Chris Montague-Breakwell

Good afternoon and welcome to the first webinar in EPA's Stormwater Pollution Prevention Webinar series. EPA's Stormwater Pollution Prevention Webinar will highlight efforts to reduce stormwater through controlling pollutants of their source. Today's webinar will cover the topic of stormwater, coal-tar sealcoats, and polycyclic aromatic hydrocarbons, PAHs. The webinar will present information on the prevalence of PAHs from coal-tar base sealcoats in the environment and on the environmental and human health impacts. The webinar will also cover action taken to address PAHs by a state and the city.

This webinar is sponsored by the EPA's Office of Wastewater Management's Stormwater Program. I am Chris Montague-Breakwell and I will be moderating the webinar. Thank you all for joining us today.

We will start by going over a few housekeeping items. The material in this and the views of the speakers and the speakers organizations on their own and do not necessarily reflect those of EPA. Mention of any commercial enterprise, product, or publication does not mean EPA endorses them.

First, I would like to briefly summarize some of the features of today's webinar. At this time, everyone is in listen only mode. By default, all attendees enter by using microphone and speakers. Please make sure that you have selected the correct audio setting in the go to webinar audio control panel either telephone or microphone and speakers. We encourage you to submit questions to our speakers during this webinar. To ask questions simply type it into the questions box in the attendee control panel and click "send." If you control panel is not showing, simply click on the small orange box with the white arrow to expand it. Each speaker will give a half-hour presentation and take 10 minutes for questions after the presentations. As the moderator, I will read the questions aloud so everyone can hear it and the speaker will then answer. If you have any technical issues, you can let us know by entering it into the question pane and then clicking on the "send" button. We will do our best to respond to your issue by posting an answer in the questions box.

This webinar will be recorded and archived so you can access it in a few weeks after today's live presentation. The archived webinar will be posted on EPA's NPDES training page at www.epa.gov/npdes/training.

It is now my pleasure to introduce our speakers. Our first speakers are Dr. Barbara Mahler and Dr. Peter Van Metre from the United States Geological Survey based in Austin, Texas. They will be presenting, "You're standing on it! Coal-tar based pavement sealcoats, PAHs' and environmental contamination." Our second speaker will be Dr. Allison Watts from the University of New Hampshire. She will be presenting "PAHs and Parking Lots: A Field Study of PAHs Exported from Sealed and Unsealed Parking Lots." Our third speaker will be Dr. Judy Crane, from the Minnesota Pollution

Control Agency. And her presentation will be "Action in Minnesota to Address PAH Contaminated Stormwater Pond Sentiments by Restricting Usage of Coal-Tar Based Sealants." Our final presenter will beat Mateo Scoggins from the city of Austin, Texas. His presentation will be "The Coal-Tar Sealant Ban and the Science in Austin, Texas."

One final note before we get started with our first speaker. We will try to answer as many questions as possible throughout this webinar. However, due to the high number of participants, not all questions will be answered. If you have any unanswered questions please e-mail the presenters directly. We will provide you with all of the presenters and EPA's contact information at the end of this webinar.

Our first presentation is from Dr.'s Mahler and Van Metre from the United States Geological Service.

Okay, Drs. Mahler and Van Metre, you can go ahead.

Dr. Barbara Mahler

Okay, great. I think we are set up. Hopefully everyone can see our screen. Thank you for the introduction, Chris.

We are, of course, very pleased that you have chosen the issue of coal-tar based sealcoats and PAHs to kick off your seminar series. And we are also very honored that you asked us to participate as presenters in this webinar.

This morning or I guess this afternoon for some people out there and morning for others, we would like to share the story with you of how we found a widely used consumer product, one that literally is right under our noses that we are standing on is a major and possibly the major source of urban PAHs in much of North America. Pete Van Metre and I work for the US Geological Survey which is the largest federal earth science research organization and the USGS researches more than just geology. Our missionary includes ecosystems and climate, hazards, human health, and importantly for today, water. So Pete and I work for the National Water Quality Assessment Program which is part of the USGS, that is NAWQA stands for. And one of the main objectives of the NAWQA program is to understand trends in sediment and in water. In other words, is water quality and sediment quality, are they getting better or are they getting worse? And the way we go about this is to collect cores of sediment from lakes around the country. And we slice them up in little intervals and we analyze them for a suite of contaminants that tends to associate with sediment. And so we use these kind of like you would use tree rings to look back in time and see how contamination has changed over time in these lakes. Well, when we look at lakes across the country and we look at different contaminants we see some different stories. We see some good news stories. On the graph I am show here or the figure, each one of those symbols is a lake that we have cored. We see for some contaminants like DDT and PCBs, that most of the trends are downward. And so that is great to see, that in the last 30 years concentrations as we move up the sediment to the most recent sediment, the

concentrations are lower than they used to be.

But a real eye-opener for us was to see that one group of contaminants; PAHs are increasing in most of the urban lakes that we sampled in the United States. So what is a PAH? Polycyclic aromatic hydrocarbon which is a mouthful. PAHs are a large group of compounds that have as their backbone the benzene ring which is the molecule I am showing here. It is six carbons that are bonded into a ring, each of which has a hydrogen atom sticking off of it. And if you think of the benzene ring like you would a six sided bathroom tile, you can arrange those in different numbers and different geometric configurations and every one of those is a PAH. So the consequence is there's a large number of PAHs' and they range from those with just a small number of benzene rings like Naphthalene, 2 rings. That is the major ingredient in many mothballs. All the way up to three, four, five, six or even more benzene rings. Now based on the number of rings and the configuration, these have different chemical properties and that turns out to be important because those that are just a few rings, lower molecular weight, are more volatile, they are more soluble, and they are more toxic, but they are also more easily broken down. Those that have a large number rings are less volatile and soluble; they tend to stick to sediment. They are more persistent. They stay around in environment a lot longer and they are more carcinogenic.

So we are concerned about PAHs because many of them have been shown to be carcinogenic, meaning they cause cancer. Teratogenic, meaning they cause birth defects. Mutagenic, meaning they cause mutations. Or toxic, meaning they kill things to a range of species and seven PAHs are listed as probable human carcinogens. So there is a reason to be concerned for them in the environment. But they are ubiquitous in the urban environment because every time we burn organic matter we create PAHs. Whether we are burning motor oil or gasoline or hamburger or cigarette we are creating PAHs. And also, those products that involve the combustion of organic matter like tires or asphalt also contain PAHs.

So historically it has been kind of a thorny job for environmental scientists to determine which PAHs are responsible for pollution because there are so many different sources. So that was our job when we saw these increasing trends in PAHs in the urban lakes was to figure out what is causing this increase. Let's take a look at a typical watershed. One that it has undergone a lot of what we call new urban development. So this is for Lake in the Hills. It is a suburban community to the west of Chicago. And like many watersheds, in the 1970s it was largely agricultural. There is a little bit of urban development right around the lake because it was a popular summertime -- place for popular summer houses if you lived in Chicago. And then a suburban development moved to the west, the watershed changed. And it now looks like many of the places where we work and live. There are single-family and multifamily residential housing. There is big box stores. There are shopping centers. There is churches, there is schools, there is roads, there is highways. And there are a lot of parking lots. And from our sediment core what we see is as population in the watershed has increased so

has the concentrations of PAHs. So it looks like the PAHs are associated with people. But you know, people don't create PAHs. We are not exuding PAHs from our pores or breathing out PAHs. It has to be an activity that we are engaged in or a product that we are using which is causing these increases in PAHs.

So the first clue to where some of these high concentrations of PAHs might be coming from came from the city of Austin. Back in the early 2000, they had a grant from EPA, as a matter of fact, as part of their NPDES program. And they were using it to sample sediment in small drainages around the city. Now we are not talking inner city or old industrial areas. These were drainages from largely residential areas, maybe from light commercial areas. They found very high concentrations of PAHs. Greater than 1,000 milligrams per kilogram. And when they shared this data with us, at first we thought there is a problem with the lab that maybe there is a decimal point in the wrong place because we had not seen PAH concentrations this high in any of the urban lakes we have measured. And we've measured some lakes in some pretty nasty areas. So this really stood out. It's about 65 times higher than the probable affects concentration where the PEC is the concentration above which we would expect to see negative effects on the benthic biota, the invertebrate critters that are living in the sediment.

So the question is where are these high PAH concentrations coming from? And so what is upstream? And a very enterprising city of Austin staff member went upstream and he saw parking lots. And the first question was well could it be the asphalt, the broken up asphalt in the parking lots that are contributing to these high concentration of PAHs? It turns out that asphalt does not have very high concentrations of PAHs. It could not be responsible for concentrations this high. But he also noticed that the parking lots had been treated or painted with a black product. And that black product is parking lot sealcoat. Sealcoat is a black liquid or emulsion that is sprayed or painted on asphalt pavement after the pavement is laid down. It's not part of the paving process. It is a product that a parking lot or driveway owner can choose to apply later on. It is typically applied to parking lots, driveways, and even the playgrounds. But it is not applied typically to streets. So you will notice in the lower left of your screen, you see a sharp contrast between the dark driveway there which has the sealcoat and the light gray of the street which does not have the sealcoat.

There are two principal types of sealcoats. One has an asphalt or oil-base and one has a coal-tar base. Now they look very similar, but they are chemically very different.

The asphalt oil-base comes from the refining of petroleum products. The coal-tar products contains coal-tar pitch. So crude coal-tar is the residue that remains from the cooking of coal. The crude coal-tar is taken and distill. And during the distillation process various lighter weight oils are removed, they have some commercial value. They are used in everything from pigments, and paint, and makeup. The residue that remains after that distillation process is coal-tar pitch. Coal-tar pitch is a nonhuman carcinogen and it is what goes into the coal-tar sealcoat product. And those products can contain anywhere from 20-35% or even a higher percentage of coal-tar pitch.

When we first started looking into PAHs and sealcoats, one thing that we heard anecdotally from folks in the industry was that the asphalt based product was predominantly used west of the continental divide. The coal-tar base product was predominantly used east of the continental divide. So in the Midwest and Northeastern United States, the Southern US was predominantly coal-tar based products.

Now our data backs that up although that is not a hard and fast rule. There are some types -- excuse me, each product is used to some degree in these two different geographic areas. But overall, the asphalt is more predominant in the West and the coal-tar is more predominant in the East largely for geographic and economic reasons.

Let's take a look at PAHs concentrations in some of the major urban sources of PAHs. These are values from the literature and they range from very low concentrations, as I mentioned, from asphalt well below 10 up to 444 for used motor oil which is always sort of pointed out as the bad boy of PAH contamination in the urban environment.

But if you took the sediment that the City of Austin collected from the urban drainages and you mixed it with used motor oil, you'd actually decrease, you would clean up the sediment because used motor oil has a lower concentration of PAHs than what was found in the sediment itself. The only way that you can come up with a concentration that high is to start with a source that is higher.

So let's take a look at our sealcoat products. Asphalt based sealcoat contains about 50 milligrams per kilogram which is very similar to what is measured in the tire particles. The coal-tar based product contains between 50,000 and 100,000 milligrams per kilogram. So right here you can imagine if even with quite a bit of dilution from dirt and sticks and leaves and whatever else ends up in sediment, the coal-tar sealcoat is still a very potent source of PAH.

So the concentrations are high which is one of my criterion for environmental relevance to the contaminant source and another one is the product or the contaminant source – is it used extensively. Well sealcoat use is indeed extensive. From the industry, we found that 85 million gallons of coal-tar based sealcoat are used every year. That is enough to cover about 170 square miles. If we look at individual watersheds and those watersheds we mapped in Austin somewhere between 1 and 2% of the total watershed area is covered in sealcoated pavement. And that amount goes up if you go to different parts of the country. For example, in the Lake of the Hills watershed, that was a watershed for which I showed the core, 4% of that watershed area is covered in sealcoated pavement. About 40% of the parking lots are sealcoated. And almost 90% of the driveway area is sealcoated and in that part of the country it is the coal-tar based sealcoat that is predominately used.

A third question for environmental relevance is does the contaminant source stay where it is put or does it get disseminated into the environment? Well when we first applied

sealcoat it makes a dark shiny surface like shown on this driveway here. But after a few months come the abrasive action of car tires driving on the sealcoat starts to wear the sealcoat into fine particles which can be removed by wind or by rain or by snowplows or even by sticking to vehicle tires and being carried off site. Eventually, you start to see that gray underlying asphalt shone through as the sealcoat is removed. And it's for this reason that sealcoat applicators recommend that sealcoat be reapplied anywhere from every two years to every five years. So it is being released into a range of different environmental departments. You just go out and brush up some of the dust off a sealcoated parking lot you will see lots of little black bits and those are the abraded bits of sealcoat.

So those abraded bits then are available to move off the parking lot and they can move into a number of different compartments some of which we have investigated. Let's start by taking a look at the pavement dust itself.

So when we have gone to some of the urban lakes to collect sediment cores, while we were there we also select parking lots. A dirty job but somebody has to do it. And we swept parking lots in the same watersheds where the lakes were located and we swept several and what you are looking at here are median concentrations of PAHs in dust swept from seal coated parking lots. You you'll notice that the concentrations in the eastern US are about 1,000 times higher than those in the western US.

Those in the eastern US are very consistent with the concentrations that the City of Austin measured in some of those urban drainages. And they conform to what we have been told about these geographic differences in use.

Now we also swept parking lots that were unsealed in the same watersheds. We see very different stories. We still see low concentrations in the West but we also see low concentrations in the East. Now, these parking lots are in the same watersheds. They are getting the same atmospheric deposition as the sealcoated parking lots. They are also getting vehicle exhaust and tire particles and leaking motor oil. The only difference between that top figure and the bottom figure is presence or absence of sealcoat.

Now another thing you might notice is that the concentrations in the East of the unsealed pavement are a little bit higher than those in the West. And we think that what is causing that is off-site transport that wind or adherence to car tires, even being pushed off by snowplows, that these particles are getting moved from sealed parking lots to unsealed parking lots. And some work done by Dr. Yanning Yang (ph) at the University of Illinois Champaign-Urbana corroborated this work very elegantly with the microscopic approach and found particles of coal-tar pitch on unsealed parking lots.

So let's move down a little bit now and look at runoff. So this pavement dust is mobile. It's available to be washed off parking lots with stormwater runoff. One of the first studies we did was a little pilot study where we looked at particles in runoff from 13

parking lots in Austin, some of which were sealcoated and some of which were not sealcoated.

So it's a pretty simple story. We are looking at a log Y axis here. What we find is that the concentrations of PAHs in the particles washing off the coal-tar sealcoated parking lot was about 65 times greater than those washing off the unsealed parking lots. And they exceed the probable effects concentration by a factor of more than 100. So these concentrations are quite a bit higher than those we've measured even in the Charles River which is in Boston Harbor. That is one of the more contaminated sites we've ever measured. They are on the same scale as PAH concentrations at EPA superfund sites that have been listed as superfund because they are old manufactured gas plants or they are coal cooking plants, they are plants where coal-tar pitch was produced and they're very high concentration of PAHs and those are the concentrations that we are measuring and runoff from the parking lots.

So let's move downstream of little bit. If it is in runoff is it ending up in streams and lakes and might these be contributing to the increasing concentrations of PAHs that we have measured in US urban lakes?

Well, to investigate this we are going to use a method that is popular. We call it environmental forensics. And it stems from the fact that there is this wide variety of PAHs from low molecular weight to high molecular weight. And a PAH source has its own PAH fingerprint. It has a characteristic proportion of different PAHs. So for example, let's take a look here at the PAH fingerprint for the burning of coal. This is for coal emissions from coal-fired power plants. From left to right, we are looking at three ring PAHs up to the five and six ring PAHs. And each of those PAHs is represented by different proportions in the coal emissions and that is its fingerprint. Now we compare that to the PAH fingerprint for sediment from Lake Anne. Lake Anne is a lake in western Virginia. It's a very lovely, high end residential community but the lake has high concentrations of PAHs. And we see for Lake Anne there is some similarities and some of differences to those coal emissions and if we measure though statistically with the correlation coefficient R we get .6. Now if R was 1 it would be a perfect match and if R is 0, it would be no match at all. So we have something of a match. Maybe coal is contributing to those PAHs.

Let's take a look at a different source. This is the PAH fingerprint for gasoline vehicle emissions. And if we compare that to Lake Anne we see a slightly higher correlation coefficient, a slightly better match. Maybe gas vehicle emissions and exhaust emissions are also potential sources of PAH in Lake Anne. Okay, so now let's look at the fingerprint for dust swept from coal-tar sealcoated parking lots. This is data we collected that I showed you a little bit earlier. If we compare that to Lake Anne, we see a very good match. In fact, we an R that is greater than .9. So this is strong at least circumstantial evidence that dust from coal-tar sealcoated parking lots is contributing to PAHs in Lake Anne. But we wanted to take a more rigorous approach so we used a model that has been developed by the EPA called contaminant mass balance source

apportionment. This is a statistical approach and how it works is that it takes the PAH fingerprints from all of the different PAH sources that you care to investigate, and it decides what combination of those sources -- how much of each of those sources would you have to mix together to create the PAH fingerprint or profile in your sediment. Or as they call it, your receptor. So in this case the receptor is our lakes, it is our lake sediment.

We use this approach and we tried out pretty much every PAH profile or fingerprint that we could find in our literature. I've divided them here in to five different categories. We looked at used motor oil, we looked at tire wear, we looked at asphalt wear, we looked at exhaust in the vehicle category. We looked at different types of coal combustion emissions. We looked at wood emissions and we looked also at a range of sealcoats associated profiles everything from the NIST standard for coal-tar all the way down to the pavement dust of coal-tar sealcoated parking lots.

So we did this for the most recent sediment deposited in 40 urban lakes that we sampled. I have divided these by the western US, the central US, and eastern US. Each one of these bars is the PAH concentration in the sediment at the top of the core from an urban lake. The height of the bar is the PAH concentration. The colors are associated with what the CMB mass balance approach told us was the contribution from a different source type. And what we see is that more than 50% of the PAHs are coming from coal-tar based sealcoats. The other two major important contributors are vehicle exhaust and coal burning which represent together somewhere between 30-40% of the contribution.

We also see that for those lakes where the PAH concentration exceeds the PEC, Probable Effect Concentration, that in all but one case that can be accounted for just by the contribution from coal-tar based sealcoats.

So let's circle back to our question about trends. Could coal-tar based sealcoats be responsible for the upward trends that we have seen in lakes? Well, we looked at six of the lakes that we sampled. These are new urban lakes, like the one in Lake of the Hills where PAH concentrations are increasing and we see that for five of these lakes, the increase is coming from the contribution from the coal-tar based sealcoats which are the orange symbols. The only one it is not -- it's coming from something else is in the lower left that is Railroad Canyon Lake in southern California where coal-tar based seal coat is not very commonly used. If you look at the Y. axis for that lake, those are the PAH concentrations. PAH concentrations in this lake were about 100 times lower than in the other lakes. And in fact, this holds true if we look at our lakes across the board, if you look at the five lakes that had low contributions for coal-tar based sealcoats, the total PAH concentration is low. It's only about 3 milligrams per kilogram. So we can say that three is a baseline urban PAH concentration in the absence of coal-tar based sealcoats.

Those lakes that had a high contribution from coal-tar based sealcoat also had a high

PAH concentrations. About 10 times higher on average. And those exceed the Probable Effect Concentrations indicating that the coal-tar sealcoat may be contributing to deleterious effects on aquatic biota.

Now I'm not going to go into a great deal of detail about stormwater ponds because Dr. Watts and Crane are going to be giving you a lot more information about that. But I want to show you this because one of the hypotheses that was floated for these high concentrations of PAHs in urban lake was atmospheric deposition. Well, if it's atmospheric deposition we would expect two adjacent stormwater ponds to have similar PAH concentrations. But in fact, these ponds have every different PAH concentrations. The one to the south is about 45 times higher than the one to the north. What is the difference? Well it can't be atmospheric deposition but the one to the north is draining a parking lot that does not have sealcoat and the one to the south is draining a parking lot that does have seal coat. And in South Carolina, it is systematically coal-tar based sealcoat that is used.

So I mentioned the PEC. There has been some wide body of literature that's looked at effects of PAHs on aquatic biota. Since we identified the coal-tar sealcoat as a source there have been some publications now in the peer-reviewed literature that are looking at the effects specifically of PAHs from coal-tar sealcoat on amphibians, on frogs and newts and also an ecological community.

So that brings up the question of well, what about human health. I'm not going to go into great deal of detail here because we are focusing on stormwater. But we have done studies that have looked at PAHs of house dust and in air which are two logical pathways for human exposure. What we found was that house dust in residences that were adjacent to parking lots with coal-tar based sealcoat, the PAH concentrations were 25 times, not 25 percent but 25 times higher than PAH concentrations in house dust in residences that were adjacent to unsealed asphalt or asphalt with the asphalt based sealcoat product for the parking lot.

The air story, if you're interested in air quality, this is pretty interesting. Recently started looking at volatilization and just after sealcoat is applied, many of the lower molecular weight PAHs in particular are quite volatile and you smell it. This stuff is volatilizing into the air at a very large rate. In fact, over the first couple of weeks about half of the PAHs are lost just to the air. And if we compare what comes off a newly sealed coated parking lot with a coal-tar based sealcoat to an unsealed asphalt parking lot, tens of thousands of times higher concentrations and fluxes are going into the air.

And if you do a mass balance and you compare the amount of PAHs going into the air each year from newly seal coated parking lot that’s with coal-tar based sealcoat, it exceeds the PAHs being produced by vehicle emissions across the United States.

So to sum up, coal-tar based sealcoat satisfies three criteria for environmental relevance. Concentrations are extremely high, the use is extensive, and it is

transported off-site. And it is transported to pretty much every environmental compartment we have looked at whether it is lake sediment or soil, house dust or air. PAH concentrations are tens to thousands of times in the background and there are associated potential effects for aquatic biota and also for human health.

We do have a website that has information you can get links to our publications. I think we have about 10 publications in the peer-reviewed literature and we have five USGS publications including a real nice short fact sheet that sums all of this up. It has some FAQs. It has links to other sources of information. And I've also put my e-mail address. As Chris mentioned you are more than welcome to contact me or Dr. Van Metre if you have any questions about this subject. And I think I have just about used my 30 minutes. And Chris, at this point are we going to have address questions?

Chris Montague-Breakwell
Yes, we will do questions. We only have a few so far so we will start. The first question. Does sealcoat actually provide any protection to asphalt or is it merely cosmetic and has marketing turned disposal of a waste product into a social norm?

Barbara Mahler
Well, I have to say right up front that Pete and I are environmental scientists we are not pavement engineers. We have requested information on how effective sealcoat is at preventing deterioration of the underlying asphalt. And we have not been able to find any either ourselves in the literature nor have we been provided any from the industry. I'm sure that they are doing tests to try and determine that. But we are not able to find any information to answer that question one way or the other. The second question is sort of the social cultural question that is one that somebody who is an expert in marketing might be able to answer far better than we can.

Chris Montague-Breakwell
Okay. Thank you. The next question, are there differences between sealcoats that are applied to streets and highways and sealcoats applied to parking lots and driveways?

Pater Van Metre
Yeah, this is Pete. In general the ones apply to streets especially the stuff they called chip sealing is a different product. That is most likely an oil-based or asphalt based product. This kind of sealcoat, the thin coating that does not have the rock chips in there is almost exclusively used on parking lots and driveways. The one exception that I have seen was a process called fog sealing that is I think a thinner, maybe more dilute pavement rejuvenating kind of product that I gather is used on roadways. And it can be made from coal-tar base. But I have very little idea of how extensive that use is. I just found one mention of it on the web from Utah. But as far as how much it adds, I don't know.

Chris Montague-Breakwell

Okay. Thank you, Pete. The next question is are there alternative sealcoats available with less PAH concentrations and are these being explored?

Barbara Mahler
Well the asphalt-based sealcoat has far lower concentrations, on the order of what you would find in higher particles so around 50. But there are polymer sealcoats that I believe have even lower PAH concentrations. And that is something that Mateo Scoggins is going to address in his presentation a little bit later this afternoon.

Pater Van Metre
As far as availability, the asphalt -- as far as we know the asphalt sealants are available pretty much nationwide.

Barbara Mahler
They are harder to get in some places than others.

Pater Van Metre
Yeah. But especially the retail stores, the 5-gallon bucket you can buy at the home improvement store. In fact, in many cases that is the major retail chains have switched to the asphalt products for homeowner use.

Chris Montague-Breakwell
Thank you. The next question, is the sealcoat used for parking lots different from tar used for roofing houses?

Barbara Mahler
No. Actually it's very similar. And I believe that the same geographic differences exist for whether it is a coal-tar based product or an asphalt based product. From an environmental standpoint, this is going to sound flippant and it is not. But -- and I don't mean it to be. We don't drive on roofs. So the real issue for releasing the PAHs into stormwater is the fact that the tires are abrading it. So in areas where there is no tire traffic, the PAH doesn't -- the sealcoat does not wear very rapidly so there is a much lower yield of PAHs off the surface that is not being driven on. It is the abrasive action of the tires that is wearing the sealcoat and breaking it up into the small particles that are then washed off.

Pater Van Metre
There is another issue though that we have not done a study of yet. But having done the recent studies the last couple of years on volatilization rates off of freshly sealed, sealcoated pavement and seeing that they are just extremely high, I don't see any reason that a similar product applied on a rooftop would not also be volatilizing at a very high rate.

Chris Montague-Breakwell
Okay, thank you. Next question. I was wondering if there are any best practices for

disposing of coal-tar debris from a remediated site?

Barbara Mahler
Again, that is one that as environmental scientists, as research hydrologists, that is not an aspect of this that we have addressed but that is a question that I think Mateo is going to be able to address in his presentation because the city of Austin has confronted that very question.

Chris Montague-Breakwell
Next question. What with the cost of roadways being what they are if these products improved lifecycle cost then every city and DOT in the country would be using those. So it seems that they do not increase lifecycle benefit. I guess that is more of a statement then a question. Did you guys have anything to say regarding that?

Pater Van Metre
In a sense, that's a similar question to the first one. So they are not used on roads because they wear off the road surface too fast from the heavy traffic. But they are used on parking lots so I guess the question goes back to the first one, what is the lifecycle benefit to a parking lot. Certainly if you are concerned about PAH releases to the environment, even if you make the asphalt last twice as long where at half the rate, the PAH release from the asphalt is trivial compared to from the sealcoat. So there's really no benefit there. But as far as the cost benefit analysis of the pavement itself that's a question we haven't addressed and aren't trained to address.

Chris Montague-Breakwell
Thank you, Pete. The next question is, this might be another question for pavement engineers, but I'm curious about parking lots that have been designed to drain away water or reduce runoff. Can sealcoats be used on those surfaces or would it render them not porous? And actually, our office to log green infrastructure works and no, you would definitely not want to apply that to a permeable asphalt or a porous paver or something like that. That would seal it and prevent the entire purpose of it draining down and actually infiltrating.

Pete, if you want to speak a bit more about that, go right ahead.

Pater Van Metre
I think you gave a fine answer, Chris.

Chris Montague-Breakwell
Let's see. I'm scrolling through the many questions we are getting. Have you – sorry, here. How are you able to conclude from the source of PAHs include dust as a source of PAHs or from coal based sealcoats that are from other sources such as coal plants, gas stations, etc. You went over PAH fingerprints. Is there one for coal based

pavement sealcoats?

Pater Van Metre
I'm not sure I fully understand but you mean separating out coal based pavement sealcoat signal from other coal-tar related sources like all industrial sites? Is that what they're getting at?

Chris Montague-Breakwell
Yeah, the question ask separating it from coal plants or gas stations.

Barbara Mahler
Well, many of the lakes that we have sampled and the parking lots that we sampled are in areas where there are no coal gasification or --

Pater Van Metre
Yeah, so a lot of it is just sort of proximity and commonsense. So if you are sampling in a suburban area that was once cornfields and it is far removed from industrial sites, and you see this very rapid recent increase in PAHs that coincide with urbanization, then you know it is not from the last – from 100 years ago some coal plant in Chicago. Lake in the Hills is a real nice example of that. So we did when we did that whole modeling study, the sources, one of the things we did do is identify all of the active coking plants in the US and then figured out how close to those any of our lakes were and very few of the lakes were within even 100 miles of the coking plant and most of them were further than that in different parts of the country. So proximity is and just to some extent common sense comes into the source analysis.

Barbara Mahler
It's similar to what we saw with the stormwater ponds where two adjacent stormwater ponds have very different concentration of PAHs. So even if there is an atmospheric source, even if there were a coal processing plant 10 miles away, it would be affecting both of those stormwater ponds similarly.

Pater Van Metre
Now there are sites in older urban industrial areas and in the Ohio River Valley or up in the northeastern US that do have coal gas plants and do have legacy contaminations from those. We have only looked a little bit just out of curiosity since we don't tend to core in those kinds of sites but we have looked at the chemical profile from soils from coal gas plant waste sites. And it is largely very similar to the profile from coal-tar based seal coat. It is pretty much the same stuff. So if you are taking -- looking at sediments from one of those -- downstream of one of those sites I think it is much trickier job to see if you could separate the two.

Chris Montague-Breakwell
Okay. Thank you so much Drs. Mahler and Van Metre. We are going to now switch to Dr. Allison Watts from the University of New Hampshire. But before we switch, I

would like to say for the people who came on late and have been asking questions, this presentation and the individual slide shows will be posted online at the EPA site in just a few weeks. And you will receive an e-mail after this webinar with a link to that as well as the final wrap up slide. We will show you the web link to that.

And without further ado, I'm going to switch to Dr. Watts from the University of New Hampshire.

Allison Watts
Hello.

Female Speaker
Hi. We can hear you.

Allison Watts
You can hear me. Okay. I would like to thank Chris very much for inviting me to speak at this. I really appreciate the opportunity and I thank it was 450 and something that I looked at last time of you who have logged in to view this webinar. Is my screen up?

Chris Montague-Breakwell
It is not. You need to accept that I have given you presenter powers. There should be a little box saying -- there you go. You are on.

Allison Watts
I'm on. Okay, excellent.

I want to spend a little bit of time talking about a study we've done at the University of New Hampshire. This study was actually born to some extent after I had seen some of the initial data that came from the city of Austin and from USGS in 2005 and 2006. And some of that Dr. Mahler has already discussed. And a lot of the samples that they have taken show very convincing evidence that coal-tar sealant is a source of PAHs. So those samples are taken in the real world and the real world is a very complicated place. And as Dr. Mahler discussed, PAHs are ubiquitous. They come from a lot of different sources. Any sample that you take out in the environment is likely to contain PAHs at some level or another. And it's often very difficult to distinguish how much a particular source is contributing to PAH concentrations in a given sample. And I thought that it would be really helpful in the process of discussion around this issue to look closely at a controlled site where we have sealant applied in some areas and no sealant applied in other areas and we do extensive sampling and determine what the difference of PAHs are under those semi-controlled conditions.

So we did a study out at the University New Hampshire stormwater site. We are the staff of the stormwater center. University of New Hampshire is in Durham, New Hampshire. We are a fairly rural area, just a little bit north of Boston. The stormwater

field site is a testing facility, which is designed to test a variety of different kinds of stormwater treatment. So what we have is we have a 9-acre parking lot a little bit north of the University. The area inside that blue line is about 9 acres and everything – that's the rain that falls in that surface all drains off the corner to that north side which is where our test center is. The really perfect thing about the site for this type of study is that there are actually two separate areas. There is one up in the north near our test facility, and one over here on the side. And those areas actually drain separately from the main site. So we can sample the stormwater from those two little areas separately from the main flow. And so we felt that this study could be implemented at the site very easily.

We had a sealant contractor come in and apply coal-tar based sealant to those two separate areas. We asked them to sort of apply in the normal way as they would in any commercial site or any university parking lot. Not that the university actually does use sealants, but if they had been.

So we had sealant applied in these two areas and then the whole center section, which is about 9 acres, has no sealant applied at all. And I just think in response to the question about porous pavement, you see Lot B. down there on the side, the section next to it that is not sealed, is actually porous pavement. That is a test lot for porous pavement and our Center Director was very, very nervous that we would accidently get some of that sealant over into the porous pavement because I think it would really destroy the pavement.

So we have these two areas. We had that sealant applied in October of 2007. And the question that we really wanted to address is where does the sealant go. You have it put down, it's applied, it's this beautiful black shiny surface. You come back a couple of years later and most of that sealant is gone. And that is not – that's what is expected. It's not intended to last. It's intended to last for a couple years and then the manufacturers expect you to reapply it. So it's not intended to be a permanent treatment. But if it's gone, what we really wanted to study was where does it go and what path does it travel down? And that is a picture of that B. Lot right after the sealant is applied and then about one year later. You can see that some of the color is starting to go and the white lines, we had it restriped after the sealant was applied so the paint is also starting to wear off.

So what are the primary mechanisms for moving sealant? Dr. Mahler discussed this a bit. Primarily abrasions from tires and from driving over the surface. Plowing has a significant impact on the surface. Tracking on tires. There is a little bit of weathering from either the heat or solar radiation on the surface. And then those particulates are carried away by stormwater or by wind. We did not look at volatilization much in the study but some of the recent research the USGS has done suggests volatilization is also a significant method of moving PAHs off the surface.

Here in New England, the plow is a significant – moves, moves a significant amount of

the sealcoat. If you look at the surface of a parking lot in New England in the spring you can see the scars and gashes where the plow has gone over it. If you look at the snow bank that has been moved, you can see the particulates of sealant. And in the spring after the snow has melted, we see a fine layer of sealant particulates where those snow banks were.

So we sampled several different pathways. We looked at stormwater runoff. We sampled about 24 storms. We aim to do about one storm a month, it depends of course a bit on the weather and what is available. We also sampled sediments in a swale that receives stormwater runoff and in a couple of different stormwater devices. We sampled surface soil adjacent to the site at both sealed and the unsealed areas and then we sampled pavement dust which was swept off the surface. All of these samples were analyzed for the 16 priority PAHs and then a subset were analyzed for extended suite, which included some of the homologs and some of the more complicated PAH compounds.

So the sampling was done by automated LSGO samplers for the stormwater. For those of you who are experienced at sampling stormwater, you don't want to go out there in the pouring rain and do it yourself with buckets. It's a lot easier to do because these automated samplers they are set to respond as soon as the flow starts off the site. And the volume is set by the length of storm and the volume that is coming off in the stormwater runoff. We had three samplers at the head of the site. One of the sampling run off from the unsealed control, one is sampling from A. lot and then one is a duplicate sample that was taking duplicate samples.

We collected both physical water samples. So this is the inside of one of those samplers. All of those are little sample bottles. The samples are collected in Teflon bags and then sent out to a lab for analysis. We also collect real-time data on water quality. So we have a probe that sits in the flow that collects flow, temperature, PHAs as well as oxygen and a bunch of other things. And those probes are on all the time so we have a continuous record of flow and water quality at the site.

Some of the samples that we collected were the street samplers which is what you see in that picture there with the different bottles and every certain amount of time a new bottle is collected. Some of the samples that we took, in fact most of the samples we took were actually volume weighted samples. So we have an average that represents the real average concentration over the course of the storm.

So for instance, here’s the results from one of the storms that we sampled. You can see the blue line is the flow coming off the site. It starts to rain about 9:00 o'clock in the morning, the flow increases and goes up and down. And then the red triangles represent the concentration of PAHs in the micro- transfer leader and as you can see they are higher at the beginning of the storm and then decrease in concentration over the course of the storm.

And this is common in stormwater samples. This is what we normally see. It's referred to as the first flush phenomena. When you have a parking lot surface, you have debris, you have dust on that surface. A lot of that initial wash off comes off in the first sort of flow from the storm and then as the storm goes on, the water becomes cleaner and cleaner. So if you're ever looking at stormwater sampling results, be quite careful if you are looking at what we call grab samples, which is where you just go in and you take one sample during the course of the storm. Because that may well not be representative of the concentrations that are collected over the entire course of the storm.

So we started sampling almost immediately after the sealant was laid down. We had our first rainstorm about 24 hours later and these are the first samples that we collected. I was quite startled. I did not really expect to see that coming off one of my parking lots. The sample from lot A. is not actually a dark fluid. What that is is a clear fluid with a very fine suspension of little black particles. Little tiny bits of sealcoat suspended in the stormwater. We saw that in the first flush coming off of this parking lot. We never saw it again. That was just some initial wash off that started at the beginning of the storm. When we looked at the parking lots after the storm was completed, we did not see any evidence wash off sealcoat. Both of the parking lots looked the same. We did not see any residual in any of the stormwater devices that received flow from it.

So we think that this happened in that initial wash off. What we don't know is how often you get these high concentrations after a sealant is applied.

The sealant was applied as according to the manufacturer's directions. As I said, we had a contractor that came in to do it. We asked them to do what they normally do. It was a warm, sunny day. It rained about 24 hours after the second coat was applied.

So let's look at the results of the stormwater sampling. These are the samples that were collected over our two year sampling period. On the left, you can see that we have the total PAH concentration in micrograms per liter and that's a log scale. So there is a very significant difference in concentrations. The red squares and diamonds are the concentrations that came off the two sealed lots. The blue circles are concentrations coming off that unsealed control in the center. And you can see that the concentrations coming off both of the sealed lots are higher for all of these storms that we sampled. They are much higher right at the beginning. In the first quarter we saw much higher concentrations and then they gradually seemed to be decreasing. If we had continued sampling, my guess is that we would eventually see all of the merging to about the same concentrations.

It's important to point out I think that there are definitely PAHs coming off that unsealed control. So even though there is no sealant there, we do have PAHs in stormwater and we see that in a lot of different areas. Stormwater is a known source of PAHs to a lot of receiving bodies.

We wanted to get a handle on what was the mass of PAHs coming off the parking lots in these different mediums. So what is the mass of PAHs being exported from the parking lots in stormwater? We took the concentrations that we measured. We did a mean for each quarter and then we took the total volume of runoff that we measured in each of those concentrations. And we developed an estimated mass per quarter for each of the parking lots. And what you can see is that the mass coming off each of the parking lots is actually roughly the same. And that is in spite of the difference in sizes. So because the unsealed control is so much larger even though the concentrations are lower the total mass coming off. But if you normalize that per acre, if you look at just the amount of mass coming off each acre of surface for that two year period, the total mass coming off the unsealed control lot is about .13 kilograms, where the total mass coming off the other two sealed lots is more on the order of 4 kilograms. So we have significantly greater mass coming off of the two sealed lots.

And remember again that these lots are adjacent so there is atmospheric deposition, there is whatever history there is related to the parking lots but those outside factors are the same. The only thing that is really different is the application of the sealcoat.

We also looked at concentrations in surface lots so again this is sort of a schematic of the site. The dots represent total PAH concentrations in the very top layer of soil, yellow is fairly low concentrations, less than 10 milligrams per kilogram. The orange is pretty much between and the red is the higher concentrations. And you can see that there are definitely higher concentrations clustered around the areas that have been sealcoated. The circles are soil and the stars are dust sweeping samples. The stars are dust off the surface. And in places where we went back and sampled again, you can see there is a line in those two different colors. And sometime this sampling, the return sampling or the duplicate samplings had fairly different results and that is kind of life in soil sampling. There are variations within a very small area.

So concentrations are much higher around the sealed lots. If you look over towards B. Lot the one down on the side of the main parking lot where the horse stable was if you remember that, you can see there are some high concentrations down there next to the unsealed surface. And that is directly related to the plowing pattern. The plow comes through over that seal surface and then because of the way the bushes and some of the sampling equipment we have, they pile the snow up next to that unsealed surface. And that clearly transported some of the sealcoat material off into that section of the parking lot.

And the highest concentrations that we saw were a little over 400 milligrams per kilogram. Benzopyrene there at 29.2 milligrams per kilogram. Those are quite high concentrations. This is a university parking lot. People are not hanging around there a lot, but if this were a residential parking lot and children were playing on that surface or playing in that soil I think that we would probably be worried about people's health effects.

We also tried to do an estimate of the mass of PAHs transported off the parking lots in the soil. So we took those concentrations, we did a little bit of averaging over the area and we estimated that there was on the order of a kilogram to 1.5 kilograms of PAHs associated with each of these parking lots in the soil. I think that is probably a significant underestimation because we did not actually sample very far from the site. There is probably elevated concentrations at a greater distance but as we merge into the background it becomes more and more difficult to tell whether we are looking at concentrations in the background or elevated concentrations from the site.

And then just for comparison, we also did some sampling at a couple of other university parking lots. So these are parking lots in the same town but not in the same parking lot. Sorry, in the same study area directly. And again, we saw relatively low concentrations in the dust and in the adjacent soil. These are pretty equivalent to background PAH concentrations in this area. We've done a fair amount of sampling for other projects and we rarely see PAHs over about five maybe as high as 10 milligrams per kilogram in surface soil.

And we also spent a fair amount of time looking at concentrations in stormwater sediment. And I think that Dr. Crane is going to talk more about stormwater later. But we did this very direct study looking at the concentrations related to our site. So this is a picture of our stormwater site, the test site and the various sort of depressions in the ground that you see there are different treatment systems. There is a gravel wetlands, the green thing is a stormwater pond and there are various other pieces there.

Flow from the main site comes on to these different treatment systems and comes down the side in the swale. And so there you go. That is the main site, the 9 acres moves down the swale on the side and mixes with flow from the smaller coal-tar sealed site. So the flow that comes down to the site is mixed from both of these parking lots.

We went out and we sampled sediments before the sealant was applied and the numbers in black at the top sort of the columns of numbers are the samples that were collected prior to any kind of sealant. So you can see the concentration, the highest concentration there is a little bit over 3 milligrams per kilogram. And this is a swale that has been in existence probably for I think three or four years at this point. So it is certainly not a pristine environment. It's been receiving stormwater. It has collected some PAHs either from atmospheric deposition or from that stormwater. And it has this background layer. The water comes down through the swale through a little stormwater pond and then eventually discharges into a little wetland over there in the corner. So we also did sampling in the wetland to sort of try and get a handle on how far the PAHs were transported down from the site.

Then we sampled again nine months after the sealant was applied and you can see the concentrations are much higher. So more on the order of 90-50 milligrams per kilogram in the swale, starting to be elevated in some of those downstream locations as

well. And we continue to sample a year and then three years after the sealant was applied. We still see elevated concentrations even three years after the sealant is applied. And I am only looking at surface sediments here so these are fairly fresh sediments which have been probably deposited within that three years period.

We also looked at -- and just for reference, if you look at the 9-acre parking lot and the relative sizes of the sealed and the unsealed areas; this represents a watershed in which approximate 4 percent of the surface is sealcoated. And if you remember Dr. Mahler's presentation, she was representing some of those watersheds; I think the Lake of the Clouds had on the order 4 percent of the watershed sealcoated. So this is representative of the amount of sealcoat that we might see in a fairly common suburban neighborhood.

We also looked at concentrations in several of the other stormwater devices. Up there at the top of the slide, you can see the concentrations in the sample of the gravel wetlands, a bioretention and a detention pond. Each of those stormwater devices has a little area at the opening into the treatment system where sediments collect. So we just call that a sediment four bay. So we collected surface sediments from those four bays. And we collected the sediments over the course of the study so some were fairly shortly after the sealcoat was applied. And the most recent ones were late last summer so approximately four years after sealant was applied. And we still see elevated concentrations four years after the sealant was applied.

We have approximately 100-160 milligrams per liter – kilograms, sorry, in the devices which are receiving storm water from the mixed sealed to unsealed surface. And then over in this one little area on the side where we had all of the flow from that parking lot goes into a small tree filter. We sampled sediments from that tree filter from an area with 100 percent sealed surface and we had concentrations up to 1700 milligrams per kilogram. When we went back and sampled that last summer those were still extremely high. I think about 600. So again we are still seeing those elevated concentrations quite a long time after the sealant is applied. Somewhere in the middle of the study for other reasons we put a small bio retention system in the median, right in the middle of the parking lot and that's collecting stormwater from about a quarter of an acre adjacent to the cars there. We also sampled that and sampled it several times and the concentrations are consistently below 2 milligrams per kilogram. So again the outside PAH inputs at the site are exactly the same in that little bioretention and for instance, the tree filter. The only difference is the application of sealcoats.

So just in summary, we see a very clear correlation between increase in sealcoat and concentrations in the stormwater sediments. So the conclusions are pretty much that there is definitely an impact from the coal-tar based sealcoat on PAH concentrations in each of these media. In stormwater we saw an increase on the order of an order of magnitude over the course of the first two years. Concentrations do decrease with time. And then surface soil we saw concentrations up to about 400 milligrams per kilogram and we don't really have a time period for that. But assumably those

concentrations would also decrease with time. The stormwater sediments we have concentrations that significantly increase with the amount of sealed surface. So up to 1,000 milligrams per kilogram in areas where the entire parking lot has sealed and we still see those elevated concentrations four years after application.

We have a little hand out pamphlet that Sea Grant put together for us if anyone is interested in it. That is on our website.

And I will take questions. I just can't resist this slide because people have a tendency to say that sealcoat is only applied during warm and sunny weather and this was several years ago I was skiing with my kids in March. When we drove home, someone had just finished sealcoating their driveway. So you never know what people are going to do.

All right, are there questions?

Chris Montague-Breakwell
Okay, now we will open the floor to questions. Our first question is in your study you tested 24 hours after the sealcoat was applied. Is there a typical curing time for sealcoat?

Allison Watts
That particular manufacture recommended seven hours. And so, yes. Applicators do have specific curing times and that applicator was seven hours.

Chris Montague-Breakwell
Okay, thank you. Next question, how was monitoring for total PAHs done? Is there a total of individual PAH compounds and if so, how were mirror non-detects handled for the low concentration samples?

Allison Watts
Yes. It is a sum. In most of these analyses we simply did not include the non-detects. When we are doing the SIMs, the SIM analysis it's extremely low detection limits. So we just did not use the detections in the non-detects.

Chris Montague-Breakwell
Next question. What BMPs can be used to reduce PAHs in runoff?

Allison Watts
Well the good news about all those PAHs in the stormwater devices is that they're doing their job. So the fact that the PAHs are in the stormwater sediments means they are not in the runoff. We did a little bit of sampling of stormwater that had run through the systems and they were all extremely low. So we saw almost no PAHs that were not removed by treatment. And I did not show it but we also did a little bit of work looking at how much of the PAH concentration is found in sediment. If you filter the sample, do

you remove most of the PAHs and the answer is that most of it is bound to particulates. So if you have a stormwater treatment device that removes particulates you will do a really good job on the PAHs. On the other hand then they are in the stormwater treatment device so you've still got them.

Chris Montague-Breakwell
Okay. Our next question is two-for. The first part is how bioavailable are PAHs and how toxic and the second question which I think can be answered with the same answer is what type of impacts might we look at in water bodies to demonstrate that water quality or aquatic life impacts are occurring?

Allison Watts
Yeah, I am not going to go deeply into that. I am not a biologist. All I can do is compare directly to screening levels and we do see are concentrations that exceed screening levels. The question of bioavailability and PAHs is ongoing. I don't think I can really address it.

Chris Montague-Breakwell
Do you have any future research topics from UNH on this topic?

Allison Watts
We don't -- at this moment we don't have any additional projects. The piece that we -- actually we do have a piece starting to look at some of the forensic data, the statistical data that Dr. Mahler was looking at and trying to see if we can determine the difference between coal-tar from manufactured gas plants of which we have a lot around here and whether we can actually distinguish that from coal-tar from parking lots. And I have to say that so far I'd say that we can't. There are some slight differences, but they are pretty subtle.

Chris Montague-Breakwell
Okay. Thank you so much. We are going to end questions now and go to our next presenter.

Allison Watts
Thank you.

Chris Montague-Breakwell
And our next -- thank you, Dr. Watts. Our next presenter is Dr. Judy Crane from the Minnesota Pollution Control Agency in St. Paul, Minnesota.

Judy Crane
Thanks so much, Chris. I really appreciate you inviting me today and I think this webinar is such a great resource for folks.

I am just looking at things here, trying to get my presentation to come up. Do you see

it?

Chris Montague-Breakwell
Yes.

Judy Crane
Okay. We will get started here. All right. Today I'm going to talk about what we are doing in Minnesota related to contaminated stormwater ponds which are getting contaminated with PAHs and then also some efforts to restrict the usage of coal-tar based sealants which as you have heard from our previous presentations are probably a major source of PAHs in many urban environments.

Now a lot of people or Minnesota is known by a lot of folks as the land of 10,000 Lakes. Well, we have over twice that amount of stormwater ponds just in the Twin Cities area.

Oops. I could not get my slides -- there we go. Sorry. To give you an overview of what I will be talking about today I will be going through why we are concerned about PAHs building up in our stormwater pond sediments here in Minnesota. How different units of government in Minnesota are addressing this issue. What the most likely sources of PAHs are to the stormwater ponds. And then I will just tell you right off the bat that the coal-tar based sealants are the major source of PAHs. So what are we doing about that?

In Minnesota, we are finding that the stormwater ponds are filling up with sediment. And this is not surprising because they are going to fill up with sediment over time but Minnesota has been a leader in using stormwater ponds as a best management practice for treating stormwater to have the flow water get reduced in the stormwater pond so the suspended sediments settle out. And also as a flood control mechanism. So about 30 years ago when these stormwater ponds were really starting to be put in, a lot of the suburbs around the Twin Cities areas of Minneapolis-St. Paul. At that time most people were more concerned about maybe metals building up in the sediments. Nobody really thought about PAHs. And so our agency, the Minnesota Pollution Control Agency, we require stormwater ponds that are permitted by us to be analyzed for PAHs and a couple of metals before the municipalities do any maintenance dredging to remove the sediments.

And there are some states I might add around the country that they have no requirements for any analysis of sediments before they are dredged out of the stormwater ponds. So I would be interested in hearing from some other folks at the end of this presentation from other states on what kind of requirements they have for stormwater ponds to be analyzed for contaminants.

So the issue is that as these ponds fill up they are not functioning properly and municipalities must then have been dredged out. And this removal of PAHs contaminated sediments especially at higher contaminated levels can be quite

expensive and it has put a big chill on a lot of municipalities in being able to deal with this issue. And in White Bear Lake, Minnesota we see past estimates of a quarter of a million just to clean out two stormwater ponds in 2007. And a lot of cities, they don't have the money to do these types of cleanups. Some municipalities have hundreds of these stormwater ponds that they are responsible for. So in the most contaminated sediments it really hampers the options that the municipalities have to use that dredged material and to dispose of it. And those cities have requested a solution from the Minnesota Legislature and also the MPCA.

So Don Berger in our stormwater program, he estimated the cost for disposal. And in Minnesota, we have, depending on the level contamination of PAHs those sediments can fall to three different levels. And the level three dredged material is the most contaminated. So the sediment must either be disposed of in a specially lined landfill that could be used for clean cover kind on a landfill or other approved options. We have a situation now with one municipality that they have received approval to have the dredged material from their pond be encapsulated in a berm that is going to be built up around the pond. So the disposal costs vary with landfill. And Don looked at a couple of landfills around here and he came up with a total cost estimate of about $40-$50 per cubic yard. However, if the material has to be treated as a waste instead of cover material, it is going to be even more expensive to dispose of that material.

And Don estimated that if just 10 percent of the estimated 20,000 stormwater ponds in the Twin Cities area here were in that level three dredged material classification, it could cost $1 billion, $1 billion to dispose of that material. So this is a really big emerging problem here in Minnesota. I think it is one that a lot of other states are going to be dealing with as their stormwater ponds that were may be implemented later than ours start to fill up and they have to deal with them.

So as we have heard in the previous presentations, coal-tar based sealants have really emerged as an important source of PAHs, in our case to the stormwater ponds. But also to other urban water bodies as well. So this is an issue that we have been tracking here at the MPCA since the USGS started publishing their work in the peer-reviewed literature. It used to be on an emerging issues team at the MPCA and we've listed the coal-tar based sealants as one of our important emerging issues in our 2007 emerging issues inventory.

So I have been providing some technical assistance to our stormwater program for about probably 3 1/2 years now especially on this issue of the PAH contamination in the ponds. I spearheaded the production of this PAH white paper that is available on our website. As Chris mentioned, all of the presentations will be available on the EPA's website in a few weeks. So don't bother having to write down the web link there. You can access that later. But this gives a good summary of the issues that we are facing and a literature survey of the research to date when this paper came out in 2010.

As we have heard previously, asphalt based sealants are a suitable alternative to the

coal-tar based sealants. It is really a simple solution that people can use asphalt based sealants or acrylic type sealants that have no PAHs or there is even like Gilsonite sealants that don't have PAHs. And about a year ago I did a survey of several home improvement stores and hardware stores and some other staff at our agency had done some additional work on that. And so there are a number of retailers that no longer sell the 5-gallon buckets of the coal-tar based sealants that homeowners could purchase and put on their driveway. They do usually sell the asphalt based and a lot of times they will sell the acrylic based sealants too. The acrylic sealants are a lot more expensive than the asphalt based sealants.

So the legislature has also been very responsive to this issue. In 2009 they provided us with funding to study this issue. They directed us to do a number of tasks of which are detailed on our website link that I give there. An example of a few is that we did not really know how many stormwater ponds are actually in the permit program that our agency deals with municipalities. So there is an inventory of stormwater ponds is one component of it. Don Berger of our staff worked with the League of Minnesota Cities to draft a model ordinance that cities could consider using if they wanted to ban coal-tar based sealants in their municipalities. The legislature also banned state agencies from purchasing undiluted coal-tar based sealant in 2010.

So there was a really great carrot that the legislature put in there for municipalities. So they had language in there that if the municipalities would pass an ordinance prohibiting or restricting the use of coal-tar based sealants that they could be considered for a grant that our agency would give out to treat contaminated sediments in their stormwater ponds.

And as a result, there are 20 municipalities in Minnesota that have passed ordinances. As you will hear in Mateo's talk after mine, Austin, Texas was the first city to pass an ordinance prohibiting the use of coal-tar based sealants followed by Dane County, Wisconsin and Washington, DC and then there has been Washington state has passed a statewide ban and other places have passed restrictions. So it is great that we have 20 municipalities now that have passed ordinances. These municipalities don't actually have to tell us that they have passed an ordinance. So I often times find out through a Google search or Tom Ennis with his Coal-Tar Free America blog site he oftentimes knows before we do. So he now has a section on his website where you can plot where the different bans are which is where this information came from.

Now another component of the legislative funding was to fund a stormwater pond sediment study. And there is a little bit of serendipity here. Back in 2008, I was assisting our stormwater program with putting together a proposal to do a study of stormwater pond sediments and that was submitted to a special legislative group. Well, it did not get funded but Representative Espowsey (ph) that was on the committee looking at the proposals, thought it was a good proposal, it should be funded. And that is really what led to this legislative action. That it provided the money to fund that study that I had wanted to do. And also, she provided these extra tasks for the agency to do

and the additional incentive there for municipalities to pass bans.

So the study that I was in charge of doing, we limited it to the municipal -- to stormwater ponds that were in that municipal separate storm sewer system or the MS4. And also, they were limited to stormwater ponds in the seven county Minneapolis/St. Paul metropolitan area here that I am showing on the map. As those would be representative of the other MS4's around the state.

So we kind of had a short duration to get this study underway. The project was funded, the money came in July 1st and we were out in October doing the sampling. And to get this project done, really got a lot of great input from municipalities around the Twin Cities area. We tapped into their expertise to get them to recommend ponds to us that were either in major residential, commercial, or industrial land use type areas. So the actual ponds we ended up sampling are shown on this map.

And we did the sampling during October and we were kind of like the mail carriers of the sampling world. We were out there in nice sunny weather to begin with but then October quickly deteriorated to being one of the coldest and wettest October's on record. So we got snowed on twice and then by the time Minnesota public radio came out to do a story on us it was like hyperthermia weather and very cold rainy weather, but we persevered. And because a lot of these stormwater ponds have a lot of vegetation around them, cattails and such because they want to keep people out of them, they are a little bit harder to get into. Some of these stormwater ponds are very small. Some are larger. So we used field kayaks to do our sampling link and we sampled three sites across each pond and we used a modified drop core here to collect the upper 15 centimeters of sediment and the sediment actually went into a very clean Pyrex mixing bowl in that blue bucket there. And it would take several samples collected at each site to get enough mass of material and then that was ferried back to land where I processed the samples. So we had three different sites that were sampled and then we had some extra sediment set aside from each one of those samples that was composited together. So we had our three samples and we had our composite sample.

And there were a large number of chemicals analyzed on the sediment samples. I will just talk today about the PAH analyses. But we did have 4 different groups of emerging contaminants analyzed on these samples in part because we wanted to see are their emerging contaminants in these samples that we are going to be concerned about too. So we wanted to be very thorough in the type of work that we were doing. So with the PAHs we had two different types of PAH’s analyzed. We had parent and carcinogenic PAHs analyzed by a local laboratory that we have a state contract with. And then we had -- and the carcinogenic PAHs were especially important for our calculations of benzopyrene equivalence and I’ll talk about. And then also we had parent and alkylating PAHs that were analyzed on just the composite samples. And those were analyzed by Battelle. So those parent and alkylating PAHs were very important and were used for environmental forensic work. As Barbara talked about this

morning, the PAHs have a fingerprint that can be used to determine sources of those PAHs in environmental samples.

So the results. Well used on a sum of 13 PAHs and these are each one of these PAH compounds are ones we have sediment quality targets for the protection of benthic organisms and these are basically -- we adopted the consensus based sediment quality guidelines that you have heard about some by Barbara, the probable effect concentrations which are the higher bond value and then also the lower threshold effect concentrations. But we call them our level one and level two sediment quality targets.

And on this map we see each of our sampling sites whether they were in a residential, commercial, or industrial area. And then the concentration values, the blue is less than the level one sediment quality target, yellow is between the level one and level two. And the red is greater than the level two sediment quality target. So we had to industrial sites and a commercial site that were all greater than the level two sediment quality target. And these sites also exceeded the equilibrium partitioning sediment benchmark toxic units of one. So that would indicate that detrimental impacts to benthic critters in the sediments at those sites will be probably happening.

Now this site in Bloomington was interesting. This had the highest PAH concentration, the total PAH concentrations were about 130 milligrams per kilogram dry weight. And this site happened to be right by an area where the city of Bloomington processes their street sweepings. So they are getting all of the goo and stuff that is filling up in the street and they sweep it off with these big machines in the spring and then deposit it there and some of that was obviously running off into this pond.

And then also, up here in New Brighton where the PAH contamination was high, this was a former brownfield site. And then this commercial area in north St. Paul was a site that had both commercial and residential input into it. It was actually just a very small stormwater pond. But it had a lot of pavement around it as well. And then also, the PAH contamination in the industrial sites were statistically greater than in the residential sites.

So okay. Well let's move on then to calculating the benzopyrene equivalent. So these are calculated based upon the carcinogenic PAHs that were measured using our equivalency factors and the values of the BaP equivalence were compared to our soil reference values of two is -- a soil reference value of two is for a residential site and three is our level two soil reference value. And depending how the values fall, we get our different categories of our dredged material. So what’s really major concern is when you get into the level three dredged material. And 60% of our ponds, nine of the ponds were at that level. So this would be the most expensive disposal that a municipality would have to do. To get back to that case where a White Bear Lake got an estimate of a quarter of a million dollars just to clean out two stormwater ponds with the sediments in it. So that is a lot of money. Now you might note here that there are clear ponds that had non-detect data and this was really surprising. PAHs are such a

ubiquitous class of contaminants, I was not expecting non-detect data for the all of the PAHs for those sites. So I wanted to find out what happened. And in closer evaluation of the procedures the lab used, the analytical lab was a production lab and they used -- well instead of -- let me back up. A lot of these sediment samples from the stormwater ponds, they are pretty gunky. Not to use a scientific term but they are really -- a lot of goo and stuff in them and it is very hard from the analytical work to get all of that gunk separated out. So it's a lot of what we call interferences. And in these samples the interferences were quite high. And so this lab what it would do to try to remove those interferences is it would dilute the sample extract sometimes several times. And what that ended up doing is it increased the reporting limits. So it ended up increasing the reporting limits so much that for some of these ponds, all of the data came back as non-detects.

So the other lab that we used we got much better data. And they used clean up columns. So one thing that we are recommending to municipalities when they have their PAH analysis done is to talk to the labs and make sure that they are using clean up columns instead of diluting the sample extract.

Okay. So -- just -- let me go back just a second here. Another thing about these calculations is that our agency and the Minnesota Department of Health are in the process of evaluating new toxicity data that is available or in draft form from the EPA. And it is likely that at some point this year we will be changing the procedures for how benzopyrene is calculated and then also how the soil reference values are calculated. So it could end up increasing or decreasing these cut off values.

All right. So Barbara talked some about using environmental forensic techniques. We are not going to solve any murders here but we are going to help to solve a mystery. So where are these PAHs coming from? Well there are some general categories that you can divvy your sample results up into just based on what type of PAHs you find. And so we know that pyralene, for example, is a diogenic or a natural PAH and that some other PAHs, especially some of the alkylated ones are more oil-based. They are what we call that petrogenic PAHs and then there is a lot of PAHs that are what we call pyrogenic, they come from combustion type sources. So in our samples we are seeing that most of the PAHs are falling into this pyrogenic category. And the diogenic are very low as we would expect. There was one pond in particular that kind of broke the mold from the other ponds. And it was called LeVander Pond. It was actually a natural little pond or lake that had stormwater diverted to it so it became a stormwater pond. And that is pretty common around here. Minnesota has a lot of lakes and so some municipalities have taken lakes or wetlands and then kind of converted them for stormwater pond use. And with that particular pond it was in a residential area and it had low concentrations of PAHs so that pyralene that was in there, the natural PAH made up a greater proportion of those PAHs that's why we see it is that 12% in that pond and then also it was located by a major road. So the oil-based PAHs were higher in that sample. But with most of the other samples they were pretty consistent with the range of PAHs that they display.

And so I am going to show you next the results of this EPA CMB model that I used that Barbara did a really nice overview of that model. And that model, the end result of that the sources that came out of it really fell more into this pyrogenic fraction. So this is -- this summary here is nice to kind of get general classifications but it does not tell you how much might be from coal-tar base sealants versus power plant emissions or from a combustion of coal or diesel so that's what I will go through next. And then at the end of my presentation, I will kind of put this all together, we are taking the diogenic source, the Petrogenic source and then breaking this pyrogenic source into a lot of different sources that we can find out if from using this CMB model and then putting that all together into a pie chart to kind of bring it all home.

So the quantitative techniques that Barbara mentioned, they provide a nice rigorous method for portioning sources. Some people also use statistical techniques like principal components analysis to try to determine where the data separates and to try and to determine sources but one thing with principal components analysis is that it's a very data intensive. So you really should have at least 50 samples to use principal components analysis. It's even better if you have hundreds of samples. And one thing that I like about the CMB model is that you could really just use it for a couple of samples. So it is really nice if a municipality wanted to use it for example, that they or their consultants could be trained to use it and that they could get an idea of the assemblage of PAHs they have in their ponds.

So Barbara talked some about how the model works. So -- and I want to thank, Pete Van Metre and Barbara Mahler for being so generous with their time. They really helped me out to learn this model; they have shared their source profiles with me. And I don't know if I could have -- I could not have done this work as well as I have without their input. So I really appreciate their assistance.

So this model helps to find out -- figures out the best combination of sources to match your sediment sample. And with this particular case with the study that I did, it worked extremely well. And the two major sources that came out as being important in the stormwater pond sediments were coal-tar based sealants and traffic tunnel air. And so if you think of traffic tunnel air like as if you went into a highway tunnel and you had some air measuring device there you could measure all of the emissions are coming off the vehicles going through that tunnel. That's what that represents. So it's a mobile source of PAHs. And in the coal-tar based sealants sum, what that is is a sum of coal-tar dust, profiles, and that also coal-tar sealants scrapings data that the USGS has obtained. Or as you heard, Barbara, talk earlier in her presentation with how they did the studies to obtain that data.

Now the model includes 12 of the 34 PAHs. And it would be great if we could use a greater number of PAHs on a model. But that is kind of a limiting factor of some of the other source profiles that are available. But they only have 12 PAHs. And really, if you got into using a lot more PAHs. You probably get into a lot more non-detect issues

with some of the data with non-detect for some of those so then how do you treat that. So different issues with that. Now the statistical results of this model I was extremely happy with. The R-squared, ideally you want it to be one and its .98 so that's quite high, that's very good. The Chi-squared values were level. The percent mass ideally would be 100%. Are here it came out to 100.6. The T value is another statistical measure that if it is less than 2 it can be an indication that we have collinearity between your sources. And here it was greater than two which is what we want to see. For 10 of the parts, for coal-tar sealants scrapings so that is really indicating this is an important, distinct source. And the mean relative percent difference between what we measured in the sediment samples for these 12 PAHs and calculated based on the model was less than 1%. So that's incredibly good. So I feel very confident about these results.

Now I also ran this model on a different data set. And this was a data set that the Metropolitan Council collected on behalf of the MPCA for a study we gave them the funding to do. And they looked at different stormwater ponds around the Twin Cities area. They had 10 different ponds and they sampled five sites in each pond. However, this was the first and only time they had done the parent and alkylated PAHs so there were some data quality issues with some of their data. So I did a QAQCE review of their data and determined that I could use 26 of the 50 sediment samples they had. And then also with their study, they looked at variable depth intervals in their sample. And they did not actually record what that depth interval was for each site. So we know they were between 15 and 45 centimeters.

And with that study, it also came out very close to mind that the coal-tar based sealant sum was the major source. But then they also saw other sources like the wood combustion or coal and the traffic tunnel air, also being sources. And that might be because you have a history that has developed in that sediment profile. So if they had a longer sediment core then maybe there were other sources that were more prevalent back at that time at whatever time interval that sediment core responded to.

The statistical results of the model were acceptable with their data. It was not as great as my study. But it was still quite good. And so then to summarize here, the coal-tar based sealants were the biggest source of PAHs to stormwater ponds and then also lake sentiments in the Twin Cities because Peter Van Metre and Barbara Mahler, they also sampled a couple of lakes here in the Twin Cities. They sampled the west hub of Palmer Lake and a suburb of the Twin Cities and that main concentration was 72.2%. And I believe their use of the model they only used the coal-tar sealant depth. So they did not use both the dust and the scrapings. I used both the dust and the scrapings because here in Minnesota we sometimes -- oftentimes get a lot of snow in the wintertime and so there is a lot of snow plow action, shoveling, snowblower action that is helping to abrade the sealant even more. And then Lake Harriet which is in Minneapolis and is in an older neighborhood, that had a lower percentage of coal-tar based sealants.

So this model really provided a better estimate of combustion sources as I mentioned earlier. So what I'm going to do now is just do a portion the results and what I had with the model and multiply it by the pyrogenic fraction of the PAHs at 82.6% that I showed on an earlier slide. Here is the pie chart I promised. So it comes out that the coal-tar based sealants comprise about 58% of the total PAHs. The oil-based petrogenic sources or 15%. This traffic tunnel air is also about 15%. And then lower percentages of other sources like coal, combustion, diesel combustion, the natural sources, pine wood combustion, oil burner and gasoline combustion.

So there are some other efforts by the PCA to reduce the usage of coal-tar based sealants. And Al Innes at our agency brought in our great lakes restoration grant from the EPA to promote the phase out coal-tar based sealants. And the MPCA is taking the lead on this and he is working with folks from Michigan and Wisconsin on it. They just started the grant last fall. And they have several tasks. One was to try to implement a voluntary phase out of coal-tar based sealants in Minnesota and in partnership with the Pavement Coating Technology Council. This partnership could not be negotiated. So we have moved on with other activities. And another was to contact retailers to build on that survey that I've done a year ago to determine where it is still being sold and try to promote voluntary phase outs. I determined that Sears is still selling coal-tar based sealants and then I think they have been trying to contact Sears management to see if they could get them to phase out the use of it.

A real big success story here is that Jet-Black which is a commercial applicator has committed to switch from coal-tar based sealants to asphalt based sealants in Minnesota and Wisconsin over the next two years. And they're also promoting this use in 10 other states. So they are the largest commercial applicator in the US and two days ago they got an award from our governors via our MPCA Commissioner for their pollution prevention efforts. Al and his group will also work with other users to try to phase out coal-tar based sealants and work with suppliers and researchers to try to promote feasible alternatives and hopefully have no PAHs in them and then importantly, he wants -- he and his collaborators will be sharing these strategies and products with other states. It's a very important component of the project. So if you want further information about anything with the scientific technical issues like with the stormwater pond study I conducted you can contact me. Any policy management issues you can contact Marni Karnowski, the Supervisor in the Municipal Stormwater Unit. Any of the pollution prevention issues associated with this GLRI grant contact Al. And then also, we have a webpage on the coal-tar based sealants and restricting their use.

Thanks so much. I will take any questions.

Chris Montague-Breakwell
Okay, thank you. First question, what does proper disposal of PAH contaminated sediment entail?

Judy Crane

Right, well if the dredged material is in the level three category, that material can either be used as a clean cover at a specially lined landfill or if the landfill determines that -- or if it's determined to be hazardous waste then it would actually have to be disposed of in the landfill. This is a problem because there is limited landfill space to dispose of all of this material.

Chris Montague-Breakwell
Next question. You mentioned retailers that no longer sell coal-tar based sealants. Is this just in Minnesota or nationwide?

Judy Crane
No. This is pretty much nationwide. It has been known for several years that Lowe's, and The Home Depot quit selling coal-tar based sealants as a result of the ban that was passed in Austin, Texas and I also contacted them to follow up on that. And then like I did a variety of Google searches and looked at the MSDS sheets for products, coal-tar sealant or asphalt based sealant products that manufacturers put out. And, for example, Agway is a retailer that is just located in the Northeast US, so I determined that they don't use the coal-tar based sealants anymore whereas Menards is one that is located more in the upper Midwest and so they don't use it either.

Chris Montague-Breakwell
Next question. What types of ordinances have cities in Minnesota implemented, bans or restrictions?

Judy Crane
Right. A number of them have used the model ordinance language that Don Burgert (ph) developed in consultation with the League of Minnesota Cities. So sometimes the language of that was to ban the use of undiluted coal-tar because that is how it was phrased in the legislative language. But some municipalities in their ordinances, they may have a fine of several hundred dollars or $1,000 that would be imposed if somebody is caught using the coal-tar based sealants. And other ordinances don't mention any fine. So they just say that they don't want to have the -- don't want to have it used in their municipality anymore. And then some of them also provide a stipulation that if somebody is doing a research project that then they would be allowed to use it. So there is different language with the ordinances. If one wants to do a Google search of Minnesota city ordinances, coal-tar based sealants, then a lot of these ordinances will pop up and they can look at them themselves.

Chris Montague-Breakwell
Next question. Just a clarification question. When you were discussing lab errors and testing for PAHs, did you say to make sure that the lab uses "clean up column ." If so, what are clean up columns?

Judy Crane
Right. Good question. It was not a lab error so much as a procedure that labs use.

A lot of these high production labs that may have -- offer lower-cost for their analysis, they kind of get -- are able to achieve that sometimes by using cost saving measures like deluding the sample extract instead of running it through a cleanup column. And so a cleanup column is something that may have alumina. It actually is a glass column, it may have different components. It could have alumina or silica gel and so like when you are doing the analytical process you could try to extract the PAHs off of the sediment sample. You have this liquid, solvent sample that the PAHs are in and you can actually run that sample extract through this column and it will percolate down through the column and so some of these interfering compounds will be removed by the alumina or silica gel and sometimes they put a little layer of copper in there to remove sulfides. What comes out in the bottom is cleaner and then that can be reduced down and then inserted onto the GC type system, to actual -- get your actual concentration data for the PAHs.

Chris Montague-Breakwell
Next question. Does it follow that if the MPCA calculation of 10% level pre-pond yielded a 1 billion-dollar cleanup estimate than the 60% study level would yield the potential cleanup cost of 6 billion?

Judy Crane
No. And the reason for that, I was thinking about this earlier. The reason for that is that we don't know yet really how many ponds are in residential areas versus commercial versus industrial. So in my study we had 5 ponds in each category. But maybe in the Twin Cities or in all the MS4s in Minnesota, maybe we have more of the mix like maybe 60% residential, maybe it is 20% commercial and 20% industrial. So it was more of the industrial ponds were statistically significant higher concentrations of PAHs. And those were the ones -- actually quite a few of the ponds. Yeah, quite a few of the ponds ended up in that level three material but still I think we would have to have a better accounting of how many ponds are actually in each type of land-use classification and then the other issue that comes up is that how these benzopyrene equivalents are calculated and then also, how the soil reference values are determined is likely going to be changing later on this fall based on new toxicity data that has become available. So I can't really say whether they are going to go up or down. Myself, I have my own feeling for what is going to happen. I think it is going to be more helpful to municipalities. But at this point I can't say. So they can stay tuned and probably by this fall we will have some new information out on how those should be calculated.

Chris Montague-Breakwell
The next question is: Did your sampling include private homeowner ponds or were they just municipal ponds?

Judy Crane
Right. That is a good question too. I mentioned at the beginning of my field study that we just limited to the regulated ponds and the MS4 program. It would have been nice

to have included some private ponds too especially -- but then again, you have to get them to volunteer a pond and it was a little challenging with this study to get enough ponds in the industrial category and there were some ponds that I went too that, for example, they had too much cattail detritus in the sediment and we could not get a cohesive sediment sample so then we couldn't use those ponds. So there was kind of like one last ditch e-mail that I sent out to the municipalities to try and get another industrial pond that I could look at that we did end up including in the studying. So no, there were no private ponds included in the study.

Chris Montague-Breakwell
Next question. Why did Minnesota ban coal-tar sealant products for government agencies and not for private use? And how can cities deal with this private use?

Judy Crane
Right. When that legislation was passed, actually the legislature almost put in a statewide ban on coal-tar based sealants. But at the time, I think it's the League of Minnesota Cities wanted to have more information collected on how it might impact businesses to have a statewide ban so they initiated the ban on just state agencies and really that was more for show because the Department of Transportation in Minnesota, for example, has not used coal-tar based sealants for years and I don't think any other state agencies were really using it anyway. But it is in there in the language. And then the second question was -- could you repeat that one?

Chris Montague-Breakwell
How can cities deal with the private use of the coal-tar based sealants?

Judy Crane
Is that if a -- well, if they have passed their own ordinance then they have that that they can use for enforcing it. And then some municipalities -- actually quite a few municipalities have quarterly newsletters that go out to their citizens or they have it on their website. And so a number of them have been putting information in these newsletters to encourage people to quit using coal-tar based sealants and to switch to asphalt or not even use any sealant at all. And really, I mean people have many alternatives to them. They could have different types of driveways. They could have concrete, permeable pavers, gravel. You don't have to have an asphalt driveway. And also since a lot of retailers are not carrying the coal-tar based sealant anymore, I think Sears and I think that is maybe the major one around here in Minnesota where you can even find it. You know, there is not as many places where private owners could get that material.

Chris Montague-Breakwell
Okay. We have no further questions at this time. Thank you, Dr. Crane, for speaking.

Judy Crane
Thanks so much.

Chris Montague-Breakwell
We now move to our final speaker, Mateo Scoggins, from the city of Austin, Texas. And Mateo, I'm going to hand over the presentation powers to you.

Mateo Scoggins
Okay, everybody, can you hear me?

Chris Montague-Breakwell
Can you speak up a little Mateo?

Mateo Scoggins
Yes.

Chris Montague-Breakwell
We just lost his audio. Okay. I'm going to chat him. Chat message. We have lost the speaker for a moment. I'm going to try and get Mateo back on. Stand by.

Judy Crane
Chris, this is Judy. Could I mention one other thing?

Chris Montague-Breakwell
Go ahead, Judy, while we try and get Mateo on the line.

Judy Crane
Just while we are trying to get Mateo on is that also there has been federal legislation that has been proposed and I think it is in some committee right now to try to have a nationwide ban on coal-tar based sealants. It probably does not have much of a chance of getting passed but at least there has been some activity by the federal government in that regard.

Chris Montague-Breakwell
Okay. Thank you, Judy. We are still waiting for Mateo Scoggins to call back and we can see his screen but he has lost audio.

Mateo Scoggins
So, it is me. I am back. Sorry about that. My phone got disconnected.

Chris Montague-Breakwell
Glad to have you back. Go right ahead.

Mateo Scoggins
[laughing]
All right, let me know. Is that you on the full screen there?

Chris Montague-Breakwell
Yes, it is up and running. Go right ahead.

Mateo Scoggins
Okay, thanks, everybody for hanging in there. Again, my name is Mateo Scoggins. I work for the city of Austin and I am really going to be giving you kind of an overview of a lot of stuff that folks have talked about today because we've been involved with this story since the very beginning. But I'm going to try and graze over some of the kind of chronology of it because Barbara Mahler did a great job of kind of overviewing how this whole story developed. And I am going to be focusing on a couple of things. One is really what our focus was which is we kind of learned very quickly in this process in about 2003 or '04 that coal-tar sealant was a potent source of PAHs and definitely coming off parking lots and getting into our waterways. But what we did not know is once it got into our waterways what does that mean. Austin is a relatively progressive city. We have got a lot of citizens who are very interested in the environment and particularly in our water resources. And one of the focuses of our whole group, the 60 odd people who work in the kind of environmental resource monitoring group and management group, is kind of looking at our water resources and how they are affected by environmental pollutants. So our first big question was yes, it is getting into our waterways, but what does that mean. And we felt like that question really needed to be answered before we could ban coal-tar sealants. To kind of cut to the chase, we did ban coal-tar sealants in 2006. I'm going to talk a little bit about what led up to that ban but the truth was that we needed to tie that coal-tar sealant source of PAHs to a bioavailable kind of confirmation that we were seeing degradation in our waterways from that source of PAHs. So that is kind of the back story of this. So yes, I'm going to talk a little bit about what led up to that and then I'm going to talk a little bit about how it's been having a ban here for the last six years. Let's see. Let's go ahead and jump in here.

We are in pretty much the center of Texas. The red dot there on the map is the capital. We are kind of dwarfed a little bit by Dallas and Houston around us but we are a growing city. We have got about 1 million people in the metro area which expands outside of our jurisdiction but it all kinds of tied to the Austin area. We are an MS4 permittee phase one. We have about -- I mentioned about 60 people in the group that I work in who just work on water quality issues and efforts. We monitor 45 different watersheds in Austin, three reservoirs. Two of those are on the Colorado River, the main water source for our drinking of water in Austin. One of them is the tower generation coolant reservoir that is outside the city. And just to give you for a feel, we've been doing this for 25 years. As I said, the citizens here have asked for a strong kind of environmental city monitoring group and we've been doing that. We have a lot of data about the health and quality of our waters.

Okay. Barb went over really, I think eloquently, all of the core data that the USGS collected back in the late '90s and early 2000's and we got to look at this data in around

2001 or 2002 and saw this increase in trend of PAHs in our local water body. This is actually in Lady Bird Lake that goes right down the middle of Austin. So this trend was obviously of concern to us. We also, as I mentioned, looked at PAHs in all of the watersheds in Austin. This is just to give you a feel that's kind of what you're looking at there is the overall kind of jurisdiction of Austin. As you see, those dots represent individual monitoring places where we've collected sediment. We have a predominant kind of problem with PAHs in the urban core that kind of goes up and down to the north and south there where you see the red dots. Every one of those red dots is a sediment data point that was over that probable effect concentrations that Judy talked about. That value of about 23 milligrams per kilogram is where you would expect to see some kind of environmental degradation occurring.

So our long-term monitoring data was saying that we had some problems with PAHs around our city and we were looking all around and we also saw some of those yellow dots which is the values that were over the protection limit and maybe of concern but not up above that PEC. Again, this is just to give context for what we were thinking about at the time. What really concerned us though was some of these really high numbers that Barbara Mahler mentioned in her talk. We did have that contaminated sediment grant in the late '90s and these numbers worried us enough to start sending them around the country and asking people what was going on with that. Pete and Barb got involved at that point. And they started telling us that there is no way those numbers could be that high. There must be a problem as Barbara mentioned.

I am going to talk a lot about this value over here -- not a lot but for a minute this 161. Some of those really high numbers you see are in heavily urbanized areas in Austin. That number, 161, which is in Barton Creek, right above Barton Springs Pool was of concern to us because it was in a place where we did not really understand what the sources were. At the time, there were a lot of different sources of PAHs as both Barbara and Alison and Judy all talked about. But we really were not concerned about that mainly because the fact that it is right up stream of Barton Springs Pool, a well-loved and extremely well appreciated and used resource in Austin, considered kind of the jewel in Austin and kind of the center of the environmental movement in the Austin area. So the fact that we had pretty high PAHs upstream of this resource and in addition to it being a watershed that was relatively underdeveloped lead us to do a little more kind of deeper source tracking of that particular problem. Again, I'm going to graze through some of the stuff quickly because I know you've heard this story already. But what we have found was that if we look downstream of Barton Springs and in Barton Springs, the values of those total PAHs and again, this is the sum of the 16 EPA priority pollutants that everyone has been talking about today. Those values were less than 5 milligrams per kilogram. As you moved upstream and got to that site above of Barton Springs Pool we started to see an order of magnitude shift there. Some values up in the hundreds over a few years in sampling. We found a tributary just upstream of that pool where we jumped up another order of magnitude. Once we got into that tributary we kept going upstream until we got up to the head of a parking lot up here and another order of magnitude hump. Now we are in the 500-5,000 range on that on our

log scale there. Again, obviously we are getting into some serious source issues here. We actually went up to the very top of the parking lot and did scrapings of that parking lot and that jumped up another full order of magnitude up into the 30,000 milligrams per kilogram range. That was pretty much the “aha” moment that Tom Bashara, our colleague here kind of came to at the time that we were learning this. Again, this is all ancient history in a lot of ways. This was back in 2004, I believe, that we started collecting all this data over a range of about two years. And this is when we decided okay, we need to figure, now we know that this stuff is the source getting into a tribs and probably causing hotspots all over the city but is that enough to take this to the next step and trying do something about it.

We started talking to the industry and they found out that they estimate about 600,000 gallons of coal-tar sealants was being applied annually at that time. The Wash-off study, that Pete and Barb talked about, gave it some preliminary data early on that yes, it is wearing of these parking lots in concentrations much higher than other sources and we also were seeing the concentrations increasing in our local reservoir and these hotspots all over Austin. But could we again, tie it directly to actual water quality degradation in our streams and to the kind of the health and ecology of these systems? So that was kind of where we focused our efforts in order to see how far we take this. We felt like that part of the pie was missing. And it was important and so we set about to do a series of ecological studies that would answer those questions for the Austin area.

We looked at it in a weight of evidence approach where we used that kind of chemical source tracking that you saw already looking up at sources and tying them to parking lot areas. We also did a laboratory toxicity study where we looked at how spiked sediments would affect lab organisms. We did a field control microcosm study where we put a community of organisms in very controlled an environment where we could control the quantity of coal-tar sealant and not get it into these little microcosm's. And then we did a field verification looking at how parking lots drain directly to streams might be affecting the community's downstream of those parking lots. I will quickly go over those three studies.

The lab tox study again, there has been a ton of work done in the past about how PAHs are toxic to aquatic life in literature since the 70s. But what we really need to do and this is mainly because of some concerns from the industry and other folks around the country that said that coal-tar sealants, yes, it has high PAHs and yes, it probably is coming off these parking lots but it is not bioavailable. It's so tightly bound to the sediment that this source has been shown in other older studies that it was not as bioavailable to biology as some of the other sources of PAHs. So we really wanted to know okay, so if we spike sediment in the lab controlled setting and put in kind of typical lab organisms, how will they respond to different concentrations of that coal-tar source of PAHs. We spiked three different treatments. A low treatment which is about 17 milligrams per kilogram or below that PEC we've been talking about. A medium concentration which was about 50 milligrams per kilogram. And the high which is

closer to 300. Those same three levels: the low, medium and high are the same ones we will use in the next experiment. I just want to reiterate that. What we found -- we did that not only with the coal-tar sealants, but also used the equivalent weights of asphalt sealant. We did not want to equivalently try to get the same PAH concentration from the asphalt sealant because it would have been 10 times as much sealant to try or 100 times to even get close to that amount of PAHs. We just wanted a feeling for if the coal-tar sealant and the asphalt sealant in equal masses would affect the biology differently in this experiment. What we found is as you see on this left bar chart over here is that our controls had 100% survival of the organisms we are talking about here. It is high/low as that little crustacean. The controls has both 100% survivability or survival. The low treatment in the coal-tar had a significant loss of mortality of the organisms at 81. The medium dropped way down to 30% survival and then the high was down to 13. The asphalt sealant showed no significant toxicity to those treatments. But again, you have a nice dose response of these organisms to the coal-tar sealant. And these numbers again, that first one is below the PEC and the second one is above the PEC.

Now if you add UV lights to PAHs, this is another known phenomenon in the literature that UV lights will enhance the toxicity of PAHs. So we followed up after that first 28 day exposure period and added UV lights and what that did is actually make the toxicity in both of our treatments, both the asphalt and the coal-tar sealant significantly more toxic. We lost all -- almost all the organisms in the low treatment going from 81 down to 10% survival. And in the medium and high we had no survival in those treatments from the coal-tar sealant. And another interesting thing is we actually did get a dose response of toxicity response to the asphalt sealant after that UV light was added.

So that's what we got. We felt very confident that our results were consistent and pretty clear that we had toxicity to coal-tar sealant at levels that would be predicted by that PEC, that probable effect concentration.

All right, the next experiment, as I mentioned, this was trying to get at more of a community or an actual real -- more of a feel effect but in a more controlled setting. And what we did is we spiked actual little tubs of sediment that had been inoculated with the same levels of low, medium, and high concentrations of PAHs from coal-tar sealant using that ground up sealant. By the way, that ground up pavement sealant is made by taking sealant, Tom Bashara, our colleague also came up with this method of painting the sealant, coal-tar sealant on the clean glass and then waiting for three days for it dry and then scraping it off that glass so we could have kind of a dried product for use in these experiments.

What we found in this experiment, I will make sure I have that right. So we inoculated these bins with different levels of coal-tar sealant having both and then we put in a community of organisms collected from a reference stream into these bins and waited for 24 days and then pulled them out and looked to see how those that community of organisms responded to those three different treatment levels and compare that to a

control.

What we found was this general pattern and many of the measures we've looked at kind of the most typical is what you are seeing here the number of organisms that we found in these bins after that exposure period. So that left axis is actually the total number of organisms. What we found was kind of an enhancement of the community in the low treatment which is kind of odd and I can talk a little bit about that but in the medium and in the high treatments we saw significant dose responses to -- basically to that PAH coal-tar sealant source. An interesting thing to note on there, we used another measure besides the PEC, that probable effect concentration, in 23. We also used the equilibrium partitioning sediment benchmark or the ESB toxicity units that the EPA developed to look at how toxic these PAHs are in an actual sediment setting so that basically kind of standardize it based on the different PAHs that are there and the amount of organic carbon that is in the sample that tells you how toxic sediments might be to actual organisms. And what you see in those numbers there is that the low treatment actually was below that toxicity unit of 1.0. Once it's below -- when it is above a 1.0 it is considered to have significant toxicity expected in these communities. So what we are imagining is that this was not high enough to actually cause any toxic effects and possibly was due to an actual addition of carbon sources and kind of a ramping up of the microbial community in this kind of a confined environment. But what we did find is once the toxicity went above one we started to see toxicity in the entire community in those medium and high treatments.

If you look to the actual individual responses in the microcosms we saw even a little bit more of a pronounced and clear dose response. This is a proclivious midge; it is often used again, in kind of environmental monitoring. IT is -- we found that it had a very clear and significant dose response to these coal-tar sealant treatments dropping in organisms as the concentration of sealant and PAHs in these microcosms increased. Going down to actually no survival in the highest treatment over here.

And then our final experiment, this field study. This is again, more of a confirmation of what we had already kind of documented in the lab setting. But we went out and did was we found parking lots that drained directly to a stream. In other words there was a direct connection of some source that went from a parking lot that was confirmed to have coal-tar sealant that drained down into the parking lot and we looked at the sediment concentrations of PAHs above that parking lot drainage and below that drainage. We looked at seven different parking lots and five of them we found had significant increases in total PAHs below that parking lot entrance. In some cases well above from non-detect down at the bottom here all the way up to 33 or 34 milligrams per kilogram in this first one. Some of the other ones were much smaller in their increase but all of them had notable increases in PAH concentrations below the parking lot.

Then what we did is we look at the communities above that parking lot and downstream of the parking lot in riffles and pools. And generally what we found was that there was

a definite decrease in community health downstream of these parking lots in all five of these cases. The general pattern is expressed over here on this right graph but you are looking at loss of Taxa or loss of diversity on the Y. axis and then it changed in those toxicity units. In other words as it goes from the upstream and we looked at the toxicity units upstream versus how negatively they were affected by the change in PAHs at the downstream site. And we found that change in toxicity is very well correlated and explained the loss of Taxa that we are seeing at these sites. They are square on that one. It's about a .75 which is pretty good for a small data set like this. So again we are seeing increases in PAHs downstream of parking lots and a predictable community response to those increases.

So at this point, as I mentioned and kind of reviewed before we noticed that coal-tar sealants were a concentrated source. We knew that they were possibly a major source to the PAHs that—or excuse me, to the streams that were studied in Barbara Mahler and Peter Van Metre's study and that we co-authored with them and we were also able to demonstrate clear ecological impact in Austin in our local stream systems. We -- used chemical tracing. We looked at lab and field toxicity and we did field verification. At that point we were ready to go forward with a ban on the use and sale of coal-tar sealant in Austin. Again, this is in it about 2005 that we really came to this conclusion. We started an intensive ban outreach effort and had several stakeholder meetings. We did presentations of a lot of the biological data that you just saw and some of the other chemical -- excuse me chemical tracing. We published several of these studies in peer-reviewed journals. We did technical briefings around the country to EPA, USGS and the Department of Interior. We also even did a congressional briefing in Washington, DC. Very exciting for us ho-dunks down Texans. And then we also did an intensive public process here in Austin that is required to go through any sort of an ordinance adoption which entails going through several public board and commission meetings and then eventually taking it to consult where it was voted in unanimously by our council and supported. So at that point which is in late 2005, we had a ban in Austin, Texas.

What that looked like was prohibiting the use in our jurisdiction and the sale unless the intended application could be documented to be outside of our jurisdiction. This essentially has not happened. No one is selling coal-tar sealant in Austin so this really has not been an issue that we know of.

Enforcement has been kind of a long and pretty relatively simple process for us as we have incorporated it into our existing program. It is mostly driven by complaints that people see someone sealing and they are concerned about and we have a hotline. And our staff spends a lot of time out and about in the city and they have gotten really good at noting when sealant is going down and they've gotten really good field tests for documenting when it is or is not cold-tar.

The fines if someone is caught and confirmed can be up to $2,000 a day. Although we have actually never had to fine anyone. We have had nine violations to date. Those

violations have been kind of across the board in different size lots and different locations around the city but in general they are outside contractors that have come into Austin and are claiming ignorance that they did not know the local laws and that is kind of the generalization. And in general the way we have dealt with those is kind of deferred adjudication which means we established a period in which we will work out a solution together and we have always been able to work something out during that, usually it's a six-month period. Almost all of those have been some kind of remediation. That looks like often and in most cases it is laying over a surface coating of an alternative sealant product that is not cold-tar and in almost all the time it's been in asphalt based product. That kind of an encapsulation of the old – of the sealcoat that was put down. And in one case, they actually removed you using kind of a shot blast approach and a vacuum. In one case they actually encapsulated the entire sealant with a new coating of asphalt.

In addition, to kind of our kind of enforcement, we did have one big state legal challenge a big industry player here in Texas took this to the state environmental agency, the Texas Commission on Environmental Quality and basically asked that they not allow the city of Austin to ban coal-tar sealants because it was against some obscure state rules and also that they didn't have sufficient technical and scientific proof that this was the problem. We went and did a big kind of briefing and kind of a quasi-legal hearing at the Commission on Environmental Quality. And we won that where the state sided with the city and said that we had perfectly legal rights to have an ordinance like this and we provided sufficient scientific evidence to uphold our ordinance. So that was really a breath of fresh air for us.

We have, as other folks have mentioned, we feel like right after we put our ban into place locally Lowe's and Home Depot both started pulling coal-tar sealant off their shelves. And pretty soon after that I think it was about a year later they decided to do that nationally. Again I think it was based on what Judy says that there is a very common and relatively comparably economically costing alternative with the asphalt sealant. So that was not a big problem for them.

There has also been a lot of other post-ban research and media attention that has come up here and there over the last six years. Anything from different papers that Pete and Barb, and other folks in the area have published, other agencies and states that have kind of read about what we did and decided they wanted to ban something too and we've often gotten involved and provided them with technical help on what they were working on.

Just recently the Austin Independent School District decided they were going to basically remove all of the legacy coal-tar sealant that has been put down before our ban went into place over the next 3-6 years in an effort to eliminate that source from our local school system which we are very happy about that.

And another kind of great development, our House of Representative Lloyd Doggett recently put together a bill and its sitting on the House's floor right now in committee

actually that would ban cold-tar sealants nationally. I'm not sure how much momentum this bill has but we are hoping if not this year maybe next year it will come back and have a little bit more.

A couple other things I kind of wanted to talk about, things that came up in other questions from the previous talks were the idea of alternative products. For a while we would actually list all the alternative products that we knew of on our website and we still keep that up to date. But it is essentially mostly asphalt based products. There are a few other latex products that we have been introduced to and heard of but we really don't see them used in the Austin area on any kind of a large-scale. I think there have been a couple of applications around the city. So as far as the hope of new products that could one, not be black or be gray or be some other color that would not be such a heat island issue and would not absorb as much heat and also that would maybe stay longer or not had any kind of PAHs or any other chemicals in them we have not really seen that market developed here.

Disposal issues. People asked about that. In Texas at least, it is the landfills that we work with it is legal in Texas to basically take coal-tar sealant and sealant contaminated soil and put it into our landfills. So that has not been a huge issue for us when we have had to do remediation or deal with contaminated soils, but I understand that in other parts of the country that may be a lot bigger deal.

Another thing I wanted to point out is although the industry out there is unhappy a lot of times with what is going on with moving this away from coal-tar sealants and toward asphalt they are generally from what we understand they like using cold-tar sealants, a lot of them at least, and what we found is that even if there are alternatives available the industry tells the customers that the coal-tar sealant is really what's going to stay longer and be a better product. So we found that they end up using them almost exclusively when those are an option.

I'm going to quickly go through kind of some ban monitoring that we've been doing over the last -- since well before our ban went into effect actually as I mentioned we have been looking at PAHs in Austin. But once our ban went into effect we really wanted to know whether our ban would reduce kind of the PAHs problem around Austin. It has only been six years and as I think Barbara Mahler kind of stated pretty clearly, these are very stable and long-lived compounds. They are going to be out in the environment for a long time. And also we believe and we still see them out there. There is a lot of legacy sources in Austin still and they are still shedding some quantity of sealant from those aging lots so we are still getting an influxes probably. So we think it is still too early to make any kind of strong conclusions about how what – how well this ban is working on reducing PAHs loads to Austin's water sources.

We also have noted recently we looked at some of the character of the PAHs that we are seeing in our water bodies and a lot of them are those larger more benzene rings heavier PAHs. And it kind of generally suggesting that they are older in character. So

we are thinking that falls into our assumption or our hypotheses that these are legacy sources.

We are also seeing some watersheds that those patterns are actually the trends over time are decreasing the three or four we have seen that very distinct decrease. But most of our watersheds are not showing any clear spatial pattern or excuse me, temporal pattern and no strong and even in some cases there are actually some increases and we are still looking into those.

This graph we are seeing here is our receiving water body. Lady Bird Lake that kind of get drainage from a lot of our urban creeks and this is kind of where we want to look for long-term trends. We are really not seen anything as you can see over the last five years since the ban was put into effect it's pretty flat. May be at the end we are starting to see a decrease but who knows. It will be at least 10 if not 20 years before we will really be able to tell how much of an effect this ban has had on long-term PAH trends.

Alright that is pretty much what I got. I guess one thing I did want to point out is that as I mentioned early on Austin is a relatively progressive city. I think a municipal ban is a very inherently a political process and it can be very painful in a lot of ways. We have seen that throughout the country when other municipalities that have tried to do this. I think it is questionable how effective or how feasible it would be for cities all over the country to institute these bans. I do think the evidence and the science is growing quickly and very kind of convincingly. But I think it's really difficult to think that everyone can go through the same process. I think that we got lucky and stumbled upon this again in a progressive environment we were able to make this work. And I think we did a really good thing. I guess I would just like to open it up to questions there.

Chris Montague-Breakwell
Thank you Mateo. We will now open to the floor to questions. You can type them in. I have a few ready to go right now. First, what is the purpose of using UV light for the bioassay test?

Mateo Scoggins
Okay. So UV light has been shown – in a lot of the older literature to excite or enhanced the toxic effects of PAHs in aquatic environments in the sediments. The exact mechanism I am not completely sure but it's a narcosis effect and what it does is it increases the cellular ability to handle the kind of the toxic effects that PAHs have on membranes. Is that enough?

Chris Montague-Breakwell
Yes. Thank you. Our next question, and by far the most popular, is there a field test for determining coal-tar sealcoat versus asphalt?

Mateo Scoggins

Yes, there is. We actually have a write up of it and we are going to be putting together a little kind of official report on how to do that test and kind of an overview of how we have used it here in Austin that I can send out to folks if you guys want to e-mail me. Chris, I think you are going to put our contact information out there for everyone, right?

Chris Montague-Breakwell
Yes.

Mateo Scoggins
Essentially you scrape a little bit of the material off the parking lot and you have to do that carefully because there can be layers and layers of sealant on a parking lot. So you can't just scrape everything. You have to try and get the layer you really want to focus on. You dissolve that in a solvent and basically the solvent that we used, if it's an asphalt sealant it dissolves into the solvent and makes the black muck coffee looking stuff. And if it's a coal-tar sealant it does not dissolve but it turns the solvent into kind of a tea color or kind of a -- what is it -- the word I'm looking for -- like a tannic color basically. And it sometimes kind of glows a yellow color.

Chris Montague-Breakwell
Okay. Next question, what sort of outreach have you done to raise awareness of the ban?

Mateo Scoggins
In the Austin area?

Chris Montague-Breakwell
Yes, I presume.

Mateo Scoggins
Okay, well, we have done quite a bit. We did a lot when the ban first went into effect obviously actually before the ban went into effect we did a big outreach campaign calling for a voluntary ban. We contacted all of the applicators and manufacturers in the Austin area to let them know what we were doing and brought them together for those stakeholder meetings that I mentioned. Sent out fliers to everyone letting them know we were concerned about it and we wanted them to voluntarily stop using it. Then once the actual legal ban went into effect we did that all over again and sent out flyers working with both the applicator community, the manufacturers and also to retail businesses around the city that sold and/or had sealant products on their shelves. And then we have continued that process I think almost annually we are in contact with all of the retail folks who sell and apply sealants in the Austin area kind of letting them know what we are doing and what's going on and what concerns are around.

Chris Montague-Breakwell
Next question. How long after coal-tar sealcoat is applied does it remain a source of PAHs? Is there a point at which remediation is no longer necessary because all of the

PAHs have already been released into the environment?

Mateo Scoggins
That is a great question. You saw a lot of the graphs that we have seen today; particularly Allison showed some of the stormwater graphs showing that kind of basically a loss of PAHs load over time. Yes, I think at some point it would not be worth a whole lot of trouble if it is 80, 90, 100 percent of the sealant is worn off the parking lot. I think that that curve and that rate is highly dependent on a really wide variety of things. Climate, how well it was applied in the first place. The actual type of product that is put down, the skill that the applicator had. We did a wear-off study published in the environmental science and technology and looked at a bunch of loss around Austin and the wear-off rates that we saw there. Ad basically after five years, most of these lots had lost anywhere from 15-50 percent of their sealant. So the wear, that kind of the end of the trail is where you don't have any sealant left I think is highly variable. But I do think after 5-10 years you are probably looking at limited diminishing returns on spending any effort to clean that up.

Chris Montague-Breakwell
Next question. Are you aware of the occupational exposures to workers who apply or remove coal-tar sealcoat?

Mateo Scoggins
I am aware that it's a hazard. I don't actually know a lot about the OSHA rules, but from what I understand there is quite a bit of regulatory input in this field. I don't know -- we hear a lot from the industry that they don't have any problems with occupational health issues with the sealant. People who actually seal the coal-tar sealant. But I think it seems to me that if you are spending all of your time with that stuff volatizing in the air while you are spraying it would be an occupational hazard for sure.

Chris Montague-Breakwell
Next question. How have coal-tar sealcoat producers and suppliers been impacted by the ban and how did Austin address impacts to businesses?

Mateo Scoggins
That is another really good question. Part of our outreach and part of our continuing kind of work with the industry in Austin is understanding how economically -- that was one of our big concerns when we started talking about the ban was how is this economically going to affect small businesses and even larger businesses in the Austin area. From what we could tell talking to them and talking to the other applicators around the country, the fact that there is an alternative product, the asphalt based sealant, and that it is readily available and uses the same -- essentially the same technology to apply it, not exactly the same, we believe that there was kind of a one to one trade off there and we believe there was minimal economic damage done to most of the companies in the Austin area to switch over to asphalt based sealants. I am

sure that there was some problems with different success rates that people had with the different products and I'm sure that there were some folks who decided they did that wanted to seal at all if they could not get coal-tar sealant but we have not been able to quantify any of that. Our general feeling is that the economics effect on the industry as a whole were pretty minimal. But we don't have any real direct way of measuring exactly how that has played out over the last six years.

Chris Montague-Breakwell
Next question. Is cold-tar sealcoat more effective and more longer-lasting than other sealant types?

Mateo Scoggins
I don't have an answer to that question. As kind of Pete Van Metre said, there has been a lot of questions about that over the entire time we've been looking at this issue. The industry has not documented anything in the peer-review literature that we can really sink our teeth into as far as which ones work better. There is some evidence in some of kind of the ASTM or standard testing methods that coal-tar sealant is potentially lasting longer definitely under kind of a gas or oil kind of contamination scenario. And there is also, I would guess I would call it anecdotal evidence from the industry that coal-tar sealant holds up a lot better and a lot longer than the asphalt sealant product. Our kind of anecdotal and field experience here in Austin is that there are definitely a wide range of quality in the asphalt based products. Some of them really don't seem to hold up very well and some of them seem to hold up really well. But we don't know overall if there is any kind of clear answer on that other than that one of them is a lot more toxic and problematic from an environmental perspective. So whatever other issues there maybe it's for the asphalt we feel that there are probably small compared to the environmental cost.

Chris Montague-Breakwell
Next question. Are these sealants, coal-tar epoxy, that would be a two-part system that is mixed prior to application?

Mateo Scoggins
No. It is an emulsion. Again, I am not an industry expert. There are a lot of people around that know a lot more about this than I do. But the way they make coal-tar sealant is they emulsify actual refined coal-tar with water, sand, and clay particles and I think it is a pretty specialized process where they kind of mix it all together and it all gets held in an emulsion and then that emulsion is sprayed on the ground and then it dries in place. There is not any binder or epoxy kind of process from what I understand. Asphalt sealant is a little different, but I think it is essentially the same idea. You take the binder, in that case is your asphalt sealant instead of the cold-tar and it’s also put into a slurry and dried on site. But it is affected a lot more by temperature than the coal-tar sealant is.

Chris Montague-Breakwell
Okay. That was our last question. Thank you, Mateo.

Mateo Scoggins
Thank you, all. Again, I would welcome any questions from cities around the country that are interested in this topic. I had to skip over a lot of stuff and we do have a lot of people, a lot of them in the room right now who have been working with this issue for the last 10 years and I think anyone who wants to send us any questions or concerns we would love to hear from you.

Chris Montague-Breakwell
Thank you, Mateo. This concludes today's webinar. Thanks to all of our speakers. As a reminder if you have any questions that were not addressed in today's webinar, please contact the speaker or EPA at the address on your screen.

I also want to remind you to fill out the webinar evaluation survey that will soon appear in your screen window. Please consider completing the survey and let us know your thoughts. We do appreciate your feedback as we work to improve our webinars. EPA is planning to hold additional stormwater pollution prevention webinars in the coming months. So we are particularly interested in your feedback on what other topics you would like to hear about. And I will leave the screen up for a second before going to the next certificate slide so you can take down the contact information.

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