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Presentation

Patrick Jones: Good afternoon, and welcome to today's web seminar from – this seminar is sponsored by the EPA's Decentralized Wastewater MOU Program. My name is Patrick Jones, and I will be handling the technical aspects of today's seminar.

While we wait for the others to log on I would like to cover a few housekeeping items. By now, you should have the GoToWebinar application running and should see the welcome presentation on your screen. If you're having technical difficulties using GoToWebinar you may submit questions to us via the questions panel or visit www.gotowebinar.com and select the FAQs in the blue navigation bar on the left side of the page.

We encourage you to ask questions throughout this web seminar so that we may be equipped to respond to you. To ask these questions please use the GoToWebinar questions panel to submit them. Your questions panel will look something like this on your screen. From time to time during the presentation it will shrink so that you are able to see the entire slide. If this happens and you need to submit a question select the orange button at the top of that menu. It will re-enlarge, you can then type your question in and click send. It will submit the question to the moderator. And, again, we encourage you to submit questions throughout the presentations.

After today's seminar there will be a short survey. Please take a moment to fill this out. Your feedback is vital to helping us provide the highest quality speakers and information to meet your needs.

Today's seminar will be moderated by Maureen Tooke. Maureen joined the United States Environmental Protection Agency in November of 2004. She is currently a member of the Sustainable Communities Branch in the Office of Wastewater Management. This unit focuses on the wastewater infrastructure needs of small and rural communities. Maureen manages the Decentralized MOU Partnership that is hosting today's webinar.

With that, we are ready to start the seminar. I will now turn the seminar over to Maureen. Maureen?

Maureen Tooke: Thank you, Patrick. Thanks for everyone's attendance today. I'm going to introduce our presenters.

First, we have Dr. Max Zarate-Bermudez. He is an Environmental Epidemiologist in the Environmental Health Services Branch of CDC's National Center for Environmental Health in the Division of Emergency and Environmental Health Services. He serves as the scientific liaison of the CDC NCEH, with the EPA's National Drinking Water Advisory Council. He has more than 15 years of experience working on water and wastewater issues related to public health.

Our second presenter is Bob Rubin. He is a Professor Emeritus at North Carolina University, and has worked as a visiting scientist for EPA in [inaudible] Wastewater Management. He has worked with a wide range of communities and local and state health departments to identify and design systems that meet the onsite wastewater needs in a way that is sustainable and cost efficient.

Our third presenter is Bob Hicks. He is with the Virginia Department of Health. He began his career in public health at the Prince William County Health District, working first as a Field Environmental Health Specialist and then as a Supervisor of Environmental Health Specialist. For the last 27 years he has served as the Director of Office and Environmental Health Services for the Virginia Department of Health. In this position he provides leadership for most Virginia Department of Health environmental programs by managing over 60 employees and providing guidance to 119 local health departments, over 450 environmental health specialists in those units across the Commonwealth of Virginia.

And, with that, we can get started with Dr. Zarate-Bermudez.

Max Zarate-Bermudez: Thank you, Maureen, and thanks, everybody who are attending this webinar. And on behalf of my colleagues here at the CDC, NCEH, who work on segways with this, issues related to public health, we want to welcome everyone who is attending this webinar.

The title of my presentation today is Enhanced Perspective on Onsite Wastewater Systems, A Public Health Contribution to the Wellbeing of Communities. And it is important for CDC since it became part of the EPA's [inaudible] understanding to work together with partners who are working on this effort in the offer of health respect to either, you know, revealing some issues that these systems might have, but also emphasizing the opportunities for the wellbeing of the environment and communities, as a whole.

Today what I will present is why, an enhanced perspective on onsite wastewater systems and why is this a contribution of public health to the wellbeing of communities? And I would like to exemplify this presentation by findings of a two-year study that we ended last year in collaboration with colleagues from East Carolina University and North Carolina State University in eastern and North Carolina, in a coastal area of North Carolina. And, finally, I'll cover remaining promising and challenging aspects of onsite wastewater systems.

As you know, the [inaudible] wastewater systems not only involve what we know today at advanced onsite wastewater systems, but still a majority of the systems that we have servicing millions of houses in the United States are conventional onsite wastewater systems. And they have called attention of many people working in environmental public health, I would say in the last 15 to 20 years.

Let me start with this slide, and I think it's important for anyone when we are trying to identify issues and address those issues related to conventional onsite wastewater systems, it is important to know the component of these systems. And, as you know, the majority of you, better than me, you know, most of the components of these systems are not above ground. These components are below ground, and we really don't know how they perform.

As I said before, in the last 15 to 20 years a lot of attention has been put on onsite wastewater systems because papers, not only within the United States, but also papers published internationally, especially in Canada, indicate that there is a lot of association between contaminated drinking water, especially in houses that are located in areas where there septic systems are – have high densities or taking houses that have a septic system serving the house.

So what we don't know is really the fate of some contaminants that might be in the wastewater that has been treated and been disposed by onsite wastewater systems. As you know, the soil is like a barrier, acts like a barrier to the passing of many of these contaminants, many of them are microorganisms. But we really don't know the fate of the microorganisms in shallow aquifer, especially in coastal areas.

Let me go back a little bit about why we did this study in North Carolina in a coastal area, because in many areas of coastal North Carolina there are rivers [inaudible] into other coastal areas in the United States that are nutrient sensitive. And the contributions of nutrients to surface waters haven't been counted very well yet, especially for non-point sources of pollution, one of them being onsite wastewater systems.

Something also that calls the attention for us is we really don't know if pathways exist for contaminants in [inaudible] with the system that may reach different aquifers, and at some point could probably even get into the wells that are serving drinking waters in houses that have both onsite wastewater systems and also private wells.

Something also that is very important to take into account is what are the environmental conditions of the different components of onsite wastewater systems. As you know, septic tanks have mainly two areas, you know, the upper part is considered an aerobic part, and the upper part is considered an anaerobic part of the system. So we have to understand these environmental conditions in order to – for them to make sense of data that we are collecting with regards to the fate of different types of contaminants, can be chemicals or can be microorganisms.

Very special field, as you know, is known to be an aerobic part of the system where nitrification occurs, but it's also important to know what's happening in the soil. And as we go deeper in the soil we can find biomat and we can find [inaudible] anaerobic in that tank, variables sometimes of reactions that occurred with some chemical components of the wastewater. In this case nitric for example can go under [inaudible] conditions can go all the way to the nitrification.

So why an enhanced perspective on onsite wastewater systems? Some of the environmental issues that are attributed to malfunctioning of conventional onsite wastewater systems that have been published are excess of nutrients are transported already to [inaudible]. Microbial contaminations causing the closure of shellfish areas and the beaches. And we don't even know if these contaminants are coming from onsite wastewater treatment.

And in Florida, for example, it was reported in early 2000 that even [inaudible] or 24 inches separation between the bottom of the drainage and the surface of the water table can be safe for protecting the shallow aquifers from microbial contamination.

By [inaudible] Borchardt published work that he had done in Wisconsin and where he found association between houses that are served with onsite wastewater systems, and the occurrence of diarrhea diseases, especially in children. So this called attention of EPA, the Office of Groundwater and [inaudible] it caused a couple of groundwater contaminants in late 2000 and Borchardt presented his work there. What really is not very clear if the pathways of contamination really occur, if onsite wastewater systems are the ones to blame.

So that's why we started this study in North Carolina and we wanted to focus our attention in the coastal part of the State. I don't know if you know, but North Carolina is estimated at almost 40% of the population of North Carolina is served with onsite wastewater systems. As you go towards the coast it's estimated that 60% of the population is served with onsite wastewater systems.

And you can imagine what happens in near coastal areas. The size of the lot size, more or less, for [inaudible] the systems would increase, and is not rare to find in parts of North Carolina that are up to 200 systems per square mile, 200 onsite wastewater systems per square mile. Also, that part of the State is actually [inaudible] area so if there are issues with regards to coastal beaches that will hurt the tourism industry, but also in that area there are a lot of shellfisheries, and if contamination is occurring it can also hurt the economic development of those areas of North Carolina.

In the picture that you can see, towards your left, one of the systems, the two systems that we studied in North Carolina are within those squares. I don't know if you can clearly see that, but one is towards the bottom of the picture to the left, that's in Goose Creek and that house was adjacent to the [inaudible] and the other system was a little more inland and is located in the middle part towards the upper part of the – sorry, towards the left, in the upper part of the picture.

So, again, why is this a contribution to the wellbeing of communities? Because an enhanced knowledge of the onsite wastewater systems and the wastewater management in general in coastal areas can contribute to the wellbeing of communities, and if something is going wrong it can be remediated and contribute to the economic development of the whole area.

Also, design and implementation of corrective actions that would prevent future risks if these are needed to be implemented. And, as I indicated before, the communities can benefit from assessing water and sources in a more interconnected and integrated manner and will only go to benefit the economic activities that are predominant in areas like coastal areas.

It also helps in better protecting the environment, and if the environment is protected we know that public health will be protected. And the contributions to economic development and wellbeing of communities we – can be achieved. There are challenges, and we are willing to work in addressing those challenges.

So let me show to you some of the findings that were achieved in this two-year study in North Carolina. First of all, the approach was for the assembling of a multidisciplinary team, that was composed by geologists, environmental health scientists, soil scientists, public health experts, and students of the geological program, geological scientist program at East Carolina University.

We did the site selection, soil morphology, and identification of the system components, and you know that these are not an easy task. Characterization of the shallow aquifers, we needed to know where the wastewater plume is going to, the delineation of the wastewater plume, and orientation. We did the monitoring of the performance of the system, and we scheduled [inaudible] sampling in these systems. The two sites were sampled during year one, but only the site that was next to the [inaudible] was sampled during year two.

And this is showing the sampling points for year one of the site one, that is the figure to the left in your screens. And we doubled the [inaudible] sampling points for the study done in year two. Our findings indicated that the flow of direction of the wastewater plume was going towards the [inaudible] in the case of site one, and in the case of site two it was dispersed to different parts of the aquifer, and that was probably influenced by houses that were in closer proximity, the lots for site two were smaller than the lots for site one, for example.

The geoprobe sediment cores collected up to depths of five meters, and that showed relatively homogeneous sandy soil. Low permeability in organic rich clays and wood debris found in site two, and there were as deep as -- less than one-foot down, it was like probably three-quarters of a foot. The characteristics of shallow aquifers allowed to be homogeneous in sandy sediments, and the onsite wastewater systems in coastal areas depending on their location have been shown that can be comparable to the [inaudible] of contaminants into the shallow aquifers.

Let me go back to that slide, but also in here, too, for site one we have the occurrence of severe weather events. We had like an epidemic of tornadoes before the middle of the year, and in August as you might remember we had Hurricane [inaudible] that dropped almost 17 inches of rain during that time.

The monitoring performance, these are some of the indicators, the physical chemical indicators in the left column of the screen. And we have the microbial [inaudible] indicators in the right column of the screen. And, as I indicated before, these parameters were sampled on a bimonthly basis.

What our findings indicated is that setbacks that are 30 meters for North Carolina between onsite wastewater systems and surface waters, that is 100 feet, are probably not protective of surface waters because we found that the nutrients can be offset up to 40, 50 meters from the dispersion field. Onsite wastewater systems in sandy soils may add this whole organic nitrogen loading to adjacent surface waters, and the monitoring of the [inaudible] organic nitrogen I think is very important to take into account.

Regarding the microbial [inaudible] indicator data more spatially and temporarily variable than the nutrients data, and probably for year two that was caused because this thing, weather event that we had. If you remember, in one of the earlier slides I indicated that knowing the environmental conditions of the components of the system, but also knowing the environmental conditions of the media in the environment is very important to know the fate of both nutrients and microbial [inaudible] from onsite wastewater system because that can help us in indicating, for example, in the case of microorganisms survivability of microorganisms in the environment.

E.coli and enterococci densities decline to less than background levels within and outside the dispersion field area. Enterococci was monitored because, as you know, enterococci is an indicator of organisms to monitor water quality in beaches. Found elevated microbial densities during several sampling events in background wells or in wells more than 70 meters from the dispersion field.

What we didn't find, especially after monitoring for three or four sampling events, wells in houses that neighbor the sites, number two was that those different wells were not contaminated. However, I think a more intensive monitoring program and more studies are needed in order to rule out that these deeper wells are safe from contamination from onsite wastewater systems.

Patrick Jones: Max?

Max Zarate-Bermudez: And this slide is showing to you the different species of nitrogens that were found, and this is for site number one. The median total of nitrogen and the soil organic nitrogen are shown for the tanks, the backgrounds. As you can see, by the levels in the graph to the left, were lower than one milligram per liter and, in general, levels of ammonia in the [inaudible] nitrogen, in the graph to the right of the screen were lower than 10 milligrams per liter. Occasionally we found this level of organic nitrogen in elevated concentrations, more than 10 milligrams per liter, and that's why we indicated that it's important that this [inaudible] organic nitrogen is monitored in these types of systems, or , in general, in different systems that exist around coastal areas.

As you can see here, this spatial and temporal distribution of microorganisms are more variable than the distribution of nitrogen species, and this is showing [inaudible] E.coli and eccocci levels that were found around site number one. Something to emphasize is that we didn't find levels that were higher than the limits recommended for recreational waters.

Patrick Jones: Max?

Max Zarate-Bermudez: Some of the accomplishments – yes?

Patrick Jones: I just wanted to let you know you have about two or three minutes to wrap-up your presentation.

Max Zarate-Bermudez: Thank you very much. I'm about to finish. Capacity building an important component of our study design because, as you know, many local health departments need people that have the experience and good training with regards to assessing the performance of these types of systems. We have some graduate students that completed this work with us, and also we have some publications that were submitted to the general environmental health, and also new funding opportunities that were gathered at the local level, mainly the State of North Carolina and the East Carolina University.

Some of the limitations were mainly limitations of funding. This was initially a three-year study, but we suffered caps and we were able to fund only two years of this study, and we didn't do the epidemiological study, part of the study. And I can tell you that an average of $100,000 per year was used in this study.

About the remaining promising and challenging aspects, elevated nutrient concentrations found in this dispersion field are higher than the setback. Dissolved P returns to background levels over a shorter distance than we saw nitrogen concentrations, and that's important to continue studying. And microbial indicators are more spatially and temporally variable than nutrients, and I think that's also important to continue studying.

More challenges aspect, need of more comprehensive tracing of human waste, so [inaudible] tracking is encouraged to be incorporated in future studies, and extreme [inaudible] events contribute to the variability of data. De-nitrification if where the production of nitrogen to oxygen, nitrogen and oxygen could be generated, so that is a powerful greenhouse gas and that needs to be monitored. Climate change may have a large influence in the treatment capabilities of onsite wastewater systems.

Promising aspects, de-nitrification. The coastal North Carolina is possibly because we can produce the loads of nitrogen to surface waters if that occurs, and data from studies in northern coastal area, studies are useful in building up a large database that hopefully can be beneficial for – not only for the State of North Carolina but for other coastal states in the country. They'll be centralized for use applications [inaudible] onsite energy and resource efficiency, that is important to take into account. These systems are cheaper to manage and to operate and maintain than centralized systems.

However, the message from CDC is that there is room for both in the populations of our country, and decentralized onsite wastewater systems can save a high portion of the tremendous energy costs and emissions associated with pumping. And that is cited here, a study done by the California Energy Commission, and I encourage everyone to review that study.

And, finally, acknowledgements to people at ECU and NCSU and also colleagues within CDC, and if you have any questions I'll be happy to answer after the presentations. And I have to make this disclaimer, the findings and conclusions of this presentation are mine, not reflecting by any means the perspectives of the CDC. Thank you very much.

Maureen Tooke: Thank you, Max, for your presentation.

We'll move on to Bob Rubin now with the University of North Carolina.

Bob Rubin: It's not showing up for some reason. Can you hear me? I can't get my slides up.

Maureen Tooke: Click on your PowerPoint on your toolbar.

Bob Rubin: Oh, thank you.

Maureen Tooke: You're welcome. And just hit F5 now.

Bob Rubin: Got it. Thank you. Thank you.

Maureen Tooke: There you go.

Bob Rubin: Good afternoon, everyone, or good day, everyone. My name is Bob Rubin. I'd like to talk with you a little bit about some design and management issues that are associated with distributed wastewater systems as we look at protecting public health and environmental quality.

Let me begin by sharing with you the Decentralized Program Strategy that EPA has, and I hope many of you have already seen this. We've been talking about this for over 10 years, and the Agency's position, and I did a little work there for a number of years, is that all wastewater systems are managed appropriately, perform effectively, and are acknowledged as a component of our nation's wastewater infrastructure.

The only way we can achieve that is to assure that systems are designed, installed, operated, maintained, and managed properly. And in that respect, EPA will serve as a catalyst for improving system management through efforts like this and partnering with other organizations and other entities to assure that systems are done properly.

There's a lot of interest in onsite systems and potential impacts to public health. In 2000 there was an outbreak of disease in New York State that was associated with a state fair, and notice please the outbreak may have resulted from contamination of the fair's well number six by septic systems on the ground, on the fairgrounds, and also by runoff from nearby youth cattle barns.

It's very, very difficult when you start looking at incidents of disease and epidemiological studies to attribute public health consequences to properly functioning onsite infrastructure, onsite wastewater infrastructure and onsite water infrastructure. There have been studies over many, many years. A couple of things to consider. First, is it's very difficult to define boundary conditions associated with these onsite wastewater treatment systems. These are systems that are located through space, and identifying plumes, identifying boundary conditions that truly represent a system boundary, very difficult to do.

Some of my colleagues here in North Carolina, [Craig Coggler] and [Mark Sodsy], a number of years ago looked at virus indicators in coastal sands. They did find them in close proximity to the wastewater systems, but as monitoring wells and monitoring locations moved further from the system there was a great deal of attenuation.

[Dick Ovis] and [Damon Anderson] in Florida about 10 years ago looked at a number of indicators – biological indicators, as well as some of the other indicators, and again found that as you move further from the source, either a trench or an infiltration basin or chamber, that pollutants do tend to attenuate.

And let me emphasize that detection in those cases was not a hazard. There was no incidence of disease associated with any of these monitoring activities. Similarly, Mark Borchardt up in Wisconsin did a study a number of years ago looking at groundwater wells, a groundwater well in Door County, Wisconsin. The soils were poor, they were very thin. The well was improperly cased. The wastewater system was possibly designed inappropriately. There was an outbreak of Norovirus, they did detect Norovirus in the shallow groundwater well. Patrons and employees at a local restaurant were sickened. What I'd like to emphasize there is although the employees at the restaurant were sick they didn't all go home.

So in this particular instance detection was a hazard. There were Noroviruses that were detected and people did come down with Norovirus disease. So when you look at groundwater studies we may or may not have issues. Looking at epidemiological studies true linkage between onsite wastewater system and disease, very difficult to document.

What are some of the issues? EPA is encouraging states to look very comprehensively at their programs. We have some states in the country that are truly leading the pack when we start looking at siting size and design, operation and maintenance criteria.

We've got to do a better job of incorporating planning issues into our distributed wastewater system perspective. We've got to do a better job of incorporating sound science and engineering into the design and the operation of these systems. And as we look at onsite systems as a permanent part of our infrastructure we've got to manage these systems. We've got to manage them to protect public health and environmental quality and to protect the aesthetic of the community.

It's not uncommon to see in some communities onsite systems as the wastewater management option of necessity, so we've got to look at protecting the aesthetic and the public health in that community, especially where these systems are the only option that's available.

I think it's important to look from a design perspective, what are the functions of an onsite wastewater treatment system? First, and this was really the initial design criteria, that system must accept a hydraulic load from a site, the water has to move into, through and off of a site through some boundary, and that's that transmission component. If water is not transmitted off of the site it tends to pond and pool and treatment efficiency is reduced.

The next thing that has to happen is the process component. The pollutants have to be accepted and attenuated on that site, and we address those functions with proper design and management. I'd like to emphasize the importance of soil as a treatment medium. Even when we utilize high levels of pretreatments the soil ultimately accepts liquid treated or partially treated, highly treated or partially treated, and that soil must accept the liquid and must accept and attenuate both the process and the liquid component.

Where site and soil presents a limitation we do have a number of alternative designs. We do have pretreatment and disinfection that we can use and, again, as we look at alternative designs and these pretreatment options, and I'll talk more about those in just a minute, management becomes absolutely essential as a tool for minimizing risk and optimizing system performance.

So when we look at system dysfunction what we typically find is that poor site selection or poor site assessment lead to inadequate separation, distances to some limiting condition, that improper design may cause the surfacing of effluent, they did not specify a hydraulic loading rate properly, and untreated liquid may surface or untreated liquid may discharge to shallow groundwater. Again, that's [inaudible].

The other thing we see frequently is improper installation, operation, and maintenance, and that could be of a wastewater system or of a well, wells improperly sited or improperly cased. We've also see, and I think Dr. Bermudez mentioned this just a few minutes ago, in excessively high rain events we may see infiltration into these systems. Please remember that these systems are designed to assimilate a relatively small hydraulic load, relatively low pollutant load. When we get those infiltration events and hydraulic overloads that provides or creates tremendous stress on that system. So we may see some leakage.

I did spend some time working at EPA and, Maureen, I remain a shameless promoter of EPA. If you have not visited your EPA website I urge you all to take a look at EPA/gov/owm/septic – there are a number of outstanding resources available there and you can download them and print them out.

When you look at a program it's very important to incorporate into your local programs these elements that EPA has described – participation and planning, some assessment of performance of systems, and adequate site evaluation, design and permitting issues or activities, some oversight of construction, a program to assure that systems are operated and maintained properly, opportunities to manage the residuals that are generated in these systems, and residuals management is going to be more critical as we see more intensive management of the systems.

I do believe, and I think many people share with me, the need for certification and training and licensing efforts. Systems, especially those that involve some level of advanced treatment or alternative dispersal do have to be inspected and monitored. There has to be a program in place to deal with collective action, who is going to pay, and how will you assure that these systems are maintained and corrected in a timely manner. Records and reports are reviewed and, if necessary, that there's some financial assistance for folks involved in a program.

Looking at wastewater management please consider first your water supply, so either groundwater and creating these wellhead protection areas, as depicted in the slide on the left. Assure that there aren't undue pollutant sources in that wellhead protection zone. If you're looking at surface water areas, like they've done in New York State around some of the water supplies for the City of New York, they've created surface power supply protection areas where they're using some higher levels of management.

So look at your surface water or your groundwater resources and develop your management programs, first and foremost, to protect public health and environmental quality in these very sensitive areas. And where these areas exist it may be more important to develop higher and higher levels of system management and use more sophisticated treatment systems.

We've tried over the last 30 years to incorporate a more aggressive science based and technology based program that we incorporate into local rules. EPA has designed manuals for onsite systems and, again, what we've tried to do at the state level is incorporate those into rule. I've cited two rules here from North Carolina, our onsite rule is Chapter 18, our reclaimed water rule, is Chapter 15. And you will see more emphasis on reclaimed water in some of these onsite applications.

I am familiar with rules in a lot of different states, and those of you in other states please become very familiar with your state and local rule or local ordinance, that's what drives these programs, unlike the NPDES' efforts these programs are typically regulated at the state level, not necessarily at the federal level. So look carefully at your rules to see what's in your state rule or state or local ordinance and optimize that design.

Some of the things that we look at as we look at design and operation, what are the characteristics of the site, what are the slope conditions, and what is the landscape position, what are drainage features on the site. And this concept of hydraulic boundary, how water flows off of a piece of property, as well as property lines. We've got to assure that we protect water quality at property lines. Those are the site features.

We also look at soil factors. We have to follow texture structure and consistency. And those will vary dramatically as we move from one position to another on a slope. Those of you who are not familiar with siting features, please go out and work with site evaluators and local health people as they go through their assessment of site and soil conditions to learn about how these systems fit best in receiving environments.

On that slope I just showed you, the soil resources on the left are typically from the up slope location, and I don't know if you can see these color patterns in here, but these color patterns or these blotches indicate that there's some seasonal saturation that may have existed on these sites and that causes some of these colored features that we see on the left, these blotches of red. The pictures on the left – I'm sorry, on the right – the gray colors that we see in there are typical of saturated soils. And you can see that these saturated soils exist very shallow as we move downslope and we have influence of drainage on soils and influence of water and longer periods of saturation.

Our design has to take those considerations, the site and soil considerations into the factors that we use in design, and where we have these limitations we have differences that we can – we have specific technologies that we can use to overcome hydraulic limitations or nutrient limitations, soil depth limitations, or these boundary condition limitations.

And, again, appropriate design is an exercise in getting proper treatment at the boundary.   So our first goal is to conserve those resources on a site. Our second goal is to assure that we get treatment, treatment, treatment as liquid and those constituents move further and further down gradient.

Our treatment can be a very, very simple septic tank or we can use some of the more advanced options, aerobic treatment. Typically there are two types – fixed media or suspended media. We can use disinfection to reduce pathogen levels. And, again, look at your state's standards. In North Carolina or in the Health and Human Services regulation, the one I cited just a minute ago, there's two levels of treatment – TS1 or TS2.

If your state does not have a standard NSF, American National Standards has just come out with a new standard for reclaimed water, the standard, the 350 standard. And I urge you to go take a look at some of the information that NSF has on treatment systems and treatment standards. So that's the treatment, pre-treatment before the liquid goes to the soil.

The next thing we look at is whether the soil based treatment options, most of our onsite systems are shallow, subsurface treatment systems. We do have some that are relatively deep. And more and more interest today in pressurized distribution, for example, the drip irrigation option.

Pre-treatment, again, the processes have different capabilities for removing [VOD] and TSS. Our North Carolina standards are TS1 and TS2 standards, I just mentioned, are listed in the table on the left-hand side of your screen. We are just now coming out with reuse standards for onsite wastewater systems here in North Carolina, and our reuse standards for our onsite systems where the water is used for limited public access you can see are considerably more stringent than our TS1 or TS2 numbers, especially on the coliform.

On the right-hand side you see a typical suspended media system on the lower screen, and a typical fixed media system on the upper portion of that screen.

Dispersal, again, traditional systems use gravity induced drainage. There the separation distance could be three or four feet required between the bottom of the trench and some restrictive layer or shallow groundwater. Most of those treatment stand, it's our prescripted, they're in code.

As we look at alternative disposal technologies or dispersal technologies many of them are pump or pressure dosed. Typically, we can use much shallower placement of that liquid. And here, again, we're using this performance based standard as opposed to a prescriptive based standard. We're imposing monitoring requirements on the systems with these alternative or performance based systems.

A typical gravity dosed system we're looking at soils of typically four, maybe five feet or more in depth as a gravity line placed in some aggregate or some media. Most of the soils are covered with vegetation. And over time we get liquid that moves along the entire bottom of that system and that whole system then begins to just drain at a constant rate.

Pressure dosed, typically we use low pressure distribution systems or drip irrigation systems or low pressure pipe systems typically follow contours, drip systems follow contours. Drip systems are typically buried in direct soil contact. Low pressure systems are typically buried in some kind of trench. Our drip systems use engineered orifices, and I'm seeing all across the country today a tremendous interest in these drip dispersal systems. And, again, less separation distance required because of the treatment and because of the more uniform dosing, we utilize the entire soil volume much more effectively than we do some of the more conventional or gravity distribution.

Next step we're seeing higher and higher levels of treatment and we're seeing onsite reuse. There are a number of state standards out there of [inaudible]. I did include the Virginia standard there, and our North Carolina standard, our [2U] or our 1900 rule, and all states or many states now are developing standards for reuse.

We're seeing onsite reuse in large urban areas. The [Solaire] facility in Manhattan utilizes treatments and reuse in a multifamily, residential facility. The liquid is treated in the basement of the building and recycled back through the building for toilet flushing, cooling towers, and irrigation of the park that you see in the picture.

We also have projects here in North Carolina, a rural high school, as well as a city park, where we're actually treating and reusing water from those wastewater systems, indoors for toilet flushing, and outdoors for irrigation. All of these facilities are lead platinum or lead gold, and they use these water recycling efforts as a mechanism to gain credits and points in the lead rating system.

As we look at that or as we look at those options we've got to manage all of the components of that system. The treatment component, whether it be a simple septic system or one of those more advanced treatment units, the dispersal component, how we get water out to the field and get that water into, though, and off the site. We've got to assure that the entity that does the management, the people that oversee the individual operation, the system or the infrastructure, the owners, as well as that whole onsite infrastructure are managed properly, and our regulatory component has to be managed. Regulation is not static. Regulation continues to evolve and to grow and develop as we learn more about systems and how they perform.

There are some resources I'd like to make you all aware of. EPA has their Reuse Guide, the 62504 Guide, and the Onsite Systems Manual, I discussed that briefly at the outset – those are available from EPA. The Water Environment Federation has a manual, in fact, it's number 16 on natural systems, available from Water Environment Federation. If you have not visited the WERF Decentralized website, Water Environment Research Foundation, please go to werf.org and visit their Decentralized System Guide. If you haven't visited NSF, look at the NSF standard. And please, please, please look at your state laws, state rules, and state regulations.

We know a lot about wastewater and wastewater characteristics and wastewater treatment. Our whole goal of our program is to ensure that these systems are designed and operated and maintained to reduce risk. We can do a good job of treating wastewater. We can do a good job of evaluating sites and soils and maintaining adequate setbacks. We can do a good job of design. And all of those fit into this management program that EPA and our state agencies strongly encourage.

My name is Bob Rubin. I'm at North Carolina State University. My contact information is down there at the bottom of the screen. So thank you, all, very much.

Maureen Tooke: Thank you, Bob.

While we have a little switch of presenters here, give it a minute there. Our next presenter is Bob Hicks with the Virginia Department of Health. We'll get started right now.

Bob Hicks: Hello, this is Bob Hicks, and I'd like to thank everyone for being a part of this webinar, and I'm honored to be on the Panel with Max and Bob. And what I'm going to speak about is sort of where the Virginia Department of Health has been with its management of onsite sewage, its regulation of onsite sewage systems, where we've been, and where we're headed. And I will probably skip a couple of slides because Max and Bob have done a good job of expressing a point, I'll reemphasize those as I go along. Let's see here, I'm –

Patrick Jones: Bob, just click on the PowerPoint and then you can use your keyboard.

Bob Hicks: Okay, there we go. Here we go. Okay, in Virginia for a long time our mission has been trying to keep human waste separate from the environment, especially the water environment we live in. And although we've learned a lot about, more about technology that can improve our treatment of wastewater and how diseases occur through the people, oral pathways, basically, our mission has been – has remained the same. And this slide was to show that that's not what we want occurring.

This is a map from the Census Bureau, basically showing how many – sort of the reliance states have on using onsite wastewater systems. And, as you can see, Bob and Max both talked about North Carolina. They have a little bit greater reliance on onsite wastewater systems, but we're in that middle category, between 26% and 40% of the residents' needs – use onsite wastewater in Virginia.

What I'm going to show you, I'm going to show you this slide, it's a sort of a historic look at what Virginia's regulatory role has been in regulating its onsite sewage systems. This is sort of a timeline, if you will, at the bottom, where most of our resources and activities that were spent looking or involved in the permitting, and evaluation, system design, monitoring construction and installation of systems, and issuing operation permit, and all that occurred before really there was a risk to the environment or anyone's health because nothing had been flushed into the system and ultimately into the environment.

And if you looked at our program then we were pretty much a construction permitting program. All of our resources spent processing applications, doing the site evaluations, and at one time many years ago, 20 years, 15 to 20 years ago, the Health Department in Virginia pretty much did all those different steps of that process except for, of course, installing the system and constructing the system. But we did the site evaluation, we did the system design, we issued the permit, and then we inspected, monitored the inspection and issued an operation permit.

And it was based on a – pretty much a prescriptive program of if you – your application and site met certain soil and site conditions, like Bob Rubin has just described, ones that are suitable, you got a permit. If it didn't you did not get a permit.

So I want to just talk a little bit again, reemphasizing what Bob Rubin said about EPA's response to Congress in the late 1990s, talking about that managed decentralized systems are a cost effective and a long-term option for meeting both public health and water quality goals, especially in areas that were less – more rural in nature, and Virginia has a lot of areas that are very rural in nature. It also has a fairly number of high density areas that still rely on onsite sewage systems as the means of wastewater disposal.

So our goal has always been we want to get the harmful elements reduced that are in wastewater. We want to take that water that has been treated, either in a conventional system or an alternative wastewater system, distribute it back into the environment. And we hope that this effluent is treated before it reaches that groundwater in our environment.

Again, this is a typical conventional system design, that you've already seen. What we're trying to show here is a well-drained soil, properly sited, with wells properly located at a safe distance and properly designed, they do a pretty good job of removing the microbes that are in the wastewater.

One of our problems, of course, recently, and I'll explain a little bit more about that, though, is nitrogen. Nitrogen is not easily removed from conventional systems and, basically, it will continue on until it hits a point that it can't move any further and slides along there and can enter our streams and waterways.

Actually, you don't see nitrogen very often, but you can see it if it's moving in the other direction, that is, and if there's nitrification occurring right below the surface. And you can see here's an aerial shot of the conventional system and you can see the nitrification lines where you have nitrogen in hopefully no ponding yet of water, but they're showing that it could be a little bit of pumping up concern.

Now our – we have a lot of the coastal areas that were described by Max and Bob in Virginia. We have a lot of waterways, and this is an example of a house that's pretty close to our waterways, and we question, okay, what's happening with this wastewater system, both with the microbes and the nutrients?

We also in Virginia have a number of older homes that are still occupied that either don't have any wastewater system or an inadequate wastewater system, and these, unfortunately we have thousands of these in Virginia, and this is an area that we've tried to work on over the years with some degree of success.

And we have – this is a picture of – a photo of a community that's really close – not too far from our State Capitol here, actually it's within 10 miles of the State Capitol, and we have some poor communities that they only have – their wastewater system is still the outhouse.

We also have shellfish, a sanitation program in Virginia, and what you're looking here is you're looking at some – an area that we have shellfish harvest areas in. And we have a program where they – not only do they look at the processing plants, but they look at the – they do land surveys, watershed surveys, looking at the houses and looking at the sources of pollution.

And in this case this is the [Lojack Bay] in Gloucester County, and what you're looking for, what this showed you here, you have some triangles that are showing areas where there have been identified problems, whether there's a greywater discharge or [inaudible] onsite system, this great pipe going to the waterways.

And then we look at some of our sampling stations here, these are -- the green crosses there are where we have shellfish stacked around and actually sample the bacteriological condition of the waterways there. And they use that in combination with their watershed surveys, and then we end up having to make decisions on whether or not the harvesting areas are actually safe for harvesting shellfish or if they're prohibited or in some cases they're restricted for one reason or another. Sometimes this is done on a seasonal basis, but obviously our waste from our communities impact our economy, and in this case our fisheries' economy.

Another concern in the Commonwealth is we have a lot of tourism areas. This is, and maybe hopefully have common visitors at Virginia Beach, one of our popular beach areas there. In this case, we have a program that's ongoing where we are actually sampling the fishing areas, and in this case we have about 20 different sites that we are fishing or sampling to look, make sure that the water levels are safe for beach use.

And our results have been always not real good. We, for instance, in last – in 2010 we had a total of 38 advisories, advising people that it was not safe to swim and that occurred over 81 days, covering 16 different beaches across the Commonwealth. And we are concerned about our tourists and we want them to come and be safe, so this has been in many of the cases some of the impact of these results or contaminations is from onsite system.

We have another issue, a big issue with the Chesapeake Bay. We're working with a number of other states to try to do some things to clean-up the Chesapeake Bay, and this is called the Chesapeake Bay [TMBL]. Basically, EPA has set – put us on a diet, a pollution diet so that we could – if the states work together we can meet some of the clean water standards that have been set for the Bay. There have been caps placed on nitrogen phosphorous and sediment loads for all the six different Bay watershed space in Washington, D.C. And then the states set load caps for the different point and nonpoint sources. And the target for this cleanup is 2025, so that seems a long time away, but since we've been working, the states have been working on this problem for a number of years, and not making as much progress as we should be, that's not much time.

Obviously, these are the different nitrogen loads to the Chesapeake Bay. This is showing that obviously you have municipal and industrial wastewater, atmospheric deposition, you have agriculture contributions from manure, you have chemical fertilizers from agriculture. And about 4% at least at the time of this picture chart, was attributed to onsite sewage systems.

And if you look at that – those different sources in a different way you can see the nitrogen loads by sources, and although septic or onsite is fairly low you need to look at what the trend has been. Our municipal wastewater systems and our agriculture have been making tremendous strides in reducing the nitrogen loads from their sources over the years, so you see a downward trend. Unfortunately, you have some reduction in the forest area, but urban runoff and septic have – are showing slight increases over the years, and there's been no downward trend.

So for Virginia, we have about a million onsite systems throughout the Commonwealth, but within the Chesapeake Bay watershed it's estimated we have about 540,000 onsite sewage systems. And this contributes to about almost nearly 3 million pounds of nitrogen per year, and as I mentioned earlier it's about 4% of the total load. And the estimate EPA has for every system that about 40% of nitrogen from that onsite system eventually reaches a spring. And so our current watershed, the WIP stands for watershed implementation plan, is to reduce our load down to 2.5, 2.4 million pounds, and this is our cap for the State.

Now there's – they've got some pretty serious, significant consequences if we don't make progress on meeting our reduction loads here, and you can see some of these. Obviously, you – they could step in and do some rate oversight of some of our [MPDFs] permits. They can require net improvement offsets. They could basically change some of our grants or conditions from our grants that the EPA offers to the State or is involved with the State, but there are some pretty significant things that could occur if we don't get our loads there.

So, obviously, as has been mentioned before, nitrogen is a concern in our wastewater, and basically that comes from amino acids in the urea from the body, and the bottom line, each person probably contributes somewhere between nine and 12 pounds of nitrogen each year to – in its waste, and so that's – it's going to be there. If you have people you're going to have nitrogen there.

So looking at the nitrogen cycle, we need to evaluate that in terms of what can be done and in terms of this is the natural nitrogen cycle, and obviously we're going to look at parts of that to see how – what we can do to kind of minimize or reduce our loads from the onsite wastewater systems.

So picking the proper mechanisms is important. We basically have the two-step biological process, nitrification and de-nitrification to get removal. And through what we are doing in Virginia is looking at ways to reduce it from our onsite systems, and right now we only have authority – we have, in Virginia, we have conventional onsite sewage systems and then legislatively they're called alternative onsite sewage systems or the ones where you have some sort of pretreatment or some other means of dispersal other than gravity flow.

And so we only have authority to remove nitrogen from those systems, and so we're looking at trying to get a 50% reduction from all of our small alternative onsite sewage systems. And if it's a larger alternative system like, such as what we call a mass drain field, we do require and can require a standard for where the project boundary is for that large system.

So one of the things we're trying to do is to look at legislation, or we're not doing it right now but it's under discussion by the legislators is to eventually have to, in order to get any significant reduction from onsite is to look at our conventional existing systems and what should be done there as far as nitrogen goes.

Also, one benefit would be to promote community systems where you would take older existing systems and have it managed with some pretreatment and other ways to reduce the nitrogen load and manage it that way. Currently there's – we have a legislation now within parts of our Chesapeake Bay watershed localities can require a pump out of all systems, but it's not required throughout that watershed nor throughout the State. And we're looking at ways to maybe develop some tax credit as an incentive for people to upgrade their systems and other financial incentives.

We just recently adopted final regs for our alternative onsite sewage systems, and the purpose, of course, is to protect public health, surface water and groundwater. It gave us authority to establish a program that we could regulate the operation and maintenance of these alternative systems, and we also stepped away from our – we didn't change our prescriptive requirements, but we established performance requirements, such as in other setbacks so that it was protective of public health and the environment.

And one of the things that was mentioned by Bob a little bit was we are fortunate enough now that we have a licensed program not under the Virginia Department of Health, but another agency, where the various stakeholders that help evaluate soils, design alternative systems and install them are now licensed, but they have to meet certain training requirements. So that's a very positive step forward.

But getting back to the regulations, and they can be kind of controversial because now for the first time people are being told that they have to have their system operated and maintained by a licensed operator. And we've set a frequency right now of one annual inspection. It talks about what samples are required, what is required by the operator in terms of when he goes there what is he going to record in terms of the operation and how well it's working or not working, if something needed to be fixed, then you record that.

And he submits that electronically to our reporting system. And we've been – this has been in place now for a little bit, not quite a year, but we had emergency regs before that so we have data that's from about 7,000 systems or inspections that have been submitted online.

Again, this is what the operator needs to kind of keep a record of. He's going to be doing the sampling results. If there is a report of incident that caused him to go out and make an investigation or inspection, he reports that. Any type of corrective actions or repairs are made, and any pump outs that he does, and providing information to the actual system owner.

These are some of the sampling and monitoring requirements for these onsite alternative systems. For some of our small ones we'll have initial grab samples after – within 180 days. And, basically, generally approved systems after that would only need a sample once every five years. And systems that we call non-generally approved, they'll have four samples the first two years and annually thereafter.

And if it's a larger alternative system, we commonly call a mass drain field here, that will be --

the sampling and monitoring will be dependent on the scale of the system, the size, how many gallons per day capable of treating.

And these are some of the performance requirements. Bob mentioned that each state does its own ones. We have some hydraulic loading rates. These are – we have certain effluent requirements for septic tank effluent. TL is treatment level, 2, 3. We have a treatment level 3 with disinfection, and that's something where we would use where there's – these are being installed close to the water table. And there's some other groundwater protections for all of these alternative systems, and obviously, as I mentioned before, we have some nutrient requirements for the alternative systems that will become effective in one year.

Some of our systems, and we have a lot of coastal areas that where the groundwater is very close to the surface, sometimes it's right at the surface. And we call that if it's less than six inches from the surface then we call it direct dispersal. It is allowed. They're going to be at the highest level of treatment with disinfection in order for it to be installed. These would be engineered systems, so obviously you have a licensed professional designing these. And so we have to meet the effluent and groundwater quality standards that our sister agency, the Department of Environmental Quality, has established and that there are, obviously, performance requirements for these systems.

The result is a lot of areas that we couldn't develop in our prescriptive regulations that we've operated under for many years are now developable. And it's changed a lot -- some localities that relied on septic tanks where there's zoning and planning, now these areas are open for development. We don't put them in wetlands, that's something that is under the authority of our sister agency, and so we don't install these under – in any wetlands.

Obviously, these are the concerns that have already been mentioned before – our human pathogens, nitrogen, and other nutrients, some of the concerns in the future are some of the endocrine disrupters and others.

So this is getting to my last slide here, and if you remember I showed you the timeline very early on, where we spent all of our resources for the most part in looking at systems before they were actually installed or before they were actually in use, the first blush. So our change is now looking at the systems after they're in use when there is really a risk, and we are now doing risk assessment, we're doing performance monitoring, and we have an oversight of the operation and maintenance that is done by our private sector licensed operators.

So I'll end there, and entertain any questions.

Patrick Jones: Maureen, are you there?

Maureen Tooke: I'm sorry, I must have been muted. I was talking – I'm sorry. We're going to make these presentations and the transcript from this available on the septic Wiki, on the website that the partnership has been utilizing over the last year or so, and I think it's just up on your screen now where they're archived. It'll take about two weeks, give or take, to develop the transcript from this, but we will have the questions or answers available, as well, if we aren't able to get through all of them.

The first question is for Max, with regard to your [Norturana] study, would the study discuss the findings from a single residential wastewater system?

Max Zarate-Bermudez: Could you repeat the question, Maureen, please?

Maureen Tooke: They wondered if the study, the findings from your study was from a single residential wastewater system?

Max Zarate-Bermudez: Yes, we studied two residences during year one, and we studied one residence in year two where we doubled the number of monitoring wells, the [inaudible] at two different depths. And the reason we did this is because there are a few studies that can actualize the performance of onsite wastewater systems even at individual level. And, as you know, with $100,000 we were limited in the number of our residences that we studied.

Maureen Tooke: Okay, the next question, the next several are for you, Max, just so you know.

Max Zarate-Bermudez: Okay, I'm ready.

Maureen Tooke: Okay, this one has a little bit of background. It says that the asker of the question had indicated that he saw those E.coli levels were higher than in the recreational water standards than in the diagram around the house, yet he heard that they were within the recreational parameters. Can you explain the discrepancy and where was the soil absorption system in relationship to the house?

Max Zarate-Bermudez: Okay, let's see – that, the E.coli values, okay, in the – let's see, I don't know if – is it possible to put my screen back so I can show – I do not have it up?

Maureen Tooke: Patrick, if you can show – have Max show his screen? Thank you.

Max Zarate-Bermudez: Okay, perfect. So the E.coli in coliform units per 100 MLs are important, you know? And here is the history, here is the house, and the drain field is here, okay? So, as you can see, the levels of the E.coli virus in different – spatially, and also these happen temporarily. I mean we found temporal variations of it. So since this is the history, you know, we probably what is needed to do is to have more something [inaudible] to know what contributions can be associated with the onsite wastewater system. So, but we didn't find concentrations that are above the recommendations by EPA [inaudible].

Maureen Tooke: Okay, we only have a few minutes left, I'm going to have to filter some of these, so I won't be able to probably get through all the questions.

One of the questions for you, Max, also – what are the likely sources of bacteria in the background wells?

Max Zarate-Bermudez: We did bacterial source tracking for the samples in site one during year two, and we can only indicate that there were strains of E.coli that were found were of human source. We tested for wildlife, birds, we tested for dogs, and we didn't find those strains in the shallow aquifer, so that's why our conclusion was that it seems that there is not an association between the onsite wastewater and the contamination of shallow aquifers with the system.

Maureen Tooke: Okay, let's see, we'll move on to Bob Rubin. I see a couple of questions for you. Let's see, a graph showing the concentrations of nitrogen as a function of distance from the drain field would be useful. What percentage of the nitrogen is nitrate nitrogen versus other forms of nitrogen?

Bob Rubin: Please remember, we had 20 minutes to discuss design and operation of systems, that's not a whole lot. In the septic tank effluent the predominant form of nitrogen is ammonia or TKN. Immediately around the drain field the predominant form of nitrogen is still ammonia or TKN. As you move away from the drain field the nitrate levels do, the ammonia, the organic nitrogen mineralizes and you do get nitrate formation.

There's still anaerobic pockets in the soil, and in those anaerobic pockets you will get de-nitrification. As water moves to the water table we have anaerobic conditions or close to the water table and you will start forming or you start de-nitrifying, and then as liquid moves through the zone between the land and the surface water, the [hyperic] zone you again get de-nitrification.

So nitrogen is a great indicator, and we're also striving to do work now with nitrogen, 14 nitrogen, 15 ratios to distinguish between different forms or different sources of nitrogen, whether it's historical nitrogen or hysterical nitrogen, that could have been from previous agricultural practices or some offsite source. So our ability to look at nitrogen is evolving as our ability to look at bacterial indicators. I hope I answered your question.

Maureen Tooke: Okay, we're having so many questions come in, we're probably going to have to answer these separately offline. We'll get the answers to you.

Let me see, also for Bob, does North Carolina allow rapid infiltration basins?

Bob Rubin: Yes, but they are permitted through our Division of Water Quality, not through our Division of Environmental Health.

Maureen Tooke: Okay, I've got a couple for Bob Hicks. I'll try, we're running out of time here.

Is there a property transfer inspection requirement for septic systems in the project?

Bob Hicks: That's usually in the Commonwealth. We don't have a regulation for that, but the mortgage industry requires usually an inspection of an onsite system as part of the transaction.

Maureen Tooke: Okay, great. Let's see, I think we're going to have to end this, we're at two-thirty. As I said before, we'll get these archived and the questions answered. I will filter through these to make sure the appropriate presenter gets these questions.

Max Zarate-Bermudez: Maureen, if I can just say briefly something? This is Max.

Maureen Tooke: Sure.

Max Zarate-Bermudez: I was very interested in Bob Hicks and also Bob Rubins' presentations. And Bob Hicks, you know, the methodology to assess onsite wastewater systems performance in North Carolina is available, if you think that can be of use for the water that you are [inaudible].

Bob Rubin: Yes, thank you.

Maureen Tooke: Great. Just a little plug for the MOU Partnership soon to be released. Some I guess position papers, if you will, on the benefits and usefulness and adequate treatment that decentralized wastewater systems provide for communities, particularly small communities that are challenged fiscally, if you will. And sometimes they are, they can be an option for communities versus a sewer, sometimes is not an affordable option for communities. But be on the look for those in early September, we will be releasing those to the masses, and for various audiences to become educated on the options that decentralized wastewater treatment does provide.

Thank you for your – for listening in, and thank you to all the presenters, and we'll get this all out to you as soon as possible. Thank you.

Bob Rubin: Thank you.