishery with a lot of channel erosion problems; having wet ponds is not going to address the temperature issues and is not going to address those overall volume issues either. So you may want to invest more of your energy into the bioretention program noting that yes it is going to take more education, more outreach, more inspections and all that stuff, but knowing that that's going to be the way you are going to get to your water quality objectives.

Michael Novotney: I think that's a great point Nikos. One of the things I tried to stress earlier is that retrofitting should be viewed as being able to address a whole slew of watershed problems, not only flood control and channel protection, but also water quality and also demonstration and education. And the benefit of using some of those smaller on-site practices is that they allow you to meet those objectives often more effectively than the larger single use facilities.

Deb Caraco: I think we pointed out earlier too Mike that is kind of overall to all of this, is that often when you do retrofit analysis you end up trying to use a combination of small and large site practices. Some of, again, especially within existing ponds, some of those larger ones are really easy to get at but you probably do need to combine several different types of practices to meet your long term objective.

John Kosco: Great. Our next question is from Thomas in Arizona, reminds us again about arid areas. We always seem to sometimes forget that these areas have different needs. But in areas such as Phoenix with only 3 to 7 inches of rainfall, no real affordable streams to discharge into, what type of practices or BMPs could they be looking at for retrofits?

Michael Novotney: Well the City of Tucson actually has I think a pretty good rain water harvesting type manual, and not rainwater harvesting in the idea of cisterns and rain barrels like we might think about outside of those arid climates down there, but grading the landscaping in a way that captures and retains the ground water on-site and allows it to infiltrate and recharge some of those shallow ground water aquifers. So I think in those cases it can be as simple as down stop disconnection to grading where the stormwater is allowed to perhaps filter through some of the native vegetation on the site and pass into the ground and recharge some of those ground water aquifers that are out there.

Nikos Singelis: Absolutely. We were in Phoenix not too long ago and talked about how we might balance some of these things because in those kinds of climates the whole flood issue is a bigger issue and so you might want to choose things differently based on sort of elevating that flood protection criteria and sort of adjust your scope that way in those drier climates.

John Kosco: Okay, last question for this Q and A session is for Dan. And Jeff from Ohio asks who maintains the stormwater quality BMPs you have been able to install as part of the retrofits? Is it the city or private?

Dan Frisbee: The ones that we have installed up to this point are all publicly owned and on public land, in a park, in a school, so it is city operations, our Public Works Department and crews that would go in and do any maintenance that is needed. And if it gets to be anything really technical we would maybe have to bring in some outside help. But in some of the bioretention situations where some of the maintenance is really maintenance and upkeep of the plants and some of the materials, we've got a great volunteer coordinator that really engages the community and brings in activist groups to come in and help do some mulching, help take care of the plants. So it is really a combination.

Nikos Singelis: Okay, let's get ourselves back on track here. We will have another I think 2 question and answer breaks later on. So Mike you want to take it away? We are going to now

talk about how to do some initial screening so you have a basic direction of where to go and look around. So Desktop Analysis is the first thing.

Michael Novotney: That's right. So we talked a lot about scoping and giving your retrofit program a specific focus and specific direction. So after completing Step 1 you should have a really good idea about the retrofit objectives that you've got and the locations and practices that will help you most effectively meet those objectives. So in this Desktop assessment step you are basically rapidly searching for and assessing potential retrofit sites. The idea is to save yourself a lot of time in the field by spending time in your cube or your office identifying potential locations to go out and further investigate. And several key tasks include securing GIS data or other mapping data, conducting a desktop search for retrofit sites, and then preparing some base maps that can be used during field work. First task you need to tackle is to secure mapping data, whether that is GIS or paper maps. I just point out that while you can use paper maps, I think GIS data is really the best way to go because not only can you do your desktop assessment quicker and more efficiently but it is also an ideal way to store some of that retrofit data that you collect as you move through the rest of the process. And there is some essential data that you need, topography, hydrology, some of those other ones listed on your screen.

Dan, I think the City of Charlottesville did a great job with their desktop assessment and I believe you guys used the city's GIS to do that, correct?

Dan Frisbee: That's correct. We have some really great GIS data that we have collected in the city and we were able to hand a lot of that data over to the Center. They did a wonderful job doing some analysis of that data, and the point of that was to get an initial ranking of the retrofit potential for some of these public lands we were going to visit. The task really was essential in order to kind of initially prioritize the best opportunities that were out there. Existing data and topography were analyzed, first of all to refine some of the city's sub-watersheds, which were in need, as well to analyze drainage areas for each of the public properties and digitize impervious surfaces on each of the public properties as well. After all that was done we went through a process of categorizing each property as either contributing, receiving or mixed. And the point of this was to get a better indication of what kinds of practices we might be able to accomplish on these sites. Contributing properties such as the one you are going to see in the lower left hand corner of this slide are located at or close to the upper reaches of the sub-watershed. They are really contributing runoff to the downstream system, but receiving little from off-site. So because of that most of your potential is going to be to treat on-site runoff from those sites.

Receiving properties on the other hand, such as the one in the upper right hand corner of this slide, are located near the bottom or the downstream end of the sub-watershed. So in contrast to contributing properties, they might be receiving quite a bit of runoff from upstream off-site areas. So there is at least the potential there to divert, capture and treat off-site runoff on these properties.

Now the actual feasibility of doing this is dependent on a lot of site conditions such as slope, flow, existing infrastructure on those properties, and area that is actually available for treatment, not just the area of the property itself. So field investigations for those sites can look at both on-site and off-site runoff treatment.

Mixed properties, as you can probably imagine, are somewhere in the middle of the sub-watershed and can also consider both.

Some further analysis was done to look at amounts of runoff and available space that could be treated, needs from previous city watershed assessment efforts, and all of this led to an identification of properties with high, medium and low retrofit potential. And those are the ones that were prioritized for field work.

Michael Novotney: I think the city did a great job with our Desktop assessment. I remember being down there last July in the 100 degree weather and really being thankful for the amount of time that you guys spent finding the most effective sites and the best sites for potential retrofitting. What the city did at that level of detail might be a little beyond what most communities will do; a lot of communities will just use their desktop assessment to find a list of potential sites to go out and visit rather than doing the detailed assessment that the city did.

These next couple of slides shows some of the search criteria that you can use to assess your base maps, your GIS information for potential retrofit location. So both storage retrofits and on-site retrofits can be searched for on the desktop. I would just point out that on-site retrofits are usually a little more difficult to identify from the desktop just because it is hard to tell from aerial photography whether or not you can disconnect the down spout or treat a little bit of a parking lot in a bioretention area.

Nikos Singelis: Probably your resolution is not high enough to see at that small of detail.

Michael Novotney: What you can do is pick out general areas to go out and then get out in the field and assess the potential for on-site retrofits. So before you can jump out in the field, I recommend preparing some base maps for each of those potential retrofit sites. It really helps a lot when you are out at the site to collect information quickly, particularly for existing conditions. And level of detail is really determined by the available data and by the preferences of the field crew but there is some essential data that you need to include on the base maps which you can see on your screen.

I would just like to point out that while it can be tempting to add a lot more data that might help in your site assessment, maybe soil information, property ownership, land use, a lot of that stuff tends to clutter up your map, so these can actually become less useful to the field crews out at the site.

Just on your screen now is an example of a nice, clean and simple base map. Notice that we still have some useful layers on there, topo-aerial photo, the storm drain infrastructure and stormwater infrastructure leaves a lot of room for notes and sketching. So I think this is a good example of how to prepare your base maps.

So now we are going to dive into once you have done your scoping and you have picked out your locations that have, are going to allow you to potentially meet your retrofit objectives most effectively, you are going to actually get out in the field and assess those retrofit sites. And this is where the fun really comes in. You are going to collect all the information you need to determine whether or not a retrofit practice can be installed at the site, and you are collecting that information to create an initial concept design and some sketches and descriptions. So there are a couple of key tasks; we will talk a little bit about each one of those here on the next few slides.

There is some advanced preparation work that you all need to do before heading out in the field to conduct your site assessment, and that is really just gathering your equipment, your base maps, your materials. This table on the screen right now shows the equipment that you need and all of this stuff is really useful for assessing site conditions and recording what you see out there. The materials that you need are the field forms, the RRI forms, Retrofit Reconnaissance Inventory forms, which we have included a blank copy of in your resource packet. Retrofit field guide,

authorization letters from the city or local government or regional authority explaining to property owners what you are doing out there, especially if you are going on a private property. Contact numbers in case of emergency and then photo ID and business cards.

Some of you may be wondering exactly what the field guide is. Basically that is a simplified guide to provide field crews with some guidance on conducting retrofitting in a consistent matter. You might have multiple crews going out so that field guide can help them assess sites in similar ways. And we have included a template for that field guide in the additional resources for this webcast.

So now you are all set; you are finally ready to go out in the field and spend some time out there, take pictures, make sketches. We have developed a pretty nice retrofit reconnaissance inventory form to help your field crews quickly and efficiently address retrofit sites and collect all of the information that you need. And again we have included a blank copy of that form in your resources list.

Nikos Singelis: Now this is another common feature of all Center products is to have a form with a strange little acronym at the top.

Michael Novotney: We love the acronyms. We have the word SOUP that is out there in the stormwater world.

Nikos Singelis: RRI.

Michael Novotney: RRI – the Retrofit Reconnaissance Inventory. So basically the idea is to use both the form and the base map to collect that important information that you need to make a call on whether or not you can actually do a retrofit at that site. And while we can't really go into a lot of detail about what you need to look for at every potential location, I will spend a little bit of time on existing ponds here because Deb talked about those this morning. Basically you are going to start at the potential location of your retrofit. It always kills you to spend time in the contributing drainage area or investigating upstream and downstream stormwater infrastructure just to find a sanitary sewer line maybe a couple of feet below the surface when you were planning to excavate that pond to create additional storage.

So always check the potential site of your retrofit first and then move up or downstream to determine whether or not you can conduct a retrofit there. Additional guidance on each of those storage and on-site retrofit locations is provided in the retrofit manual. So you can go back and check those out. Really without going into a lot of detail, I want to give you just what the big picture idea of the RRI is. And that is again collecting that information that you need to be able to make the call on whether you can do a retrofit or not and collect that information you need to produce a pretty basic concept sketch of your retrofit and a little short description of it as well.

It doesn't necessarily have to be pretty, and we are going to walk though a quick example of a completed RRI form on these next few slides. And I know it is probably extremely difficult to see there on your screen, but we have included a copy of this completed form in your resources with the webcast so you can go back and print out those resources and have this form. But basically there are seven sections to the RRI form starting off with some header information, and basic information about the watershed, the time and data of your visit and a record of any pictures that you might have taken. Some room for a site description and proposed retrofit location – what exactly are you looking at there. Then we move in on the bottom of page 1 there a description of a drainage area and existing stormwater management. This is where you go ahead and investigate your contributing drainage area, make a call on how big it is. You might have to do that through mapping; perhaps back in the office like Dan and the City of Charlottesville did or for the on-site retrofits often you can't use maps or GIS data because the resolution is not good enough so you actually have to walk the site to delineate your drainage areas in that case. But basically a description of what is going on there with both infrastructure and your drainage area.

Page 2 of the form then moves into the proposed retrofits, so there is room to describe what your retrofit is, what treatment option it is, and really a couple of checks on the realism of your concept. Some room to do some computations on capture volumes, if you want to treat water quality or do channel protection, you are looking at a target capture volume and an actual available capture volume at your site. So the key is to match that available capture volume with your target. And where you have your target much greater than what you can actually do on-site, that's where you run into a little bit of a problem.

Nikos Singelis: Where you might decide that it is really not effective to pursue that.

Michael Novotney: Exactly, and this is where the idea of a walk-away volume, introducing another term here. But basically before going out into the field you want to make a call as to hey if I can only capture 50% of my target volume, perhaps I don't do the retrofit because it is going to be under size, we are going to have maintenance volumes, and it is not going to be providing the bang for the buck that we are looking for.

Nikos Singelis: That kind of relates to what Dan was saying earlier. I think yours was one inch from the site itself?

Dan Frisbee: That's correct, and if we were collecting off-site runoff we were going to try and capture like the quarter inch. And there were couple of instances where we got there, started looking at the site, we had what we thought was going to be a great retrofit, come to find out we just really didn't have the capture volume available and it just wasn't going to make sense financially to proceed with it. So we looked elsewhere.

Nikos Singelis: Yes, so that is a really good priority setting tool there to set some kind of a goal and then evaluate in that way.

Michael Novotney: Yes, I always recommend using that walk-away volume idea to be able to screen sites. So that is one check, the other is your site constraints on the bottom of that second page. It goes through utility constraints, land use constraints, ownership constraints, so that is the other check on the realism of your concept.

The last part of the form, pages 3 and 4 provide room for your sketch and I like to use the sketch just to do your proposed conditions. Often it gets a little cluttered if you are trying to draw both existing and proposed conditions. And I like to concentrate just on what the retrofit will ultimately be. So here you see a sketch of a proposed wet pond retrofit and then page 4 provides room for notes and some initial calls on whether the project makes sense or not down there at the bottom of page 4.

As you can see on this next slide we will show the base map for this same site that the retrofit form was filled out for. And this where the base map really comes in handy. And I said on the retrofit form I like to use the sketch to just show proposed conditions. This base map you can

show your existing conditions really accurately and they comes in handy when you are delineating on-site drainage areas and making notes of the existing conditions. So the base maps are great for the existing conditions at a retrofit site.

Our next slide is going to show a little bit more detail about that concept sketch, but I said, it doesn't have to be pretty, but what it does have to do is convey the basic ideas behind your retrofit; what excavation is needed, how is stormwater going to be conveyed into your practice; what does the outlook structure look like or is it an infiltration basin? Usually just the plan views needed; you might also need to sketch a little profile view if you are doing a filter practice and show what media you might have used or if elevations really make a difference at the site. Photographs also really help you document your proposed retrofit and your existing condition as well.

So I know Dan used the retrofit form extensively in the City of Charlottesville and I think found it pretty useful.

Dan Frisbee: Yes, I would say we definitely did. To talk a little bit about that field work that did happen, as I have mentioned before we had prioritized sites and kind of trimmed down the overall to a subset of 24 for field work which we evaluated over the course of 3 days. The field teams were led by a Center staff person who had done the retrofitting exercising before, had the experience, included other Center staff, but also included city staff. We really wanted to tag along and participate for a few reasons. We wanted to learn the process that was happening in order to be able to replicate it on our own in the future. We also wanted to see and kind of gain as much insight into the potential retrofits as possible as they were being diagnosed. And we also wanted to be there to provide any historic or current knowledge about the properties, whether it be ongoing master plans or any programming conflicts that a retrofit might run into.

We had detailed field maps. We had the center's RRI form and we were using the methodology, talked about from the center's new manual. And again to make another tie back to our MS4 program, when we were out there we were also conscious of addressing a piece of MCM 3 – Illicit Discharge Detection and Elimination. Because during the field visits we very much had our eyes open for any suspicious or illicit discharges that might be coming from the public properties themselves which I am happy to say we didn't find, or from private properties. And we actually did find one from a private property and we were able to address that.

A total of 121 potential projects were identified. 74 of those actually being retrofit projects. Concept sketches were drawn in the field for many of those and you can see the various kinds of practices that were identified on this slide. But in addition to those hard practices, we were also looking for landscape management and stewardship practices such as opportunities for tree planting or a designation of no-mow areas or areas where we could repair some erosion that was active. We also looked for pollution prevention opportunities such as dumpster management or material storage, places where street sweeping might help or a stream cleanup would be in order. Unstable stormwater outfalls were also looked at. They can be a significant source of erosion and sediment deposition if they are not stable. Also features in our GIS that weren't mapped correctly were identified. So we really took it as an opportunity not to just identify hard retrofits but a whole suite of management practices. And again that ties back to our MS4 permit, MCM #6 which is Pollution Prevention and Good Housekeeping for Municipal Operations. We could tie some of these into ongoing management of our properties we were going to be getting some water quality improvement there as well.

Michael Novotney: That's great, Dan. I think it is important to point out, even though you are out there doing retrofitting it is important not to keep your eyes closed and just look at retrofitting. Look at everything else that is going around you as well.

Dan Frisbee: Absolutely.

Nikos Singelis: Pollution prevention can be very cost effective so we should always keep that in mind. And Dan sort of alluded to this already, but we are going to jump now into compiling an inventory of possible sites here, and that is sort of the step 4 here, and I think Deb you were going to talk about how this connects as the next step in the process.

Deb Caraco: Sure, Mike just went through and explained the process of going out into the field. The step of compiling is just the process of taking the data and the design view made in the field and compiling those into something that all the field crew terms can understand and that you can convey to other people. One of the most important things that you want to do when you compile the retrofits of course is to take the designs that seem the most promising and develop them into concept designs. Typically this would be about a 30% design, which would mean that your sketches are readable to other people, all the information that you need as far as do you have enough head to construct the practice, exactly the details of what the practice is, how stormwater

will be conveyed is really easily understood. These will not be construction documents of course, but it will be something that brings you to that next design level.

And then another thing that you are going to want to be able to produce as a part of that is graphics that are able to help other people understand the location and types of practices that will be proposed as a part of the stormwater retrofit inventory. And Dan, what types of graphics did you all produce as part of yours?

Dan Frisbee: Well in addition to just the study itself, there was a set of information compiled for each one of the sites that we visited. And that set of information included a summary sheet of all of the retrofit possibilities and other observations that were noted there. Also a map which visually depicted where those particular opportunities were. Also there was quite a bit of analysis done on pollutant removal and a copy of the RRI form was also in there. And importantly we also received all of the GIS data; Mike touched on this earlier. This included our sub-watersheds, our drainage areas, all of the impervious cover, digitizing. So we had a database of everything that was identified and what this will do is we will use it as a tracking mechanism now and in the future as we are either putting in a retrofit or implementing a management practice; we will be able to kind of go into GIS and update it and be able to use it to kind of gauge our progress over time.

Deb Caraco: And another important thing to do of course is to just display it visually as a watershed map; it helps you to understand which reaches of a stream, which sub-watershed you are impacting.

The next step in the retrofit inventory is ranking your potential retrofits. (Inaudible) developed that you think are maybe potential retrofits as a result of your field work, now what you need to do is try to decide which are your best projects. This step 5 is basically how feasible and cost-effective are these practices. Again we talked about data per square foot of impervious cover treated, for example. The feasibility in terms of what impacts it might have on the neighborhood. An important part of this process of ranking is to consult with the neighborhood. Often, again especially if these retrofits will either directly or indirectly impact somebody's property or even your parks that people use, it is good to first of all educate people about what you are doing and also try to gather information for people, real information about now how they feel about the different practices and also the types of watershed goals that they all are interested in.

Another part kind of slightly related to this is that the retrofit inventory process that Mike was talking about is another great opportunity to interact with people and get ideas about how they feel about the practices and the resources near them.

Dan, do you want to talk about your specific scoring criteria within Charlottesville?

Dan Frisbee: Sure, as you mentioned once you have identified all of these projects you really need to evaluate and rank them. So we developed a set of screening factors, and it is important to note that they were derived from our initial performance goals. You have to make that link back. After we ran them through, they were weighted. We scored all of the projects and we only applied this ranking to the stormwater retrofits because they could be directly compared to each other based on pollutant load reduction, cost-effectiveness of removing those pollutants and these other screening factors.

We didn't rank the more stewardship activities. It doesn't mean we aren't going to do them but they can be incorporated into ongoing management plans. After they were all ranked we sat down with the Center and we reviewed the ranked projects, discussed ones that we wanted to take to the next level to the design phase. We discussed how they were ranked. We also discussed some other things such as we wanted a representation of different types of BMPs. We wanted to make sure our parks and schools were represented. We wanted to look at implementation opportunities, the master plan, the CIT issues. Also things like public safety and permitting and utility conflicts and just some good common sense and a gut check also plays into this. You can't be completely bound by your ranking process.

Nikos Singelis: And Dan how did you find the ranking process turned out once you really sort of scrubbed it?

Dan Frisbee: Well after we went through and looked at all the things beyond just the hard numbers, we still ended up choosing all ones that were in probably the top quartile of the ranking for when we moved forward, so it kind of validated the whole process and the factors that we had chosen and the goals that we had looked at.

In the end we ended up with 8 that were selected for design work. So we have this prioritized list and we will go back to that and use it as a guide beyond just selecting these first 8, but again it really is just a list; you still have to have professional judgment, funding opportunities and kind of broader city goals and initiatives are going to play into ones that are implemented in the future.

Nikos Singelis: Okay, and just in the interest of time Mike, let's run through these last three and get to some questions, Deb or whoever is going to lead on this one. We have three steps left that we need to cover.

Deb Caraco: I will go through these very quickly. Step 6 is an important one in terms of just validating or determining how far you got in your original goals. Often your goal might be to reduce runoff volume within a watershed or to, for example, reduce phosphorus load by a certain amount or certain percentage. What this does is this just allows you to go through and just calculate how much you achieved by doing different practices.

Nikos Singelis: And that is very important in keeping with that connection with the water quality goals that we have set up in the first place.

Michael Novotney: That's right, those measurable goals that we set up first, and then check on those.

Deb Caraco: Step 7 is design and construction. This would be taking those designs and maybe taking them through a 30% concept design. Or you have a conceptual design and you have your top few just bringing those through design and construction. There's still some specific analyses that need to be done and there is a lot more detail in the drawings to make those design drawings. An important part of this – it doesn't necessarily have to be the people who originally conducted the retrofit inventory but they have some involvement between the designers and the construction, especially because often to retrofit the situation there are some kind of tricky types of practices, maybe flow splitters, just unusual practices that get incorporated. So the construction is going to be a very important part of that.

Dan, I don't know if you talk about the details in Charlottesville.

Dan Frisbee: Just to touch on quickly some of the projects that were taken to the design for Charlottesville. We had some rainwater harvesting projects, a couple of bioretention, bio-swale projects, a stormwater wetland was designed. A piedmont outfall is a term that we came up with in collaboration with the Center, and that is a typical design that is meant to be applied and kind of customized to a site where you need an outfall that needs stabilization or repairs, a (inaudible) treatment cell process. Another one was a typical design for runoff diversion, diverting runoff from an untreated area such as a roadway to a bioretention or buffer area. One of the sites where a couple projects were identified was our Charlottesville High School and adjacent Performing Arts Center. A 2600 square foot bio-filter will be put in; it is going to treat runoff from 4 acres over 1.5 acres of which is impervious surface. Important to note that this site has no current stormwater management at all.

In conjunction with that there is going to be a rather large rainwater harvesting system installed there. It is going to collect runoff in about 22,000 square feet of the Performing Arts Center. And when you start running the numbers there you can quickly arrive at a very hefty sum of stormwater, over 0.5 million gallons that we can theoretically capture and then the good thing use right there on-site to replace a potable treated water source.

So the retrofit projects we identified in the study really can be seen as an important step in the formation of this retrofit culture in the city. It is hoped that these projects can create a spark that leads to ongoing retrofit activities, not only on public land but on private land as well.

The steps that were taken to design are our highest priority. We have every intention of installing many more of these retrofits in the years to come and this effort ties into a broader water resources protection program we are pursuing in the study. One of the components of that program will provide funding for these retrofits. This program is also envisioned to be funded mainly through a stormwater utility feed, so there is going to be opportunities to include incentives for private property owners to install retrofits on their own properties as well.

We will also look to incorporate these retrofits into master planning and renovation efforts; try to pull in the private sector possibly in a fee in lieu of program as Mike talked about earlier in the presentation which would again tie back to our MS4 permit and MCM5 that Nikos talked about earlier post-construction. So in these ways we really hope this retrofit culture can firmly take hold and overtime we will see some real community benefits and some real and meaningful improvements in water quality at this sub-watershed scale as well.

Just to kind of wrap things up, a few key points that I would like to emphasize and leave you all with. In order to realize the best results from your retrofits, consider them strategically and methodically. Tailor them to meet your sub-watershed's particular needs. Having a study like we had is going to be a great tool in years to come for retrofit planning. I would also say use your retrofits as demonstration projects where you can inspire and encourage private property owners to install them. And by doing this what you also do is increase the local knowledge base of stormwater management in your area, because the more familiar, understood and tangible these kind of projects are, the more they will be implemented. This ties in again to involving and educating the public about your projects, the more they are involved, the greater chance for long term success of these projects I think is pretty fair to say.

And in developed sub-watersheds like Charlottesville, installing retrofits has been identified as a really essential component of a successful watershed restoration and rehabilitation initiative. And we are also looking at this in the overall context of environmental sustainability in the city.

Nikos Singelis: Great, thank you, Dan. We certainly are very impressed by all the steps that you took to manage stormwater and to deal with retrofits and to really go through this kind of methodical process that we have been describing here. So I think folks you can see the URL there is for the study again which will be a very useful reference for folks. And I know we are going to extend a little bit for our audience there so we will extend a few minutes beyond 2:00 pm, so don't panic, but I know we had a lot of questions out there and you saw that we skipped one of the planned question breaks so we will try to take as many as we can right now. So John, what do we got there?

John Kosco: Sure the first question was for Dan. And it is from Jim who asks what method did you use to rank the retrofit projects?

Dan Frisbee: Well, there was a suite of screening criteria that was developed and they were weighted criteria so we looked at things such as pollutant removal ability, the cost-effectiveness of that pollutant removal, did the retrofits capture runoffs from on-site or was it only, or was it additionally collecting runoffs from off-site, because that was one of the goals was to try and provide some sub-watershed treatment.

We looked at other things such as did it promote bacteria removal, tying back to TMDL issues we have in the area, some pollutants of concern, as well as maintenance issues and did it support other city initiatives like our tree canopy initiative. Are we going to have to chop down a bunch of trees in order to put a retrofit and kind of striking a balance between lots of different issues that we are looking at in the city?

Nikos Singelis: Dan, are those criteria elaborated on in the study?

Michael Novotney: They are. They are. And I think the nice thing that the city did was tie those ranking criteria in with those restoration objectives and performance criteria that they set out during the scoping process for their study.

John Kosco: Great. The next question actually is probably either for Mike or Nikos. But Ellen from Boston asks have any communities implemented stormwater retrofitting program because of requirements in their MS4 permit? Have you run across any MS4 permits that require retrofitting?

Nikos Singelis: Well I guess this gets a little bit to that definitional question. But for me when we talk about redevelopment of a site, we are also talking about retrofitting it to make it work better and yes that is part of the MS4 requirements. Just to clarify in case anybody is confused, this manual is not required. This is guidance in order to help you meet that overall objective of when you do have those redevelopment sites that are an acre or bigger, but those can be dealt with so that they are more stormwater friendly once that redevelopment process is done.

Michael Novotney: Nikos I think that is the right answer. Remember what our definition of retrofit is, and that is where a stormwater management practice has been installed where there weren't any controls or where those controls didn't do everything we wanted them to do in the first place. So that can be on redevelopment sites which are covered by the MS4 permit.

Nikos Singelis: Now it is fair to say too that there are some communities out there that are requiring some kind of retrofits on existing development. We gave the example for instance before about the downspouts disconnection programs. And so those would apply to houses and

building that are already there. That wouldn't be part of the NPDES requirements, but that is something that the community is trying to do on its own.

John Kosco: Okay, next question is Jean from the city of Orange. This question is for Dan again. After the small retrofit study was completed and potential sites were prioritized, has the city set a strategy for funding of the retrofit practices?

Dan Frisbee: Yes. We certainly have. One of the – there are several sources of funding we are looking at. One was an appropriation from our city council to specifically put some of these retrofits in the ground and again that ties back to our larger water resource protection program where we want to demonstrate some of the things that citizens would see if we end up going with the stormwater utility, fees are collected, we can put some of these projects in the ground and be able to give them an example. These are the kinds of things that your stormwater dollars are going to pay for.

In addition to that we have applied for trying to use that money as matching funds to leverage additional funding through a grant opportunity to get a few more of these put into the ground in the near future.

John Kosco: Okay. Next question is Thomas from Florida, and I will open this up to anybody. He asks, when looking at small areas an on private property, what are some of the legal mechanisms used to ensure long term O&M?

Deb Caraco: Well there are a few different options. Occasionally the practice itself can be dedicated to whatever, whoever in the municipality is and that municipality would in fact own it. The other is through a formal maintenance agreement between the property owner and the municipality. Those are the kind of the two most common ways.

Michael Novotney: I think a lot of the downspout disconnection programs that are out there that have done these individual on-site practices on residential sites have used pretty much like a waiver that the property owner will sign that says I disconnected my down spout to this practice voluntarily and I agree to maintain it in safe condition over time. And they will have inspection staff that while they might not get to every site every year will go out there to make sure that

things are looking good and they will provide technical support as well to the property owners that might want to reconnect their downspouts or maybe get rid of that rain garden that was put in. So they will help out along the way, but the simple answer is yes, through the waiver and maintenance agreement.

John Kosco: Okay, our next question is Ken from California asks when talking about bang for the buck, cost-effectiveness, this part of implementation, how do you compare some of the on-site versus storage retrofit opportunities in regards to that cost and scale in terms of like bang for the buck for that.

Deb Caraco: Typically the onset for the storage practices are cheaper per impervious cover treated. So they are typically numerically more cost-effective but as Nikos pointed out earlier, often to achieve all the objectives you set out you have to use a combination of those larger practices with the somewhat more expensive on-site practices.

Michael Novotney: And remember our example that we started off with towards the beginning of the webcast, the more developed your watershed gets, the harder it is going to be to find those large storage practices. So often you have to do those on-site practices. And although they may be slightly more expensive, the answer is that you have got to use them anyway to meet your goals.

Nikos Singelis: Right, and contrary to the most common thing that Americans want is the cheapest price for anything, right. In this case price is one category that we look at in terms of making these decisions, but really it should be equally balanced with whether we are going to meet the watershed's goal that we are trying to achieve in the first place and so on. Acre by acre basis it may be more expensive to do that. You have to limit your scope to looking at things that are actually going to get you to the water quality goal and then take the most cost-effective within those.

If you just use cost-effective you may end up with something that is not going to get you anywhere. And as we talked about before, for instance, if we set a goal of infiltrating one inch from a particularly area, and that is our goal, we might be able to achieve a quarter inch relatively cheaply but we still haven't met our water quality goal. So I think we have to keep that in perspective that cost-effective is just one thing and it is not the only thing that we look at.

Michael Novotney: Never lose site of that big picture what we are actually working for.

Nikos Singelis: By the way, in case you are curious, today we have 2,294 people attending this webcast. So congratulations everybody that signed on for such a huge audience and bearing with us. We still have a couple of more minutes to take a couple of more questions, so let's use our time effectively.

John Kosco: We can take one more question. Nikos put up the next stormwater webcast on June 4, and again we hope you join in with us. The last question we can take is from Richard in Washington State who mentions that most retrofit actions in their state are tied to redevelopment due to permitting requirements; however redevelopment activities often don't correspond to the highest retrofit priority areas. Nikos, can you address is there some flexibility there for maybe doing, taking credit for off-site retrofits and high priority areas that will achieve greater water quality benefits versus these redeveloped projects.

Nikos Singelis: Yes, I think again that going through a methodical process and explaining clearly what it is that you are trying to do and why you are trying to do it really makes the most sense. And yes, in some cases you are going to choose one kind of project or one kind of area over another one, and to me that makes a lot of sense in terms of achieving your overall goals.

Deb Caraco: I think a specific mechanism too for doing that that was talked about a little bit earlier is that if you have a redevelopment criterion you need to meet you can use a fee in lieu of structure where you can say if you didn't need it on this practice, on this project, instead you can contribute to a fee that goes toward the most effective practices within the watershed.

Nikos Singelis: And there are other – in addition to the fee in lieu of program have done things where if you can't meet it on a specific site that you pay for a practice someplace else in the watershed. There are lots of ways of doing that.

Michael Novotney: That is really where it is key to have some places already diagnosed and planned out and prioritized so that when those opportunities do come up you are not scrambling

to go out there and find a place. You already have something similar to what the City of Charlottesville has now which is a catalog of retrofit opportunities that we can chip away at over the years to come.

John Kosco: Well I just wanted to make a note that the participant certificate link is up on your screen. You can also click the certificate button to get an individual certificate printed. If you have multiples, click on that PDF and you can fill in everyone's name. I would just like to remind everyone that today's webcast will be archived within a couple weeks. That will be on EPA's NPDES training website that you used to register for this webcast. An evaluation survey will appear on your screen next. Please consider completing the survey and let us know your thoughts. We do appreciate all of your feedback. And also please turn off your pop-up blocker in order to see that survey.

Also don't forget to download that certificate and complete it. I would like to thank everyone for participating in today's webcast and also thank you to Mike, Deb and Dan for presenting today.

Our next stormwater webcast as Nikos mentioned will be June 4, we will address MS4 Program performance.