

**EPA Decentralized MOU Partnership Web Seminar  
Research and Tools for Decentralized Systems from WERF and the DWRC  
September 18, 2012**

*Maureen Tooke; EPA; Office of Wastewater Management*

*Jeff Moeller; WERF; Director of Decentralized Systems Research Program*

*Brian; EPA;*

***Presentation***

Maureen Tooke: .. since 1997. He directs WERF's Decentralized Systems Research Program, which advances the science and engineering of onsite and small community wastewater systems and decentralized stormwater systems. He also oversees WERF's new research program on sustainable integrated water management, which furthers a paradigm shift in water management for cities and towns toward next generation integrated sustainable systems.

Jeff has over 20 years of experience in environmental engineering and previously worked as an engineer for Hazen and Sawyer designing water, stormwater, and wastewater systems. He has worked on water projects in the Mid-Atlantic and Southeastern United States, as well as internationally for the Inter-American Development Bank funded projects in Central America. He is a registered Professional Engineer in Virginia. Jeff has a Bachelor's Degree in Civil Engineering from North Carolina State University and a Master's Degree in Civil and Environmental Engineering from MIT.

Without further ado, we'll let Jeff begin his presentation.

Jeff Moeller: Thank you, Maureen. Appreciate the introduction. Good afternoon to everybody. I'm looking forward to today's webinar and talking with you. As Brian mentioned at the top of the webinar, today I'm going to talk about research and tools for decentralized systems from WERF and the DWRC, and DWRC, that stands for Decentralized Water Resources Collaborative.

My role at WERF, I oversee our Decentralized Systems Research Program and also, as Maureen mentioned, our Integrated Water Management Program. For those of you that aren't familiar with WERF, we're just a nonprofit research organization, located in Alexandria, Virginia, and our mission is really to advance the science and knowledge of water quality. We focus most of our research effort on wastewater issues, as well as stormwater issues.

We don't do the research in-house, we actually fund and manage research, so most of the work is contracted out to universities and consulting firms. All of our work is peer reviewed. We try to be a source of scientifically sound information and unbiased information, and make that information available for the user community to use and take advantage of. So I'm happy to share some of the results of our work with you today.

I should mention that we are also a – one of the EPA MOU partners, so I do want to thank EPA for allowing us to share this research and information with you today.

There we go, advancing a slide. Just by way of introduction, rural communities, suburbs and cities, they're all looking for ways to meet water, wastewater, and stormwater needs. We've done a lot of research on decentralized systems over the last few years, and what we're finding is that really decentralized systems can be an affordable and sustainable solution if properly designed, operated and maintained. And they really also can be used in concert with centralized approaches to optimize your wastewater system as a whole or your water system as a whole.

So today what I'm going to share with you is the result of a \$16 million research program on decentralized systems, where we worked to develop decision making tools, design information, present management options and much more.

The program that we conducted was a joint effort between WERF and the DWRC, with funding from the U.S. EPA. The partners in the DWRC are shown there, at least their logos are shown there on the right-hand side of your screen, and in addition to WERF we want to acknowledge the Consortium of Institutes for Decentralized Wastewater Treatment. That's a group of about 17 plus universities around the country that focus on developing tools and training and education for wastewater, decentralized wastewater management. Also, the Coalition for Alternative Wastewater Treatment, Electric Power Research Institute, National Rural Electric Cooperative Association, and [now a] National Onsite wastewater Recycling Association. So we appreciate the collaboration with all those partners in helping develop these research products and tools for everybody to use.

Also by way of introduction, just a little brief bit about the history of this program. This DWRC effort was conducted in two phases. The first phase between '97 and 2003 was administered by Washington University. There was over 30 projects under that effort, and then more recently in phase two, WERF administered a program from 2003 to 2010 and had over 40 projects come out of that, the majority of those projects really came out in 2009, 2010, there was over 20 projects or products that were developed in 2010.

So there's a lot of, a huge body of recent research and tools that have been developed. The EPA funding for this program ended in 2010, but since then WERF and our other partners on the DWRC have continued work under their own auspices, so actually I will share some of this ongoing and planned work with you, as well, towards the end of the presentation.

The agenda for today, just want to cover mainly three items. First, I thought to frame everything I'd talk a little bit about the program scope, what's included in the research program, what issues we covered. The majority of the time I'm going to spend focusing on research highlights and really sharing with you the products and tools that have been developed and how you can access them and use them.

And then, last, I'll share a little bit about some of the outreach tools and efforts that we've been doing. We've been placing a big emphasis on outreach and we can develop the rest, the best research product, the world's best report, but if it doesn't get into the hands of the users and if people aren't using it it's not going to help anybody. So I think that outreach is really important. Again, I want to thank EPA for conducting this webinar and helping get this information out.

Again, we also will have some time for questions and discussions, which Maureen is going to moderate.

Just in terms of the program scope, what issues did we cover? Well, there was really four main areas that we covered under our scope. The first and foremost for decentralized systems we focused on septic and onsite systems. As we know, septic and onsite systems comprise a significant component of our nation's wastewater infrastructure, there's over 25 million homes around the country that use septic systems or onsite systems, and really 20% of all housing units are served by septic systems. And if you were to include small community systems or cluster systems in there that percentage would even be much higher, so it's a good chunk of our nation's infrastructure.

The other area that we covered under our research program was, in addition to the septic systems and onsite systems, were small community and cluster systems, and these are often used in rural, in Para urban and suburban areas. And I think this area actually seems to becoming more and more important, it's really becoming a sweet spot for decentralized systems and communities trying to find cost effective solutions to their wastewater issues.

Just by one example down there on the lower right-hand side of your screen, a picture of Loudon County, Virginia. Loudon County, Virginia is just outside Washington, D.C., not far from where our offices are. This is one of the fastest growing counties in the country, and one approach they've been taking with decentralized systems for cluster and small communities is having the developers pay for their own wastewater infrastructure. Developers build to county design standards and then they turn over the wastewater units to the county to operate and maintain. So the county operates and maintains them, but this is one way that the county has been taking an approach to have growth pay for growth, and it seems to be a win, win situation in helping them deal with their wastewater management issues.

A third area that we included under our scope is urban and suburban applications of decentralized systems, and these are really what I consider some newer applications of decentralized systems. A couple pictures there just showing some examples, in the upper left-hand corner, that building there is the Solaire Building, which is located right in Manhattan in New York City. This is a high-rise apartment building, it's part of a cluster of lead certified buildings in Battery Park, if you've ever visited Manhattan.

This building uses a membrane bioreactor, which is located in the basement of the building. These membrane bioreactors treat the wastewater, they treat it to standards for reuse and reuse for non-potable purposes in the building, for toilet flushing and landscaping around the building. This has allowed this building to reduce its water use by about 50% and also its discharge through the wastewater system by about 50%. So it's proving to be a financially viable option for this building and other buildings, as well.

Over on the right-hand side of your screen, there's just a picture of Sidwell Friends School, which is located also not far from our offices in D.C. Some of you may have heard of this school before. It's actually where Sasha and Malia Obama go to school. But at this school they actually treat the wastewater onsite and they reuse it for non-potable purposes. There's also a significant

number of decentralized stormwater treatment practices going on onsite, including the green roof, rain garden, but the school has really been using their onsite systems to help educate the students about sustainable water management approaches. So I think that's a real side benefit to some of these urban and suburban applications.

And then, lastly, the fourth area that our program covered was decentralized stormwater issues. This includes low impact development and more, I guess more – a term that's gaining in popularity, green infrastructure. And I think a number of you are familiar with these techniques, they include rain gardens, green roofs, cisterns, grass [wells], all these options work to treat stormwater close to the source, to infiltrate it, to try to restore the hydrologic balance.

And just a couple of pictures, examples shown there on the bottom right corner is from Arlington, Virginia, not far from my house, a rainwater cistern, over on the left that's City Hall in Chicago, the first green roof in Chicago.

So just by way as a point of perspective, you know, philosophically speaking decentralized systems are part of a continuum of options. They don't, you know, some people kind of put them centralized versus decentralized but it's really all part of a continuum of options that can work in concert with centralized systems. I think often decentralized systems have been viewed somewhat as the redheaded stepchild of the wastewater treatment world, and it was often maybe what you did until you could connect with the central sewer.

But I think in recent years things have really changed quite a bit. certainly, a lot of advances in different areas of technologies, from membrane treatment, to centers, to monitoring. We're learning a lot more about natural systems and the benefits they provide and how they function. So this is really, these are not your fathers' decentralized systems, so to speak, and I think there appears to be a bit of a renaissance underway, if you will, in terms of decentralized systems and people are starting to view decentralized systems as a sustainable long-term approach.

Again, there's always that caveat as long as they're properly installed, operated, and maintained, but I certainly think this is an interesting time for decentralized systems and research is helping the progress to make sure these systems are given at a minimum equitable consideration with centralized systems.

So this last slide on the program scope just shows how we divided up our efforts amongst the different partners. We had three focus areas for the research, each partner focused on an area of the greatest strength or the one that was most closely aligned with their mission of the organization. We're focused on research aspects with educating, environmental science and engineering. The Coalition for Alternative Wastewater Treatment, [EPRI] and NRECA focused on research related to management, economics, and policy. And then the Consortium of Institutes and NOWRA focused on the training and education aspects. So I think these areas combined formed a very nice holistic approach to the research program.

So, with that background, I want to start diving into some of the research highlights and the reports, tools, and products that have come out of the research program. First, just a few highlights under the area of environmental science and engineering. That first project listed

there, quantitative tools to determine the expected performance of wastewater soil treatment units was one of the largest projects we did in the environmental science group.

A lot of times I think not a lot of credit is given to the work that the soil treatment units do for onsite systems. In part, that's due I think because there's still a lot known or that's been quantified about how these soil treatment units operate and how they perform, and there's quite a, as many folks know, variations in how they perform relative to different soil types and depths of the soil and topography and other conditions that might be somewhat site specific.

So one of the things that this project did, it produced a series of tools to help people quantify performance for different pollutants of interest, such as nutrients and bacteria and other contaminants. But the tools include very simple nomographs to next level of complexity, there's some spreadsheet tools that folks can use to look at, evaluate performance, and then, finally, also they include some more complex models.

So users can use these tools to determine the expected performance. For example, you want to look at nitrogen removal by a soil treatment unit and what might be making its way down into groundwater, you can use the nomographs, spreadsheet tools or complex models, depending on your time and the complexity of your problem to address the issue of concern.

The second project there, showing evaluation of greenhouse gas emissions from septic systems, was in part due to a response to I guess a study that had come out from EPA showing that there was very high greenhouse gas emissions coming from septic tanks or septic units. And the study had even shown that most of the greenhouse gases coming from wastewater treatment systems, including centralized systems, most of the gases were coming from septic systems, even though septic systems comprise a relatively small percentage, about 20% of the overall wastewater treatment units. But this study that we did actually showed that the greenhouse gases were about half of previous estimates, so I think there was some findings there to help inform greenhouse gas estimates.

A last study shown on there, influent constituent characteristics of the modern waste stream from single sources. This study focused at looking at the data that's used for design of onsite systems. A lot of the data that we've based our design on comes from studies that are now 30, 40, maybe even 50 plus years old, so really in that time the product that people are using in their households have changed. The ingredients in those products have certainly changed. The amount of water that we're using has changed.

So this study provides some new data and information on what's coming out of households and also what's coming out of septic systems to help inform new designs moving forward. One of the interesting things that came out of that study was it showed that there's actually a lot less water on average coming from households because so many households have now implemented water efficiency, water efficient devices in their homes.

Under the management and economics and policy category, we've done a lot of work looking at business attributes of successful RMEs. Also, focused, did a project that focused on international issues and [invasions] that are happening, and that project included looking at some

Swedish eco villages, Tianjin, China, [Navdar], and the United Arab Emirates. These latter two cities are actually brand-new cities that have gone up very quickly, but they incorporate eco blocks and decentralized approaches and integrated approaches, so there's a lot of lessons to be learned from some of the things that are happening in the international arena that this report has helped to capture and define.

And then, lastly, the last example I'd give under this management and economics area is a project that we did, produced a report entitled *Overcoming Barriers to Evaluation and Use of Decentralized Wastewater Technologies and Management*. I think there's long been a recognition that there's a lot of barriers to the use of decentralized systems, so this report defines what those barriers are and it also developed an action plan to help overcome those barriers. So those – that document has been a useful guidance document for this research program.

The last area I want to provide a couple of highlights on before we dive into some specific research projects is an area of training and education. And this area looked at developing educational curriculum for onsite systems, in particular focused on proper design of systems. And the educational curricula includes curricula for universities, as well as practitioners, so there's two sets of curriculum there. Under this training and education program we've also developed materials for an installer training program and materials for an O&M service provider training program.

The Consortium of Institutes for Decentralized Wastewater Treatment has really been the primary lead in this area and has conducted many of the trainings that have been associated with these projects. They've also developed a decentralized wastewater glossary. I think one thing we found in getting into some of the training, one of the challenges was that people were using different terminology, a lot of times people were talking past each other. They might have been talking about the same thing but they were talking past each other because they – there wasn't really a common defined or standardized terminology. So the glossary has worked to help define what those terms are. And it was a difficult process I think getting people to agree on the terms, but now there is a place where people can go and see those terms defined.

So now what I'd like to do is get into a couple of specific projects and so some highlights from some select projects that are available from this program. As I work through these slides, on the top left corner I'll show you the project title and then I'll include a couple of bullets for each project, showing what are some of the key benefits or findings that have come out of that particular project.

So, first off, in the area of responsible management entities, or RMEs, we developed guidance for establishing successful RMEs. I think many of you are familiar with RMEs, but just for those that aren't, you know, an RME is -- it's a legal entity that's responsible for providing management services to ensure that decentralized systems meet some sort of established criteria.

This really provides a professional management approach for performance and reliability of decentralized systems. They've – it's been proven as a successful management model and really provides a centralized management, a centralized form of management for decentralized systems.

A website was developed that has all the resources needed to establish an RME, and the website link is just shown there at the bottom of the page, it's just [werf.org/RME](http://werf.org/RME). If you go to that website, this is a screenshot of what you'll see there. There's a series of 10 fact sheets that walk you through the process of establishing an RME.

So, you know, I think these days, given the recession we hear a lot of talk about green jobs and green opportunities, and I think this, you know, RMEs are one of those places that I think that there really is a niche and a need to be filled and there are opportunities for green jobs here, jobs that can help protect the environment and clean-up our water.

The, as I mentioned, the fact sheets walk you through the process of establishing an RME. It shows you how to get started, it starts out with the basics of what is an RME and why do we need one, it talks about how to work within the local context. I think there's some communities that are out there that probably have built-in support for an RME already. Perhaps the community is around a lake, and the lake has been having some water quality problems and there's been a link made to the failing decentralized systems as a potential cause for the water quality problems.

So perhaps in that community there's a real awareness of water quality issues, the need to clean-up the lake, and there the members of that community might be very supportive of having an RME established in there to help manage the onsite system to clean-up the lake. There might be other communities, though, where that awareness may not exist and there might be a lot of resistance to having an RME, and you might need to build support for one to actually help give you some ideas for how to build support in those instances. There are communities where people, maybe they've had this septic tank in their backyard and they've never had to pay a dime for managing it, and are reluctant to all of a sudden paying an annual fee for service and management of it.

So working within the local context is very important. Also, having an understanding of the regulations and the business structures and models that are out there is very key. The RMEs that are in existence today, they come in all shapes and sizes, some of them are governmental organizations, some of them are private organizations and some of them are hybrids, you know, public/private hybrid.

They also include, these fact sheets include information for developers, designers, homeowners associations. I think homeowner associations is one of the places that have been a real challenge in terms of managing onsite systems and ensuring that they have the appropriate technical expertise to manage and operate and maintain that, so making sure that whatever RME is functioning there has the appropriate expertise was really key.

And then, last, you can see on the far right, fact sheets eight, nine and 10, talk about the steps of developing a business plan, looking at financial requirements, as well as marketing. So this is a very useful resource for anybody that's interested in establishing an RME or has an RME and is interested in improving their practices.

Another project that I want to talk about focused on performance and cost of decentralized systems. The goal of this project was really to provide basic wastewater management information to planners and decision makers in very small communities. We, for this project, set our target audience at someone we called Mayor Smith, and Mayor Smith might, as John Buchanan, who was the principal investigator on this project, so he said he might be a part-time dogcatcher so he may not be an expert in wastewater issues but he's, as a mayor he's got to deal with them.

So this project was designed to fill a void there and help provide the information for the small community decision makers. One of the products that was developed was a fact book, which is the wastewater basics for small communities. It helps local decision makers understand the wastewater basics and also helps walk them through the process of establishing a community vision for their wastewater system and how they want to manage it.

To support the fact book are a series of 19 fact sheets that provide a synopsis of all the different options available in those categories shown there – collection systems, treatment systems, and disposal, dispersal or disposal systems.

And then the last tool, product that came out of this project was a spreadsheet tool that community users can use to help estimate the costs associated with decentralized systems, and this is really more of a planning level tool. There are some default values that are included in the spreadsheet, when you don't know information or are having trouble finding information relative to costs, but certainly if you have a better local cost data you can override the default value provided in the tool.

So this tool is available at [werf.org/decentralizedcost](http://werf.org/decentralizedcost). Then when you go to that website here's a screenshot of what you'll see, all the different fact sheets that are available. For example, the collection fact sheets, there's fact sheets on gravity sewers, pressure sewers, affluent sewers, and vacuum sewers kind of systems. The treatment fact sheets you can see listed there, include everything from suspended growth systems to lagoons and construct wetlands, and then also a series of dispersal fact sheets, everything from gravity systems to low pressure and drip systems, as well as a number of other options for disposal or dispersal.

And then when you click on those fact sheets, you know, for example, if you were to go to the suspended growth, aerobic treatment fact sheet, you know, it'd give you information about what is this, what types of systems are included, how is it used, what's the compatibility with the community vision. It'll also provide information on construction and installation, O&M, as well as cost information. So these are very, again, a wealth of information provided in these fact sheets.

Going on to O&M issues, get a lot of questions around that related to decentralized systems. The Consortium of Institutes has developed a decentralized wastewater treatment O&M service provider training program. This program is designed to help ensure proper functioning of decentralized systems, provides education for practitioners, which I think is really critical, including establishing a national basis for best practices among O&M service providers. And the web link to get that information is just on the bottom of your screen onsiteconsortium.org.



As I mentioned at the beginning of this webinar, one of the areas we explored through the research in this program was urban and suburban applications of decentralized systems. So this is a project that we conducted entitled *When to Consider Distributed Systems in an Urban and Suburban Context*. These systems aren't just in rural areas anymore. Through this project, the project team looked at 20 different case studies in the U.S. and Australia where decentralized and distributed systems are being used and some areas where the traditional approach would be a centralized system.

One of the things that I think was interesting about this project is it looked at some of the decision processes that these communities use and how these projects were planned and implemented. And then through that process it developed a number of different products, one of them being a series of case studies and whitepapers, and then it also developed a decentralized wastewater stakeholder model, which is really a decision support tool that communities can use as they're trying to examine whether or not they want to use a decentralized approach.

The tools and products from this project are accessible via the web link at the bottom of this page, [werf.org/distributedwater](http://werf.org/distributedwater). When you go to that website, you know, one of the things that you'll see there are the different case studies that are available for urban and suburban applications. And the project team broke urban, suburban applications into three different categories of case studies. You have green buildings and sustainable sites, independent communities and utility optimization.

So for the green buildings, those are some of the lead buildings that are being put in and they often integrate decentralized systems in the buildings and the landscapes. These systems are often used for resource conservation and recovery and reuse of the wastewater within the facilities, such as the example of the Solaire Building in New York City that I gave, also the Sidwell Friends School example, that was – the Sidwell Friends School I think is a good example of an educational and recreation opportunity that's afforded by some of these applications in urban, suburban environments.

Also, the category of independent communities, why, you know, the other reason or one of the other reasons that these systems are being applied in urban and suburban areas is there's some communities that don't want to hook-up to large systems, they really want to maintain fiscal control or preserve their community character or might have, might be an underserved community, so they really want to take their own approach. And there's a series of case studies that provide some good examples of independent communities that have gone through this process and talks about their decision making process and why they arrived at the conclusions they did.

The last category of urban, suburban applications are what we call utility optimization, and these are really managed distributed systems, similar to the Loudon water example that I gave at the beginning of the webinar, where they're using developers to or having developers pay for their own systems and having growth pay for growth. It can also include some examples of sewer mining or satellite reuse, and I'll explain a little bit more about sewer mining in the next couple of slides here.

I did want to give one or two examples, specific examples from the case studies. Dockside Green in Victoria, British Columbia is one of the examples of the sustainable sites or green buildings, if you will. In this case, this is a – was a water centric brownfield redevelopment that's based its redevelopment on integrated resource management. So they're using fit for purpose, reclaimed water supply, augmented by rainwater, so basically they're treating the wastewater onsite and then they're reusing it for toilet flushing, landscape irrigation, watering the green roof.

And they also have a very unique little, natural stream, pond, that's flowing through the site, and that stream, pond complex provides residential access. It's enhancing the unit value, the property values of the site, and then also it does serve as providing some ecological function of biodiversity, as well. So there's some environmental benefits that are being construed from it. And then, lastly, the onsite they have a press for sludge dewatering to produce feedstock for a collocated gasification plant, so they're capturing the resources onsite.

A second example that I wanted to point out is this one at Sydney Water – Pennant Hills Golf Club. This is a privately driven sewer mining project. So sewer mining is where you have a large centralized wastewater plant and an entity taps into a wastewater trunk or main to which raw wastewater and treat it, often with a small wastewater treatment unit, such as a membrane bioreactor, and then reuse the water locally. And often this can be more economical than treating the wastewater at a central facility and then pumping it back to other parts of the area for reuse purposes. So there's an advantage here to reusing locally. In this case where they're treating with a membrane bioreactor they're reusing the water to irrigate the greens and tees and fairways at this golf club. So, but there's also, you know, this is an example of sewer mining in Australia, but this is also happening, there are many examples in the U.S. where this similar type of thing is being done.

I mentioned that this project also produced a stakeholders' decision model. I just wanted to point out that that decision model uses a triple bottom line approach, and the triple bottom line incorporates those three elements that you see on this screen – the economic, environmental and societal concerns, and trying to maximize the economic value, optimize the environmental benefit to fill community objectives. So this project proposes us as a good basis for decision making when looking at these decentralized systems and trying to figure out if it's the right approach for a given community.

I want to talk a little bit about a project that we did called – with – this is actually led by the Electric Power Research Institute, and it's case studies on new water paradigm. I think a number of you may have heard this term, new water paradigm, bandied about a bit, but I think this project actually does one of the best jobs I've seen of defining the principles of new water paradigm and what it means.

It created a platform for communities to overcome the challenges through operating under key sustainability principles and practices, used two case study examples. One from the arid Southwest, Tucson, Pima County, Arizona, and then also one from northern Kentucky to offer real world context of how communities, taking where they are right now and where they want to

be, how can they transition to this new water paradigm, because that's really the hard part is making this transition and identifying what are the obstacles and how do we overcome them.

Some of the challenges that we're finding that are driving this new water paradigm include increasing and variable energy costs, climate change. I just saw today, actually, the first eight months of 2012 have been the hottest on record in the Continental U.S. since they've been keeping records going back to the 1800s. It's also one of the driest on record, as well. So increased drought frequency is a concern, limited freshwater supplies, water quality impairment, also trying to improve the health of our ecosystems and natural service deterioration. You have certain areas, like Chesapeake Bay region that's trying to clean-up because of – and get the fish and the oyster population back up and you also have dead zones in the Gulf area, for example, we're trying to clean those areas up.

So you have those challenges and that coupled with our aging infrastructure challenges, and the real gap in funding that we have being between what's being put aside, the money being put aside for aging and restructure and really what's needed. So facing those challenges we need to find new ways to address these 21<sup>st</sup> Century challenges.

You know, I think there's a number of traditional approaches that we've used in the past, or as we're referring to in this slide is the old paradigm, and these may not be the best for going forward, you know, these solutions that we've used in the past are based on ideas or based on solutions, not just from the last couple of decades, but really from millennia, going back to Rome in time.

So the challenges that we face today we can't guarantee that the solutions that have worked in the past are going to work for the new challenges that we have in 21<sup>st</sup> Century, so that's one of the drivers to really moving towards this new paradigm. So in the past the approach we've taken has been very highly specialized when it comes to water management. In the future we're looking towards solutions being multifunctional.

Just, as one example, take a green roof, for example, now a green roof can't provide services in terms of helping control stormwater runoff, but if I were a building owner and I was looking at putting a green roof in I may not find it economically justifiable to put a green roof in just for that purpose. But if you start to add-in the other benefits that you have from it, the multifunctional benefits, such as energy savings that that green roof provides or the habitat that it provides, or the cleaner air, or the reduction in urban e-island affects, and all these other benefits, well, the scales start to tip a bit and some of these things might become no brainers if you start to look at their multipurpose and multifunctions that they provide.

Under the old paradigm we often have taken these centralized approach, where we have these large collection and treatment systems. In the future, you know, decentralized may provide an option or we certainly think that it should be given at least equitable consideration to centralized approaches. In the past had very segregated systems, had a very siloed approach for drinking water, stormwater, wastewater, as well as other infrastructures, such as transportation and energy. In the future I think we're looking towards taking a more integrated approach, and this integrated approach is really a systems approach. And by taking a systems approach you can

optimize the system as a whole instead of just one small piece of it, which can lead to efficiencies and cost savings.

In the past we've taken a very linear approach to our water systems. We've gone out in the environment, we've gotten the water, we've treated it, we've used it, treated it again, and then we've disposed it back out into the environment. I think what we're looking at in the future under the new paradigm is much more of a closed loop type system or recycling, a lot more reuse and recycling integrated in the system, such as perhaps the sewer mining effort that I talked about a little bit earlier, and as water becomes more scarce we're going to need more of these types of systems to provide the water resources that we need.

In the past we've looked at extractive approaches. In the future we want to look more at restorative approaches and restoring nature and natural functions. And then in the past some of our approaches have been inflexible and we're looking at it in the future to really move towards more adaptive approaches.

As I mentioned in the beginning, in addition to decentralized wastewater systems we, under this program, we also looked at decentralized stormwater approaches. This is a project that was – we called using rainwater to grow livable communities, we sometimes referred to it as our pretty BMPs project because part of what it did is looked at some of the aesthetics and community goals and issues related to how do you get these things implemented in a community. We recognize that not all research has to focus on just the technical issues, but there's also, you know, a softer side and some of the nontechnical issues that really need to be dealt with and overcome in order for projects to be successful.

This project developed a website to encourage and facilitate integration of BMPs in the development. The website is shown there at the bottom, [werf.org/livablecommunities](http://werf.org/livablecommunities), has a lot of tools and resources for effective communication and implementation. The content is very accessible to the public so, you know, feel free to share this with your neighbor, they'll understand it.

When you go to the website you can actually set it up for different target audiences, so if you look at the left side of the website screenshot there it says who are you? And you can click on who you are, whether you're an elected official, a municipal stormwater manager or planner, a developer, an engineer, or homeowner. And once you click on it it sets the whole website up for your perspectives, putting those resources and tools that we think would be of most interest and use to you right up front. So I think that's a real interesting and exciting way to approach this issue.

One thing I think that was interesting about this project is it looked at not only what cities did to implement stormwater BMPs, but it explains how they did it, how they got things done. And it did that through these series of case studies and there's probably a dozen or so case studies from around the country that were used, some small communities, some large communities and just a couple examples of some of the case studies, again, of how things got done.

For example, in Chicago, this was used as an example of how leadership from the top can really help you get things done and implemented when it comes to stormwater management and decentralized systems and green infrastructure. In this case Mayor Daley sought to remake the City as the greenest city in America, and the City sponsored a number of demos. Their philosophy was we want to test it first on City property and help then move it onto private properties. The photo here, you see here is City Hall, this was actually the first green roof in Chicago, was put in on City Hall, and now Chicago has more acres of green roof than any other city in the country.

I don't know if anybody knows what number two is or has – who is second on that list in terms of acres of green roofs in the country, but it's actually D.C., so I'll put in a pitch for our hometown area here. You may not know it to see it, if you came to D.C. and you got an aerial view of it it may not look like – I think there's still a long way to go in terms of increasing the percentage of green roofs, but there's a real effort underway to head in the right direction.

Chicago also has a number of other programs and green alleys and urban forestry that has also helped moving it along in terms of greening city. As an example of a grassroots approach, Philadelphia was used, where there they have a neighborhood transformation initiative that's converting areas of vacant land to valuable community assets and it's taking these vacant properties that were once an eyesore and making them very attractive community spaces that are outfitted to collect and infiltrate stormwater runoff, so they're providing a function, an eco function for the City, in particular to help them control CSO discharges.

And then just one other example of how cities, how things are getting done, in this case, Kansas City, Missouri is used as an example of marketing. I don't know if some of you may have heard that Kansas City had a big effort, initiative that they called their 10,000 rain gardens initiative. It's kind of an attention grabbing headline. They certainly got a lot of press and coverage around it. So the City provided training for landscape professionals and how to workshops and tours for putting in green gardens, and they're using it to help control CSOs and managed home water and provide green space and revitalize the City. So there's a marketing component here that is also, can help drive things and get things done.

I want to talk a little bit more about green infrastructure and decentralized stormwater approaches. This is a really interesting project that we have going on now, it's ongoing on high performance green infrastructure. And what we're talking about here is developing smart BMPs, and when I say smart BMPs I'm talking about BMPs that can think for themselves, if you will. And perhaps someday maybe they'll even be able to know when they're not working right and repair themselves. We're not quite there yet, but it's a good direction to head in.

Why do we need smart BMPs? Well, we've got millions of dumb ones out there, we can certainly make our infrastructure smarter and function a lot better. In terms of smart BMPs, what, you know, these are in part highly distributed real-time control of green infrastructure practices that incorporate weather forecasting to optimize performance.

So, just as an example, pilot technology on rainwater harvest, advanced rainwater harvesting systems, you know, when you look at the way that rainwater cisterns function now and for that

matter rain barrels, as well, and maybe you have a rain barrel at your house so you're familiar with this, but they operate in kind of a dumb fashion. In most cases when you have a really large rain form, they fill up, you know, if you're lucky you've got an owner who maybe goes out a couple days later and opens the tap and drains it so that it's ready to accept runoff from the next event, but in a lot of cases, maybe even most cases, you know, people often forget to open that tap and it stays full for awhile, and then the next storm comes and there's no capacity in the cistern or the rain barrel to capture any of that runoff from the next storm.

So what smart BMPs can do is, in their simplest definition, drain storage in advance of predicted rainfall or some other trigger. So you can have a rainwater cistern that's connected wirelessly to the internet, it can download real-time forecasting information from [NOA] and your rainwater cistern can be programmed with algorithm so, for example, it can look and it can see, ah, there's a 90% chance of a very large storm tomorrow so I'm going to open a valve and it can have an active valve that is controlled based on the algorithms, so it'll open up, release the water to irrigation or wherever else you want to use it for reuse, so that there's capacity in that cistern or rain barrel so that when the storm does arrive the next day there's capacity to capture that volume of runoff.

Some preliminary results we're getting from these pilot, advanced rainwater system pilots have captured 90% of the total runoff versus 48% for a more conventional approach, so you can really increase the efficiency of the existing infrastructure out there using a smarter approach. This is just an example of the user experience. You can have a task specific user dashboard that's accessible via the internet so that you can see how the system is operating and managed. A lot of times these technologies just use simple off-the-shelf technologies, pressure trans users and other things as part of their systems.

[Geosyntech] consultants is the contractor that's leading this effort, and they're implementing dozens of pilot projects around the country right now on different applications of these systems. So rainwater harvesting is just one application, but these systems can also be applied to active green roofs, you can use them for controlled wetlands, for CSO mitigation, smart detention, here's an example of a pilot technology for controlled under drain bio retention. And in this case, you know, the project team is investigating, okay, how can we use the technology to improve water quality treatment of the system?

For example, perhaps you can control the water level in this bio retention system to make it either aerobic or anaerobic so that you can maximize nitrogen removal and that is nitrification or de-nitrification basing on aerobic and anaerobic, the way you're operating the system. And that's all through active control of a simple flow valve at the end of the unit.

So I think this is a very interesting technology, and there may, in addition to decentralized stormwater applications, there may be wastewater applications here that people have not probed yet, so there's an opportunity there.

I did want to talk about a couple of new reports related to rainwater and graywater reuse, decentralized rainwater and graywater systems. We just had a new report come out in 2012 on stormwater, non-potable beneficial uses and affects on urban infrastructure, that included an

international literature review, reviews of stormwater quality, it includes summarizing – summaries of treatment approaches and also includes information on design approaches for sizing storage tanks.

The manual that you see there, a guidance manual for separation of graywater from blackwater came out just last year. This is using dual plumbing. It gives step-by-step guidance on source separation of graywater from blackwater, for graywater reuse. It covers all the different technologies and equipment that's out there, maintenance requirements and best practices for safe reuse. I think this could be very helpful for folks that are working on graywater systems or taking lead certification, providing step-by-step guidance in that to help with those efforts.

The last project I have shown up there, long-term study on landscape irrigation using household graywater, this is an experimental study. That report will be coming out next month, and this is a project that has looked at a number of systems in the field that have been applying graywater for five or more years. They've also looked at some newly installed graywater systems, and then they had some greenhouse studies that they did, as well. So there's a lot of field data and laboratory data to support the information and conclusions developed under this project.

One of the I think interesting findings from this study, it did show that while graywater might have increased levels of [surfactants], antimicrobials, and sodium, compared to freshwater sources, but in the study they looked at 22 different plant species and only three of the plant species investigated showed negative response to graywater irrigation. It also demonstrated that the nitrogen that's present in graywater can be beneficial to plant growth, so it's possible that fertilizer can be reduced or even eliminated in the areas where you're applying graywater for landscape irrigation.

And these are the last two projects that I wanted to mention before I talk a little bit about some of the outreach efforts. We've been moving certainly into, as I've alluded to in some of the previous slides, a more integrated approach for water management. Two things I wanted you to be aware of is, one, we're currently working with the U.S. Water Alliance to develop what we're calling a One Water Management Network. We held a meeting of several dozen different water and infrastructure related organizations in Washington, D.C. last year to develop, to bring this group together and create the network, and we're planning a follow-up meeting in early 2013 to further efforts of the network and reduce some of the barriers to integrated water management.

And then, lastly, in sort of concert with that effort, we have a new project that we're working on, looking at institutional approaches for green infrastructure and integrated water management success. So, again, it's not always the technical issues that are the barriers, sometimes it's the institutional issues, and there's a number of institutional barriers out there that we are going to try to address through this project.

We have – we're partnering with the Water Research Foundation and the Water Quality Research Association of Australia on this effort, and we'll have an RFP coming out in the next couple of months on that, so stay tuned.

Okay, I have a couple of slides on outreach, and then we'll move into questions and answers. We've placed a lot of emphasis on trying to get the word out on these 70 plus projects that are out there and tools and resources that are available. I guess if you don't remember anything else from this presentation today, remember that website at the bottom of this slide, [decentralizedwater.org](http://decentralizedwater.org). Most of the tools and resources that I have talked about today can be accessed through that website. Products are all available at no charge. This website is very easy to navigate and use. It was an award winning website, it was selected from I guess 11,000 different applications to receive an award, so it should be pretty easy to use and navigate.

One of the other tools that you can use that's available through that website is a quick guide for the – all the products that have been developed from the 70 plus projects, it's a list of all the products, a short description of each, when they were published and the target audience, so it gives you a snapshot of every product that's available from the DWRC and includes links directly to the tools and reports, so that's available from the [decentralizedwater.org](http://decentralizedwater.org) website.

Also, in terms of trying to navigate all this information, people look, you know, some people find a list of the reports and tools and the easiest thing to use, others process things differently and find that, well, the best reference is an FAQ, or frequently asked questions guide, so we've developed one of those to serve as a guide for the research and products from the DWRC. So it includes questions, such as what benefits do these centralized water systems provide or what are the costs associated with these centralized systems. And then for each of those questions it gives a very short answer, and then it gives all the links to the research and tools that are available to help answer that question and provide more detailed information.

We've done a number of briefings for federal agencies and NGOs. We did one on smart clean and green infrastructure, also, a briefing on looking at integration of a new framework and strategy for water management in cities and towns. And then some of our other outreach efforts. we've developed an educational video, it's just a short one, about seven minutes, some promotional brochures and flyers. There's a PowerPoint presentation, templates that you can use, brochures that if you have a central agency you're working with that wants to look at decentralized systems we have a brochure for them. Dedicated to the outreach web page, which is shown at the bottom of this screen, it says [work.org/decentralizedoutreach](http://work.org/decentralizedoutreach), and then we've also had a number of journal articles and magazine articles and workshop presentations and webinars, like this one. So, again, thanks to the EPA and you for sponsoring this webinar.

So I hope that we've helped provide some of the resources and tools and made you aware of what's out there and what you can use for different purposes, and I hope that we've also advanced decentralized technologies from some of the early systems you see, shown on the bottom right-hand side of the screen.

So, having said that, Maureen, I guess I'll turn it back over to you, and I'm available for any questions or discussion that anybody has.

Maureen Tooke: Okay, thanks, Jeff, great presentation. We were chatting offline about your examples, they were excellent.



So, let's see, we have a few questions and then unless a few more come in we can – if it's okay with Jeff we can open the lines for any more questions that folks have time to type in who are a little intimidated by the technology.

So our first question is to Jeff – are you seeing more interest in wastewater separation and use of graywater for non-potable uses or do you see that treating the combined waste and reusing the treated wastewater appropriately appears to be the trend?

Jeff Moeller: Yes, I don't know if we've – that's a really good question, and I don't know that it's clear that there's a trend one direction or the other. I'd say there's a trend for increasing both of those approaches, and a lot of it just depends on the community, the specific community and what their needs are and what the site constraints are and those kinds of things.

So what's appropriate for one situation may not be appropriate for another, but I think there's a general trend at least in increased use or reuse of water. On the graywater side I think actually some of the lead building standards are driving people to do a lot more reuse and also to explore either to do something like the Solaire Building, where you have a membrane bioreactor and you're treating the water to a very high standard and reusing it, or to a simpler graywater system.

I was at a meeting at a local county agency a couple months back around here, where there was a developer that wanted to put a hotel in and they wanted to be a lead certified hotel, and one of the places they thought that would be best for them to get their points for lead certification was putting in a graywater system, so they were trying to get approval from the county to do that. So there's more of that happening.

And then, again, I think on the – maybe on some of the more centralized side, at the same time you have more larger centralized agencies also treating combined, you know, the combined water and treating it and reusing it, and there's a number of cities around the country that are good examples of that, San Antonio being one.

Maureen Tooke: Okay, great, thanks. The second question is, I don't know if you can quite answer this one, but how does one change paradigms when we have an existing \$1 trillion of existing water and wastewater infrastructure needs?

Jeff Moeller: That's a very good question. I think that's – I mean that's part of the challenge, and I think the way to do it is to think creatively. And part of changing paradigms doesn't mean necessarily abandoning all the infrastructure that we have, and all the infrastructure we put in the ground, and that we've spent a lot of resources on.

I think part of it is really finding better and smarter ways to use the existing infrastructure that we have, and that's in places where we have existing systems. In new, you know, sort of new areas you can – you're open to whatever solution is available, but we are definitely constrained by some of the existing infrastructure we have but certainly we can use it in smarter ways.

I think that the high performance green infrastructure is one example, where maybe you have an existing infrastructure, like a rainwater cistern and you're operating in a dumb fashion, and you

can double capacity or efficiency with just making it work better, work smarter, and you can do that, you know, there's similar approaches that can be applied for wastewater systems, as well, so using our existing infrastructure smarter is what we need to do.

Maureen Tooke: Okay, and I think your response leads to a good answer for this last one, which I think is more directed at me, a comment about the need for funding for engineering studies for small community wastewater systems, that the commenter from New York, that they are pushing for that and making progress, looking for government funding for the State.

That would be lovely if we had the funds. Our program dollars, I'll be honest, they're not there. Our Office of Research Development may be a smarter way to go, but, Jeff, since your organization is successful and these projects have been ongoing for many years, and if there's, again, I think creatively working with other partners, as WERF is a partner with EPA. We also are struggling for funds. We get what Congress gives us, so we use our partners, but of the 16 partners, including WERF, to really do the work that we need to get done and use that time more than anything than actual dollars. So, Jeff, if you have any insights on funding sources for research and engineering?

Jeff Moeller: Yes, you know, I'd say maybe one good resource is the FAQ document that I mentioned. I think one of the questions in that FAQ was that same question that the participant asked, you know, in terms of there's a question in there, is there any help available for financing decentralized water systems? And it gives a couple of resources and links for information, and some of them are some EPA resources. Certainly, the state, well, the state revolving fund and the green set aside that there's been for that, and I think EPA has got a FAQ sheet on using the clean water SRF funds for decentralized systems, and some other approaches. But the FAQ has some links to resources to help people.

Maureen Tooke: Okay, yes, that is true. We do have a FAQ sheet on using SRF dollars. In some states, some states traditionally haven't used them, some states regularly use them. There's a few states – Ohio, Minnesota are just two examples of states that have very successfully used their SRF dollars, and it all depends on how the state decides it wants to spend its monies and if there are projects to be I guess on the books, if you will, or shovel ready, as they call them, to get on the – you know, you have to get on the state's intended use plan, they have to get on there for their project plan to be funded.

And every state is going to be different. Every state, how you fund it is going to be different, so working with your state is going to be your best bet or talking with any of the MOU partners we can certainly attempt to facilitate that. We have SRF folks here in the office that we can link you with.

Let's see, we get a new question – is there a need for training, installers and operators? I'm going to say resoundingly yes. Jeff, if you want to respond to that?

Jeff Moeller: Yes, absolutely, I think there's a real ongoing need there, and the Consortium of Institutes for Decentralized Wastewater Treatment, they had developed some of the training manuals, this O&M service provider manual and some other training programs.

John Buchanan has been the point of contact there. I would recommend if you want to go to that website, [onsiteconsortium.org](http://onsiteconsortium.org), and John Buchanan's contact information is there. He's at the University of Tennessee. He'd be the best person to talk to about training programs in your community or your state. I mean he can help organize I think a training program, either a face-to-face – most likely a face-to-face one. They might have some options that it could be done like a distance learning program, as well.

Maureen Tooke: Right. There's a lot of training that's going on out there. One of our other partners, the National Environmental Health Association, does [inaudible] and training. We've done – have been doing some training, EPA has been doing some trainings for tribes with regard to decentralized wastewater management.

I believe there's the extension services through a lot of the universities, and John is one of those. I know Minnesota, the University of Rhode Island all have extension services, and they do a great job training. So that is available out there, and you can contact myself, you can probably just Google me at EPA to get that information and I can link you up with the right people.

And the last question –

Jeff Moeller: Maureen, I was going to add – I wanted to add one more thing to that, and one more thought to that – the other thing that the Consortium has done is they actually have developed a train the trainers program, so if you're trying to develop capacity in your state for training you can work with John Buchanan and the Consortium to perhaps put on a train the trainers program where you can train some trainers in your state and they can go out and in turn train individuals. And they've done this in a number of places, and what they've found is it's really you get a big multiplier affect in terms of the number of people that are training when you take that approach. So it's been really successful so far.

Maureen Tooke: Good point, glad you remembered that one. And the last question we have so far here is, again, the same questioner from before, Bob, asked about reallocating funds to include decentralized wastewater engineering studies?

I guess the powers that be decide that. I can't do that for you, but your point is well taken and we do advocate, not just the staff here, but our management we do advocate for more support and funding for decentralized wastewater treatment. As Jeff alluded to, the redheaded stepchild scenario, kind of we fight the fight every day to get more visibility.

And with that, actually, [inaudible] if, Brian, if you can show, if I'm able to see, you can see my screen, if we can switch that? And Jeff has talked about the MOU partnership a few times here, and we actually over the last year or so have been working on papers – let me try to hide this stuff – to really highlight the importance of decentralized wastewater treatment and the benefits you can receive from them.

And here's the – if you can see my screen, here's the photo of the partners, there's 16 organizations, and you can learn more about us at EPA's brand-new web pages. We just

launched them yesterday. It's the second URL there. We have revamped our web pages, and we'll continue to do so to make them more user friendly and full of great materials for all of you.

We are asking everyone to – this is our new URL's bookmark. Our old URL will come down in about a month or so, so it won't get redirected. You can always find us by Google, but this webinar and all the others that the partnership has done and a few that we've done in collaboration with other groups are archived. On the [inaudible] Wiki is a Wikipedia site that we've, the partnership has built, and until we are able to get the – eventually, we'd like to pull all this over to our brand-new web pages, but because they were being built we had to do it in stages, so this is where they're all housed.

If you aren't registered with our Wiki, when you go to this first URL it will ask you to register, and then I can get you in and we'll have all of Jeff's presentation archived here, along with all of the others, including we mentioned about funding, we did one last year or so for the State of Ohio and how they were successful in getting over \$3 million worth of their SRF dollars to be allocated to decentralized wastewater projects in their State, where they were having many issues of failing systems.

And then the last link there is for the MOU papers. They highlight the benefits and uses for decentralized wastewater treatment, focusing on the environmental benefits, the health benefits, and the economic benefits of those. So just a little plug for this paper that we've all been working hard on.

And I think that that's all that I have, and just a little preview of our pages – here's our brand-new pages. We have scrolling of photos and then the last one here is talking about our papers, that you can reach, and then we have the partnership path here, you can learn more about the MOU partnership.

So, again, these will be on the Wiki. We'll have the slides and then in about a week or so if possible, unless we can't do it on our web, we'll have some – the proceedings from this posted there. And if there's any further questions going beyond this you can certainly e-mail Jeff or myself and I'm [tooke.maureen@epa.gov](mailto:tooke.maureen@epa.gov), and ask us some questions.

Jeff, if you have any parting comments?

Brian: Maureen, there's one more question.

Maureen Tooke: Oh, I'm sorry, I have to go back to my questions here. The last question we just got in here was what type of state certifications are required for installers and operators?

I know that they vary, every state has its own rules and requirements. I don't know if you can elaborate more on that, Jeff, for me?

Jeff Moeller: Yes, I agree. I think it's going to vary quite a bit by every state and maybe even by each county, so you have to check in with your I think local regulations regarding that.

Maureen Tooke: Right, and then and for those that don't know, most states, not all but most states run their onsite wastewater programs out of their Departments of Health, some it's their Department, their Environmental Department, but most are the Health Department is where it's mainly housed so that that would be both your County Health Department would be your first line or looking to your state.

And, actually, if you go to the EPA web pages, under our contacts for decentralized you can find out where you live and it selects the region that you live in and you can find your state, all the state contacts are going to be there for you to kind of fill out to where you live. And we have regional folks, as well, that can be contacted, they also would know the answer to that question, who to speak with. But every state really does have their own regulations, their own requirements, and it's also part of why the MOU partnership exists to try to create some cohesion between states.

I think that's all we have for today, so thank you, everyone, for your participation, and we look forward to your questions in the future and participation, and look for the webinar on the web soon. Thank you.

Jeff Moeller: Thank you, Maureen.

Maureen Tooke: Thanks, Jeff.